Tafuna, American Samoa
Flood Risk Management Study

Draft Integrated Feasibility Report and Environmental Assessment

January 2022

US Army Corps of Engineers
Honolulu District

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Tafuna Flood Risk Management Study, American Samoa

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*Sections marked with an asterisk are required for compliance with the National Environmental Policy Act

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ACRONYMS

AEP	Annual Exceedance Probability	**MMPA**	Marine Mammal Protection Act
CAA	Clean Air Act	**MSA**	Magnuson-Stevens Fishery Conservation and Management Ac
CEQ	Council on Environmental Quality	**NAAQS**	National Ambient Air Quality Standards
Cfs	Cubic feet per second	**NED**	National Economic Development
CWA	Clean Water Act	**NEPA**	National Environmental Policy Act
CZMA	Coastal Zone Management Act	**NMFS**	National Marine Fisheries Service
ESA	Endangered Species Act	**NNBF**	Natural and Nature-Based Feature
EC	Environmental Commitment	**NOAA**	National Oceanic and Atmospheric Administration
EQ	Environmental Quality	**NPEDS**	National Pollutant Discharge Elimination System
EFH	Essential Fish Habitat	**O&M**	Operations and Maintenance
FEMA	Federal Emergency Management Agency	**OMRRR**	Operations, Maintenance, Repair, Replacement and Rehabilitation.
FONSI	Finding of No Significant Impact	**OSE**	Other Social Effects
FRM	Flood Risk Management	**PED**	preconstruction, engineering and design
FWCA	Fish and Wildlife Coordination Act	**RED**	Regional Economic Development
HEC-HMS	Hydrologic Engineering Center's Hydrologic Modeling System	**TAAQS**	Territory AAQS
HPA	Historic Preservation Act	**TMDL**	Total Maximum Daily Loads
IFR/EA	Integrated Feasibility Report and Environmental Assessment	**TSP**	Tentatively Selected Plan
LERRD	Lands, easements, rights-of-way, relocations, and disposal areas	**USACE**	U.S. Army Corp of Engineers
Lf	Linear feet	**USFWS**	United States Fish and Wildlife Service
MBTA	Migratory Bird Treaty Act	**VdB**	Vibration Decibels
		WoUS	Waters of the U.S.

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 Tafuna Flood Risk Management (FRM) Feasibility Study, located on the island of Tutuila in the U.S. Territory of American Samoa, for which the American Samoa Government, represented by the American Samoa Department of Public Works, is the non-Federal sponsor. This IFR/EA, evaluates, and discloses impacts that would result from the implementation of potential FRM measures for critical areas within the Tafuna area of the island of Tutuila (the proposed study area); in accordance with federal law, regulation, and procedures the IFR/EA identifies flood hazards and analyses a series of potential alternatives, including the "No Action" alternative, to address flood risk in the proposed study area.

The study is authorized under Section 444 of the Water Resources Development Act of 1996, as amended. 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.

The Territory of American Samoa is located approximately 2,600 miles southwest of Honolulu, Hawaii. The study area is situated in the Western District of Tutuila within Tualauta County, in the northeast section of the Tafuna-Leone Plain. Tualauta County is the largest, most populated county in American Samoa, and includes the villages of Malaeimi, Tafuna, and Nuuuili.

The purpose of the study is to evaluate flooding problems and identify potential flood risk reduction alternatives within the Tafuna area on the island of Tutuila in the U.S. Territory of American Samoa, specifically along waterways that meet the minimum flow velocity of 800 cfs (Engineer Regulation (ER) 1165-2-21). The Study is needed because flooding experienced in the Tafuna area results from intense rainfall and the lack of well-defined stream channels. Typically, the streams are incapable of supporting small flood events such as a 10 percent annual exceedance probability (AEP) flow. Flooding is exacerbated by development encroaching onto the floodplain, obstructions such as thick vegetation, and constrictions at bridges and culverts.

The plan formulation process identified several structural and non-structural flood risk management measures to potentially address flood risk in the study area. An initial array of up to eight 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.

The TSP is Alternative C: Taumata Flood Barrier and Nonstructural Improvements. This alternative includes the construction of approximately 2,400 linear feet of barrier with an average height of seven ft (from ground), on the Taumata Stream. The nonstructural component of this alternative will include dry floodproofing 38 nonresidential buildings and elevating 242 residential structures (assumes 100 percent participation rate). At the FY 2022 discount rate of 2.5 percent, the total project first cost of the TSP is approximately $138 million with a benefit-to-cost ratio of 1.6.

The TSP (Alternative C) is the National Economic Development (NED) Plan. Alternative C reduces damages by approximately 81% with fewer residual damages compared to other structural alternatives and has higher NED benefits compared to other structural alternatives.

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 best management practices (BMPs) would be implemented to ensure that potential construction-related effects are avoided, minimized, and/or reduced 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 (see Sec. 6.9 Environmental Commitments). No compensatory mitigation is required.

The American Samoa Government supports Alternative C as the TSP. Alignment for the support was coordinated with the Governor of American Samoa. The public will have the opportunity to review and comment on this draft report during the 30- day public review period, which will begin in January 2022. A virtual public meeting is planned for February 2022 to present the TSP and allow the public to respond and ask questions. The final report is scheduled to be complete in 2023.

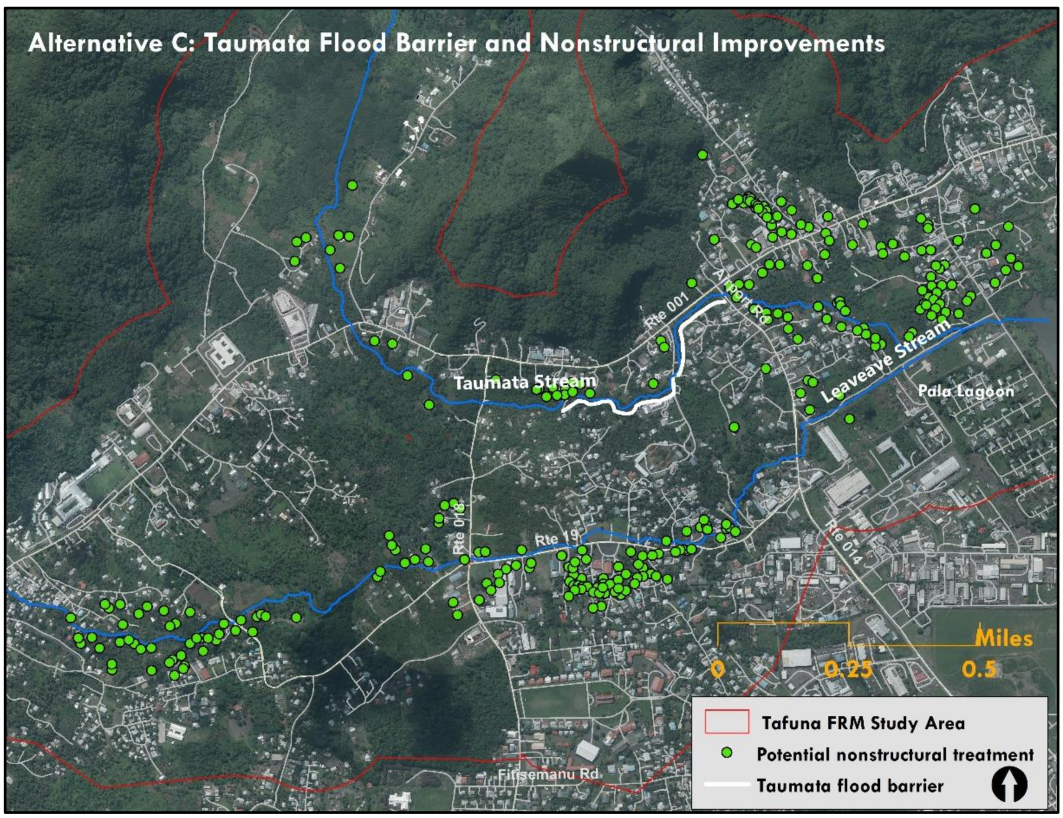

Figure 1: Alternative C, Tentatively Selected Plan

1 Introduction

This is the draft Integrated Feasibility Report and Environmental Assessment (IFR/EA) for the Tafuna Flood Risk Management (FRM) Study. The Honolulu District of the Pacific Ocean Division of USACE is the Lead Federal Agency. The American Samoa Government is the non-Federal sponsor for the study, represented by the Department of Public Works.

The study area is located within a heavily populated area of Tutuila Island known as the Tafuna-Leone Plain. Properties within the Tafuna-Leone Plain include residential and non-residential structures (e.g., commercial and government buildings), main roads, drinking water wells, churches, and school facilities and are susceptible to frequent flooding.

The Study is being conducted to address flood risk within the Tafuna-Leone Plain. The Tafuna-Leone Plain experiences intense rainfall, and most stream channels are shallow and undefined. The streams are typically incapable of supporting small flood events such as a 10 percent annual exceedance Probability (AEP) event. Flooding is intensified due to thick vegetation within channels, flat topography, constrictions at bridges and culverts, and encroaching development into the floodplain areas.

1.1 USACE Planning Process

The USACE uses a six-step planning process, which includes the following steps:

- Specification 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 Tentatively Selected Plan tentatively selected plan based upon the comparison of alternative plans

This 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 Section 4321 et seq.); the Council on Environmental Quality (CEQ) (regulations published in 40 Code of Federal Regulations 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.

1.2 Study Purpose, Need and Scope *

The purpose of the study is to evaluate flooding problems and identify potential flood risk reduction alternatives within the Tafuna area on the island of Tutuila in the U.S. Territory of American Samoa, specifically along waterways that meet the minimum flow velocity of 800 cfs requirement (Engineer Regulation (ER) 1165-2-21). The Study is needed because flooding experienced in the Tafuna area results from intense rainfall and the lack of well-defined stream channels. Typically, the streams are incapable of supporting small flood events such as a 10 percent AEP flow. Flooding is exacerbated due to encroaching development onto the floodplain, obstructions such as thick vegetation, and constrictions at bridges and culverts.

The study scope includes a series of potential alternative plans focused on flood-risk management by identifying flood hazards and potential FRM measures for critical areas within the Tafuna-Leone Plain area. Alternatives were developed in consideration of study area problems and opportunities as well as study objectives and constraints with respect to the four evaluation criteria described in the Principles and Guidelines (completeness, effectiveness, efficiency, and acceptability). The analysis of the alternative plans that address FRM needs was conducted to identify the National Economic Development (NED) Plan. The NED plan is the Tentatively Selected Plan (TSP), and the results of this analysis are documented in this decision document, which will serve as the basis for project construction authorization.

Notwithstanding Section 105(a) of the Water Resources Development Act of 1986 (33 U.S.C. 2215(a)), which specifies the cost-sharing requirements generally applicable to feasibility studies, Title IV of the Additional Supplemental Appropriations for Disaster Relief Act, 2019, Public Law 116-20, enacted June 6, 2019 (hereinafter "FY 19 Supplemental"), authorizes the Government to conduct the Study at full Federal expense to the extent that appropriations provided under the Investigations heading of the FY 19 Supplemental are available and used for such purpose.

1.3 Study Authority

This study is being conducted under the authority of Section 444 of the Water Resources Development Act of 1996 (as amended by Section 207 of the Water Resources Development Act of 1999) authorizes flood damage reduction studies to be conducted in American Samoa. The authority states:

"The Secretary may conduct studies in the interests of water resource development including navigation, flood damage reduction, and environmental restoration in that part of the Pacific region that includes American Samoa, Guam, and the Commonwealth of the Northern Mariana Islands."

1.4 Location and Description of the Study Area *

The study area is located in the mid-South Pacific Ocean on the island of Tutuila in the unincorporated U.S. territory of American Samoa (Figure 2). American Samoa is part of the Samoan Islands archipelago in Polynesia, located approximately 2,300 miles southwest of the Hawaiian Islands. It includes five volcanic islands and two coral atolls. Tutuila (55 square miles) is the largest and most populated island in American Samoa, with a population of 55,876 (2000 U.S. Census). The study area is situated in the Western District of Tutuila within Tualauta County, in the northeast section of the Tafuna-Leone Plain. Tualauta County is the largest, most populated county in American Samoa, estimated at 19,519 according to the 2015 Household Income and Expenditure Survey report (American Samoa Department of Commerce), and includes the villages of Malaeimi, Tafuna, and Nuuuili. Tualauta County experienced a large population increase and has the highest number of housing units with over 4,000 units according to the 2010 U.S. Census.

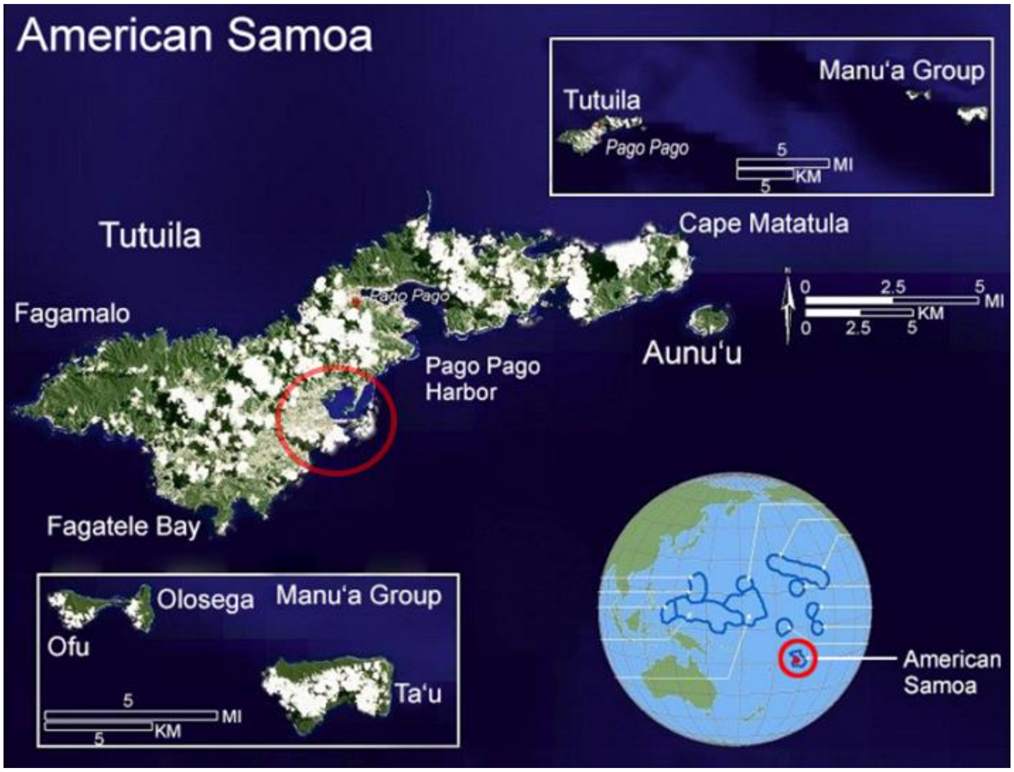

Figure 2: Project location map

The natural environment of the study area comprises two major physiographic zones of the Tafuna-Leone Plain: a) the lava delta of the Tafuna-Leone Plain; and b) the lowland mountain slopes inland of the Tafuna-Leone Plain (Figure 2). The lave delta of Tafuna-Leone Plain is the largest area of Tutuila in acreage with relatively flat slopes. Several watersheds contribute to flows to and/or are contained within the Tafuna-Leone Plain. The upper watershed portions (upstream of Route 1 Highway) that drain the mountainsides have well-defined stream cross-sections, while the lower watershed portions that drain the drier alluvial plains (downstream of Route 1 Highway) have poorly defined drainageways.

The study area is located in the Vaitele-Taumata Stream sub-drainage of the Nu'uuli Pala Watershed (6.7 square miles), and includes Taumata, Vaitele, Leaveave, Mapusagatuai, Leaveave, and Puna streams that drain the southwest slopes of Tuasivitasi Ridge, located on the northwest side of the watershed. At the end of Mapusagatuai Stream, flow continues northeast towards Taumata Stream. Flow from the upper watersheds drains east towards the shoreline at Pala Lagoon, north of Pago Pago International Airport. Elevations range from 1,200 ft mean sea level on the Tuasivitasi Ridge in Malaeimi Valley to 0 ft mean sea level at the coastal shoreline. Leaveave, Taumata, Mapusagatuai, and Vaitele streams all originate in the mountains that line the northern edge of the Tafuna-Leone Plain (Figure 3).

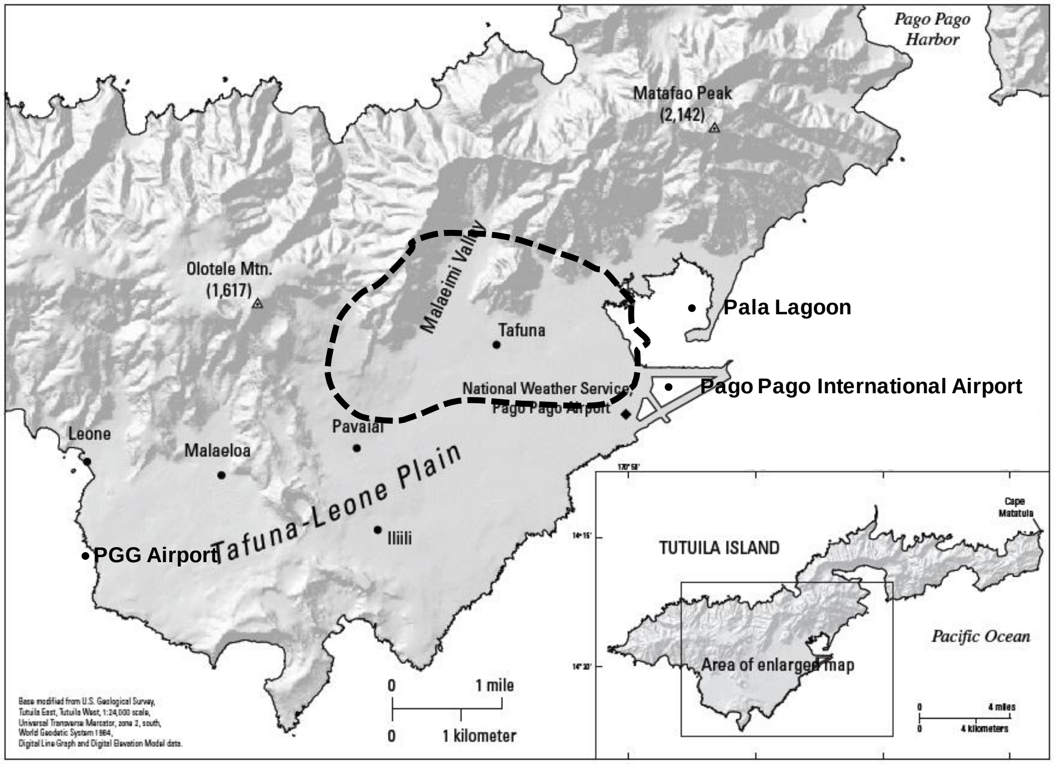

Figure 3: The Tafuna-Leone Plain and surrounding areas, Tutuila, American Samoa (from Izuka et al 2007). The approximate study area is indicated by the dashed outline

Per ER 1165-2-21, urban water damage problems associated with a natural stream or modified natural waterway may be addressed under the FRM authorities downstream from the point where the flood discharge of such a stream or waterway within an urban area is greater than 800 cubic ft per second (cfs) for the 10 percent flood. A hydraulic analysis was done of all streams, tributaries and drainage areas within the project area to identify those which met the criteria outlined in ER 1165-2-21. In accordance with ER 1165-2-21, the study area for this IFR/EA study was further refined to only include Leaveave, Taumata, and Vaitele streams which have flows greater than 800 cfs (Figure 4). Taumata and Leaveave streams are tributaries to Vaitele Stream. Further details of each stream are described below:

- Taumata Stream is the largest tributary to Vaitele Stream and is normally dry except during the rainy season. Taumata Stream drains approximately 1.82 square miles, which includes Mapusagatuai Stream basin, and has approximately 2.27 miles of stream bed. Above Route 1 Highway, the stream is heavily vegetated and has a gradual slope of 0.5 percent. Between the Route 1 Highway bridge and the confluence with Vaitele Stream, Taumata Steam meanders through residential areas, fording several low road crossings.
- Leaveave Stream originates from the north-west portion of the Tafuna Plain along the Tuasivitasi Ridge and drains 1.21 square miles. Above Route 1 Highway, the stream has defined channels with an average slope of 1.9 percent. Approximately 1,000 ft below the highway bridge, low stream flows enter a depressed area and seep into the porous substrate. Flooding is exacerbated due to heavy vegetation in the overbanks, development encroachment, and cultivation. Approximately 2,800 ft downstream of the highway bridge, Leaveave Stream virtually disappears due to heavy vegetation and flat

terrain. Residential encroachment into the lower alluvial plain in Tafuna occurs frequently due to the lack of a readily identified stream channel.

- Vaitele Stream originates from Tuasivitasi Ridge along the northeast corner of the Tafuna Plain before discharging into Pala Lagoon. The Vaitele Stream drains approximately 0.58 square miles and has about two miles of stream bed along the main stem. Above Route 1 Highway, the slope of the stream bed is approximately 1.5 percent and flattens out to 1.0 percent just below the confluence with Leaveave Stream. Residential homes line the stream banks above Route 1 Highway. Below the highway, the stream is heavily vegetated up to the mouth. The American Samoa Government correctional facility is also located along the right bank near the stream mouth.

Figure 4: Taumata, Leaveave, and Vaitele streams

Because of the lack of defined stream channels in their lower reaches on the Tafuna Plain, Leaveave, Taumata and Vaitele Streams all experience overland sheet flow and nuisance, shallow flooding that generally occurs only during or immediately after heavy rainfall.

1.5 Previous Studies

The USACE completed previous work within the study area and vicinity, including a 1994 study under the Planning Assistance to States program as well as several Floodplain Management Services studies:

Flood Hazard Study, Tafunafou, Tutuila, American Samoa. Pacific Ocean Division (1977). U.S. Army Corps of Engineers. The report evaluated the hydrologic and hydraulic characteristics of the streams and drainageways in the Tafuna area. The findings from this study were adopted by the Federal Emergency Management Agency (FEMA) in May 1991 and used to develop the 1 percent AEP floodplain for the Tafuna area.

Tafuna-Leone Plain Drainage Study: Tutuila, American Samoa. Pacific Ocean Division (1994). U.S. Army Corps of Engineers. The study identified the characteristics and flow paths of the major streams and drainage ways in the Tafuna-Leone Plain. The information was intended to provide a basis for understanding the magnitude and causes of the existing flood problems in the area and was used by FEMA for the Flood Insurance Rate Maps for Tafuna.

Hydrologic and Hydraulic Engineering Analysis Tafuna Study Area. Honolulu District (2016). U.S. Army Corps of Engineers. This report presented the methodology used and the results of the floodplain management study of the Leaveave Drainageway and Drainageway 2 in Tutuila, American Samoa. The Hydrologic Engineering Center's Hydrologic Modeling System (HEC-HMS) software was used to create a hydrologic model and determine the discharge-frequency relationships at key points in the study area.

Hydrologic and Hydraulic Engineering Analysis Tafuna Study Area. Honolulu District (2019). U.S. Army Corps of Engineers. This report presents the methodology used and the results of the floodplain management study of Drainageway 4, 5, and Unnamed Stream 15 in Tutuila, American Samoa. The HEC-HMS software was used to create a hydrologic model and determine the discharge-frequency relationships at key points in the study area. Two-dimensional (2-D) modeling was completed for Drainageway 4, 5, and Unnamed Stream 15.

1.6 Problems and Opportunities

1.6.1 Overview of Flooding Challenges

The Tafuna-Leone Plain has a history of flooding issues as population continues to develop and live on the alluvial plain beneath steep mountains that receive significant rainfall. Below, the reader will find a summary of recent large storm events and associated damages:

- Tropical Cyclone Gita caused significant flooding throughout American Samoa. Rainfall exceeded 6 inches in Pago Pago and more than 800 people were displaced from their homes throughout the islands. The damage estimate across the Territory was $7 million. A Presidential Disaster Declaration was issued on March 2, 2018.
- Torrential rainfall of greater than 21 inches from July 29 to August 03, 2014 caused overflowing of streams, severe flooding in low lying areas and roadways, and caused landslides along mountainous areas throughout the Island of Tutuila.
- In January 2004, Tropical Cyclone Heta's high winds, high surf, and heavy rainfall caused flooding, mudslides, and landslides throughout the Territory. Approximately 13.03 inches of rainfall caused an estimated $25.9 million in damages. A Presidential Disaster Declaration was issued on January 13, 2004 (Damage Report 1506).
- Typhoon Esau caused flooding, landslides, and mudslides in May 2003. American Samoa received more than 23 inches of rainfall and nearly 4,500 individuals required assistance. Damages across the Territory were estimated at $12 million. A presidential Disaster Declaration was issued on June 6, 2003.

Flooding is an increasing issue throughout the Tafuna-Leone Plain, and a number of factors exacerbate this problem. Steep terrain in some areas results in high velocity stream flow. Shallow or ill-defined stream channels can rapidly overflow, leading to overbank flooding and urban development exaggerates these flooding extremes, since grading of the land can promote changes in drainage direction in streams. Development may also lead to increases in impervious surfaces, thus reducing drainage capacity. In some cases, stream channels were redirected or moved to accommodate buildings, which caused sharp bends in the stream flow. Inadequately sized culverts are unable to accommodate stream flows during intense rainfall, causing a backup of floodwaters.

Within the study area, there are approximately 545 structures in the 0.2 percent AEP event floodplain. The total value of damageable property, structures, and contents, within the 0.2 percent AEP floodplain is approximately $210.5 million. The study area experiences significant flooding from both large storm events and frequent smaller events. Figure 5 shows flooding within the study area (along Route 19/Fagaima Road and Leaveave Stream during a relatively small event (estimated below an 0.05% AEP event) in 2020.

Figure 5: Flooding within the study area (Department of Public Works)

1.6.2 Problems

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

- Significant storm events (e.g., typhoons), as well as frequent smaller events, result in economic damages to residential, commercial, and critical infrastructure and cause road closures.
- Flooding has intensified due to encroaching development into the floodplains, and is compounded by small, shallow channels, obstructed by thick vegetation, as well as constrictions from bridges and culverts.
- Flooding affects public safety and health (e.g., contaminated drinking water) and has potential environmental impacts (e.g., increasing turbidity in Pala Lagoon as debris and trash moves through the watershed).

1.6.3 Opportunities

Opportunities to address the problems include the following:

- Increase community resiliency to flood events
- Improve public health and safety

- Improve local understanding of flood risk; improve community education/outreach to cultivate resiliency
- Reduce maintenance costs from storm damages to critical infrastructure such as roads, schools, and churches
- Improve emergency response during flood events

1.7 Objectives and Constraints

1.7.1 Planning Objective

The planning objectives for the study include the following for the 50-year period of analysis starting in 2030:

- Reduce flood risks to property and critical infrastructure during rain events in the Tafuna-Leone Plain for the 50-year period of analysis
- Reduce risk to life safety during rain events in the Tafuna-Leone Plain for the 50-year period of analysis

1.7.2 Planning Constraints

The following are the identified study constraints:

- USACE Policy constrains riverine flood risk studies to those areas which experience flow rates at or above 800 cfs at a 10 year event in accordance with ER 1165-2-216.
- Mangroves in American Samoa are considered a threatened vegetation and to the extent possible impacts should be avoided or mitigated.

1.7.3 Planning Consideration

The following consideration is identified for the study: American Samoa's communal land system may present land ownership challenges during formulation, evaluation, and implementation of alternatives. Cumulative parcel ownership data does not exist in American Samoa, making real estate considerations of alternatives based on ownership difficult to pinpoint. Early and substantial coordination with the sponsor and multiple landowners will be required.

2 Summary of Existing Conditions

The central portion of the Tafuna-Leone Plain located within its lower alluvial portion is an area of focus for many government agencies due to the potential for aggravated flood problems and the increasing rate of development in the area.

2.1 Period of Analysis

The period of analysis for this study is 50 years, beginning in 2030, which is the estimated timeframe of when construction will be completed and benefits from the flood risk reduction measures will be realized.

2.2 General Setting

The Tafuna-Leone plain experiences intense rainfall, and most stream channels are shallow and undefined. The streams are typically incapable of supporting small flood events such as a 10% AEP event. Flooding is intensified due to thick vegetation within channels, flat topography, constrictions at bridges and culverts, and encroaching development into the floodplain areas. The distribution of land use classification is shown in Figure 6. See Section 3.6 Environmental Effects and Consequences and Appendix A Hydrology and Hydraulics for additional information on both existing and future without conditions. For the purposes of this integrated report the Existing Conditions section also represents the Affected Environment for NEPA purposes. The FWOP condition is also representative of the No Action Alternative for NEPA analyses.

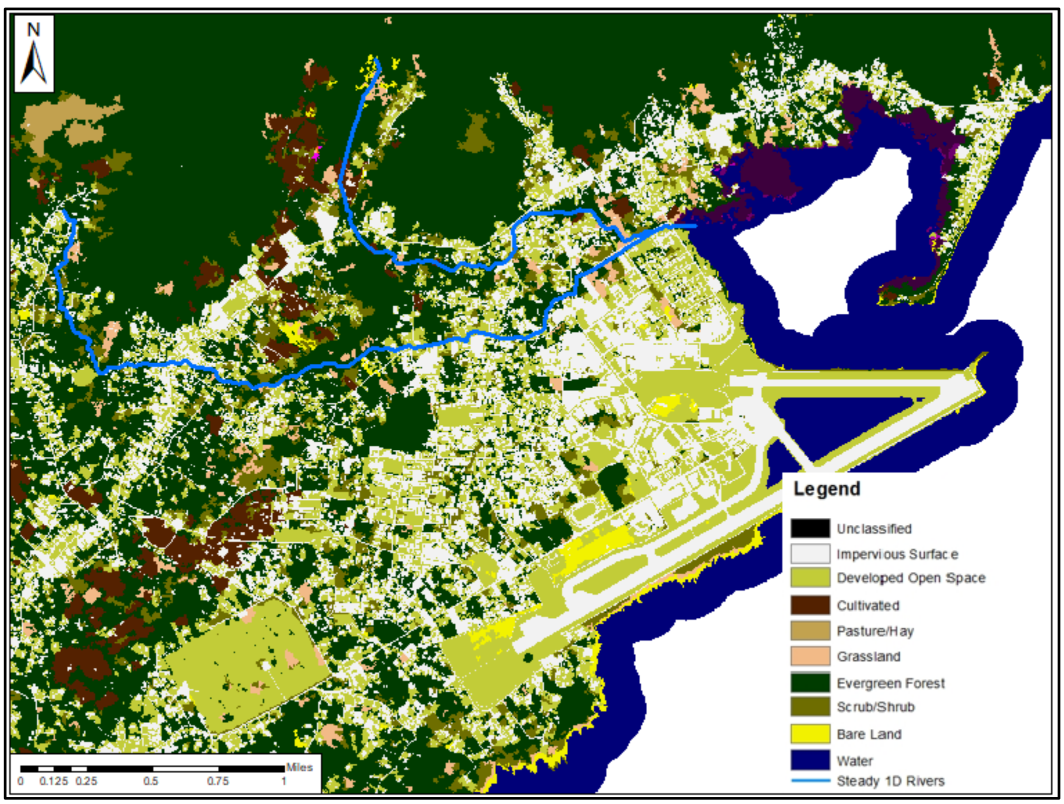

Figure 6: Tafuna-Leone Plain land use classification (NOAA OCM C-CAP Land Cover Data, 2010)

Per ER 1165-2-21, urban water damage problems associated with a natural stream or modified natural waterway may be addressed under the FRM authorities downstream from the point where the flood discharge of such a stream or waterway within an urban area is greater than 800 cfs for the 10 percent AEP flood event. A hydraulic analysis was conducted on all streams, tributaries, and drainages in the watershed to identify the flow rates. In accordance with ER 1165-2-21, the study area is limited to the following streams:

- Leaveave Stream
- Taumata Stream
- Vaitele Stream

Under the future without-out project condition, flood risk and flood-related damages will remain, with overtopping of the corresponding streams continuing within the coastal plain.

2.3 Natural Environment

The natural environment of the study area includes the terrestrial habitats, aquatic habitats, threatened and endangered species, and cultural and archaeological resources found in the area, as well as its aesthetic qualities. A complete description of the affected natural environment for these resource types is provided in Section 3.6 Environmental Effects and Consequences * under the Environmental Effects and Consequences section.

The study area is located on the Tafuna-Leone Plain, the largest area of relatively flat land on the island of Tutuila that extends from the base of the mountains towards the coast in south-western Tutuila. Most of the island's industry and much of its population is located on the plain's relatively extensive flat areas (Izuka et al 2007). The study area includes the following villages along Route 1 road from west to east: Pavai'a'i, Faleniu, Mesepa, Malaeimi to a part of Nu'uuli. Along Route 19 from the west to east are settlement of Koko Land, Tafuna village and settlement of Ottoville along the south-bound Route 18.

Within the study area, vegetation is primarily a mix of urban cultivated land and secondary scrub, an intermediate type of vegetation that occurs when cultivated land is abandoned and allowed to revert to natural forest. From an environmental perspective, water quality is a prominent concern in the study area. Most of the island's wells and pumps for groundwater distribution are found in the Tafuna-Leone plain, which is also where most residents and businesses are located. Surface water from streams, traditionally used as the primary potable water, is compromised by development along riparian areas, causing sedimentation, increased erosion, and nutrient loading from animal and human waste (e.g., piggeries and faulty septic tanks). Along the fringing lagoons and coastal shoreline, poor water quality threatens nearby mangroves, wetlands, and fringing coral reefs. The construction of the Pago Pago International Airport significantly altered natural circulation patterns in the Pala Lagoon, permanently affecting water quality and adversely impacting plants and marine wildlife.

2.4 Physical Environment

The physical environment of the study area includes its hydrology, geomorphology, water resources, and air quality. A complete description of the affected physical environment for these resource types is provided in 3.6 Environmental Effects and Consequences *.

The island of Tutuila is of volcanic origin and characterized by steep mountainsides, small valleys, and a narrow coastal fringe of relatively level land. The island is essentially the top of a composite volcano rising three miles from the ocean floor. The highest peak (Matafao Peak) is approximately 2,142 ft, and the land slopes steeply from the tops of the mountain ridges down to the ocean (FEMA 2008). The study area is situated mostly on a basaltic lava delta on the southern side of western Tutuila known as the Tafuna-Leone Plain (Tafuna Plain; see Figure 3), the largest area on the island with relatively flat slopes.

Intense rainfall and the lack of well-defined stream channels contribute to the flooding experienced in the study area. A greater potential for flooding exists in the village areas where the streams are incapable of supporting small flood events such as a 10 percent AEP flow. Flooding is intensified due to small channel sizes obstructed by thick vegetation, flat areas, constrictions from bridges and culverts, and encroaching development into the floodplain.

Under the future without-out project condition, flood risk will continue to be intensified by the physical environment in the study area.

2.5 Built Environment

The built environment of the study area is characterized by resources as they pertain to public health, noise, socioeconomics and environmental Justice, land use, utilities, public services, traffic, and recreational outlets. A complete description of the affected built environment for these resource types is provided in Section 3.6 Environmental Effects and Consequences *.

The village of Tafuna is the largest village in population and also has the largest concentration of businesses in American Samoa. It is also one of the few places in American Samoa that allows for the private purchase of land, which has encouraged development within the local area. Nu'uuli village is the fifth-largest village in land area in American Samoa and the second largest on Tutuila Island. It straddles the line between the Eastern District and the Western District and, therefore, is the only village in American Samoa that occupies two districts. Nu'uuli village is a shopping district that is home to South Pacific Traders, Nu'uuli Shopping Center, Aiga Supermarket and many more shops.

On Tutuila, concentrations of community assets are within the developed and populated lowland areas like the Tafuna Plain (Figure 7). Community assets are critical infrastructure and facilities important to the character and function of a community immediately following a major flood event, including locations with dense populations and high social vulnerability (Dobson et al. 2021).

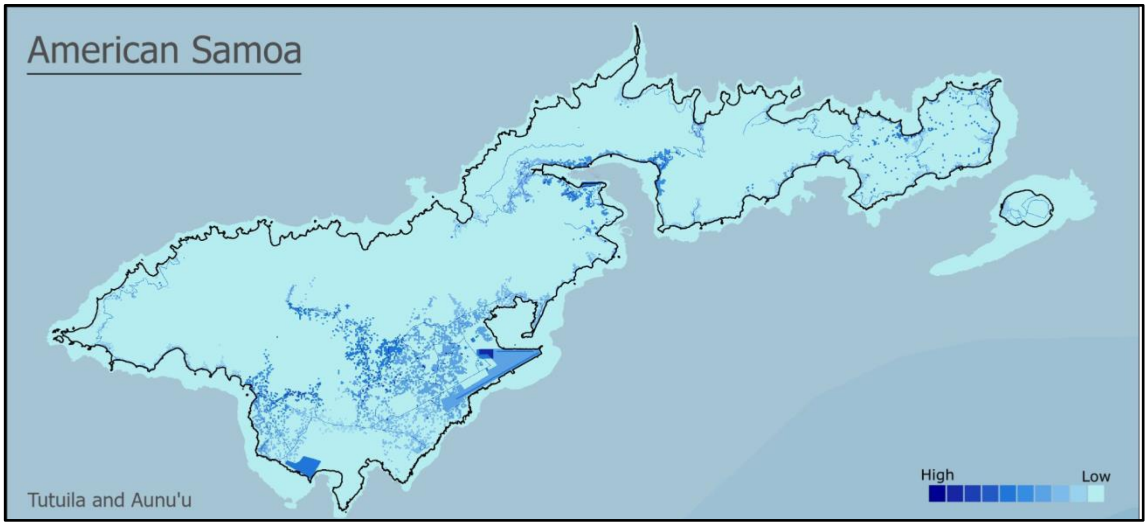

Figure 7. Community Asset Index for the Island of Tutuila (source: Dobson et al 2021)

Within the study area, The American Samoa Department of Public Works is planning a local drainage improvement project - the Route 19 Flood Mitigation Project. The proposed project will construct a drainage system in the village of Fagaima where it is constantly flooded during heavy rainfall. The drainage improvements are designed for a storm event of 5% AEP flood frequency event and include construction of a single box culvert along Route 19 (also referred to as Fagaima Road). See Figure 8 for the approximate location and extent of the Route 19 Flood Mitigation Project.

Under the future without-out project condition, Tafuna is assumed to remain the largest village in population with the largest concentration of businesses making the study area vulnerable to flood risk.

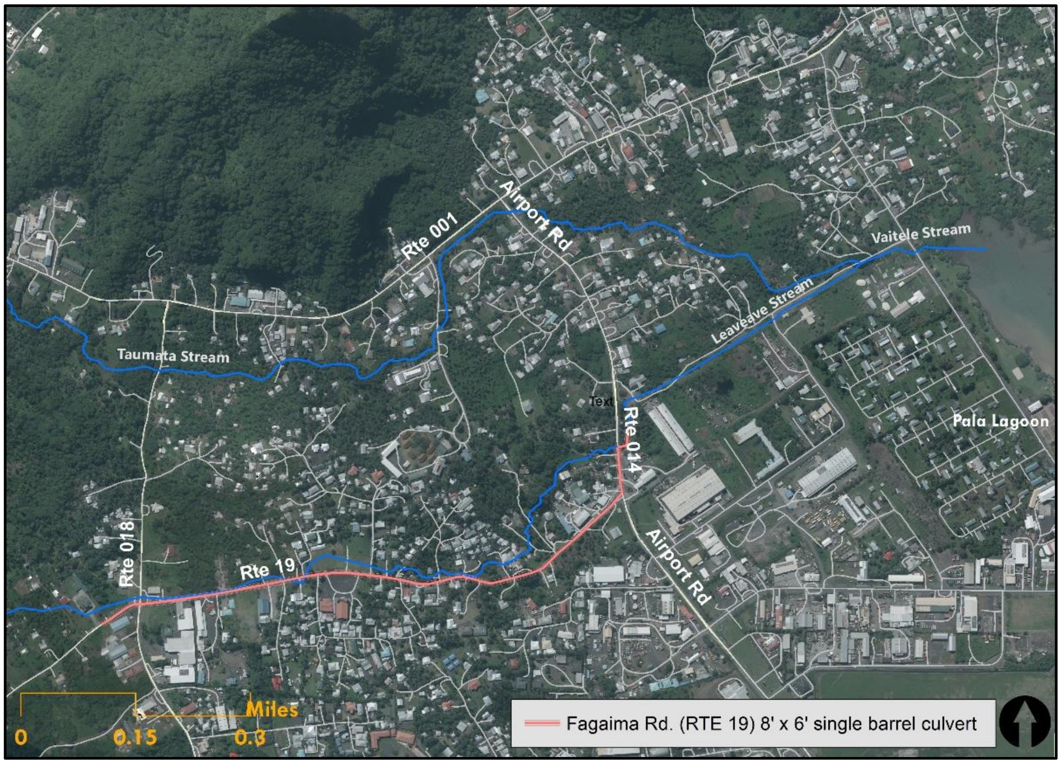

Figure 8: RTE 19/Fagaima Road flood mitigation project

2.6 Sea Level Rise and Subsidence

Relative sea level rise is a combination of a global change in sea level with subsidence, or sinking, of the tectonic plates. This phenomenon is occurring in American Samoa and was hastened by a powerful combination of near-simultaneous fault and thrust earthquakes that occurred in the Tonga Trench in September 2009.

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2.6.1 Subsidence

Based on Pago Harbor tide gauge data, this event caused Tutuila to initially rise about 2 to 3 inches at the time of the earthquake event, and then sink down about 7 to 9 inches over the next 2 to 3 years due to “relaxation from the earthquake deformation” (Scientific American, 2010; National Science Foundation, 2010).

The ongoing subsidence is estimated to be occurring at a rate of about 0.3 to 0.6 inches per year and is expected to continue in addition to anticipated climate-related sea level rise. The rate and extent of subsidence also contribute to uncertainty and will require monitoring over time to help inform relative sea level change estimates (Han et. al., 2019)

2.6.2 Sea Level Rise

Based on results from the USACE Sea Level Change Calculator (Figure 9, Table 1), sea level rise estimates range from 2.6 to 5.4 ft above relative mean sea level by the year 2080 and, 4.0 to 11.0 feet above relative mean sea level by 2130. It is important to keep in mind that these rates include a high margin of error (+/- 9.8 mm per year; 0.03 feet) based on uncertainty due to the strong influence of El Nino-Southern Oscillation forcing in the region. See Appendix A Hydrology and Hydraulics for additional detail on sea level rise and subsidence information for the study area.

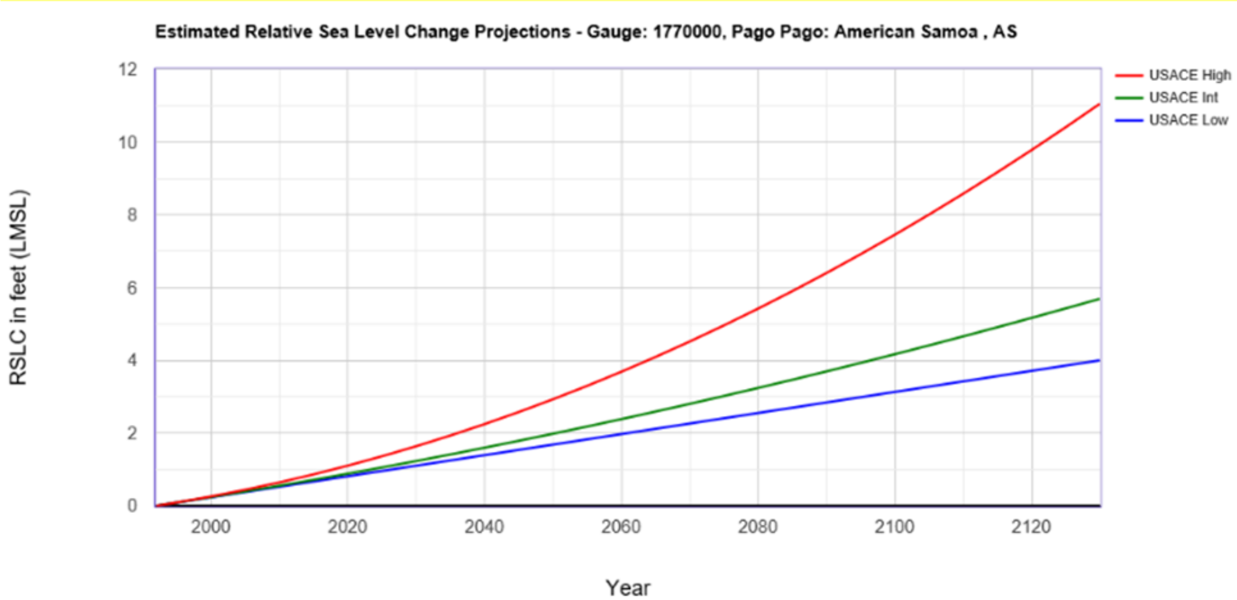

Figure 9: USACE Sea Level Change Curve Calculator, Pago Pago: American Samoa

Table 1: Estimated relative rea level change projections, Pago Pago, American Samoa

Year	Low (ft)	Intermediate (ft)	High (ft)
2030	1.112	1.24	2.256
2080	2.562	3.251	5.433
2130	4.012	5.705	11.072

2.7 Economic Environment

The study area has a history of flooding issues as the population continues to grow in the alluvial plain beneath steep mountains that receive significant rainfall. Flooding within the study area occurs relatively frequently, and significant flooding occurred numerous times within the past 20 years, including in 2003 (Typhoon Esau), 2004 (Tropical Cyclone Heta), 2014 (torrential rainfall), and 2018 (Tropical Cyclone Gita). Flooding from these storms caused millions of dollars in damages (American Samoa Hazard Mitigation Plan, 2020).

There are approximately 545 structures (both residential and non-residential) located within the 0.2 percent AEP floodplain. In addition to residential and non-residential structures, there are critical facilities such as major roads (e.g., Route 1 and 19), schools and churches. Figure 10 shows the study's structure inventory and 0.2 percent AEP future without-project floodplain.

Under the future without-out project condition, Tafuna remains the economic hub for business, government and infrastructure in American Samoa.

For a discussion on socioeconomics and environmental justice within the study area see Section 3.6.13 Socioeconomics and Environmental Justice.

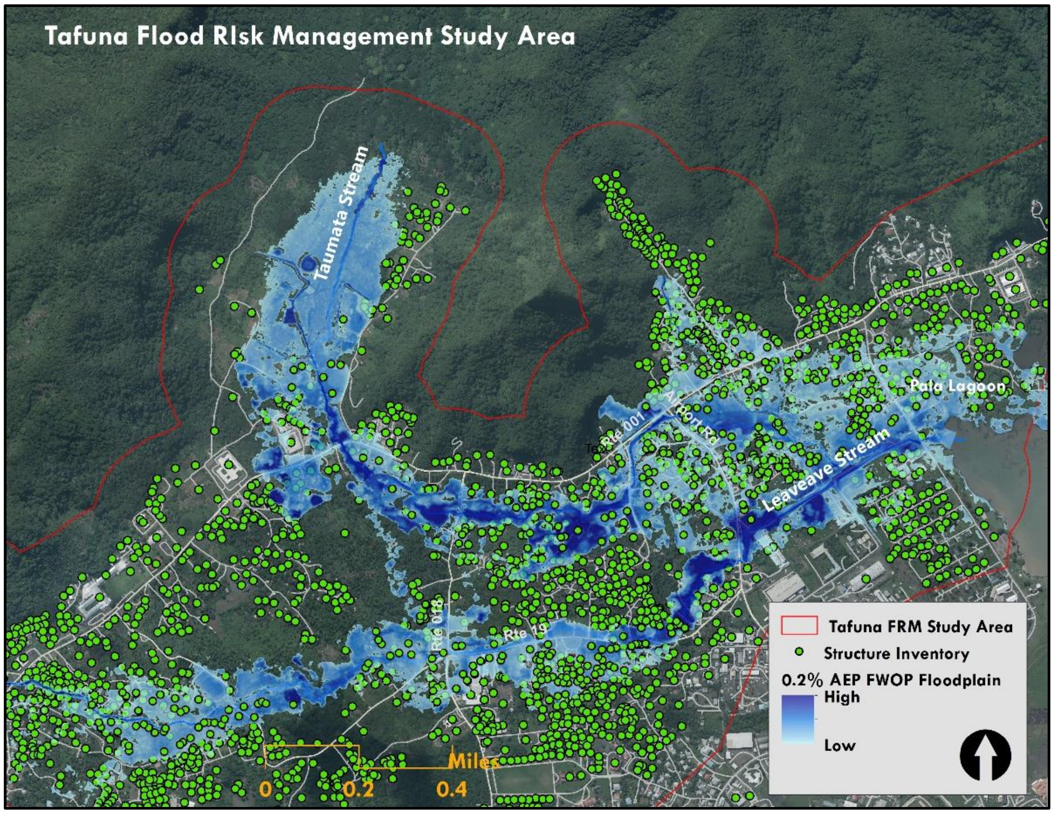

Figure 10: 0.2 percent AEP floodplain and structure inventory

2.7.1 Population and Housing

Historic and current population estimates for the study area are summarized in Table 2. From 2010 to 2020, the overall population of American Samoa declined by 10.5 percent. During the same time period, the population of Tafuna village remained very stable, rising by only 43.

Table 2: Historic and current population estimates

Area	Population		Total Change	Annualized Change Over Decade
	2010	2020	2020-2010	
Tafuna	7,945	7,988	43	+0.05%
American Samoa	55,519	47,710	-5,809	-1.1%

Source: 2018 American Samoa Statistical Yearbook and 2020 U.S. Census

Table 3 summarizes existing housing and household data for the study area. Because many areas of American Samoa lost housing units, the Tafuna Village alone was responsible for over half of net growth in housing units. The overall vacancy rate for Tualauta County, where Tafuna is located, was 12.0 percent in 2010, with a vacancy rate for rental units of only 5.4 percent. Tafuna had the highest average occupants per room for both owners and renters within Tualauta County.

Table 3: Estimated occupied and vacant housing units

Area	Total Housing Units		New Units	% Change
	2010	2020		
Tafuna	1,428	1,914	486	+34.0%
Tualauta County	4,080	5,304	1,224	+30.0%
American Samoa	10,963	11,807	844	+7.7%

Source: 2020 U.S. Census

Additional information on population, housing, socioeconomic conditions and environmental justice is located in Section 3.6.13 Socioeconomics and Environmental Justice.

2.7.2 Employment and Key Industries

Employment data by industry for American Samoa and Tualauta County are summarized in Table 4. Social services, government, and manufacturing are the three largest industries within the County. The breakdown of industries is very similar between the County and the Territory. Tualauta County is incredibly important to the American Samoa economy, with more than 35 percent of all employment and nearly 50 percent of employment in several industries.

Table 4: Employment by industry for American Samoa

Industry	Tualauta County	Percent	American Samoa	Percent
Agriculture, Fishing, Mining	102	1.6%	501	3.0%
Construction	461	7.3%	1,096	6.6%
Manufacturing	1,034	16.4%	2,753	16.5%
Wholesale	171	2.7%	335	2.0%
Retail	713	11.3%	1,614	9.7%
Transportation	444	7.0%	1,100	6.6%
Information	151	2.4%	385	2.3%
Finance, Insurance, Real Estate	192	3.0%	391	2.3%
Management, Administration	157	2.5%	330	2.0%
Education, Health, Social Services	1,213	19.2%	3,324	19.9%
Arts, Entertainment, Food Service, Tourism	420	6.7%	932	5.6%
Other Services	321	5.1%	626	3.7%
Public Administration	898	14.2%	3,229	19.3%
Military	30	0.5%	87	0.5%
Total	**6,307**	**100.0%**	**16,703**	**100.0%**

Source: 2018 American Samoa Statistical Yearbook

3 Plan Formulation *

This chapter presents results of the first step of the planning process, the specification of water and related land resources problems and opportunities in the study area. It also establishes the planning objectives and constraints, which are the basis for formulation of alternative plans and outlines the evolution of alternatives from the initial to final array. In its entirety, chapter 3 serves to meet the requirements of the NEPA alternatives analysis.

3.1 Planning Framework

Plan formulation is the process of building alternative plans that meet planning objectives and avoid planning constraints. 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 with respect to the four evaluation criteria described in the Principles and Guidelines (completeness, effectiveness, efficiency, and acceptability).

Completeness is the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects.
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 workability and viability of an alternative plan with respect to acceptance by State and local entities, tribes, and the public and compatibility with existing laws, regulations, and public policies.

3.2 Management Measures and Screening

3.2.1 Management Measures

A management measure is a feature or activity that can be implemented at a specific geographic site to address one or more planning objectives. A preliminary list of structural and nonstructural management measures is included below. Note: (*) denotes a measure that was screened out.

Nonstructural Measures

- Floodplain Zoning: Place restrictions on land usage in the areas surrounding a river by preventing or limiting development within flood zones. In addition, specific building standards and construction materials may be required to reduce potential flood damages.
- Flood Warning Systems/Evacuation Routes: Alert the community or key officials of imminent hazardous flooding conditions.
- Property Buyouts or Relocations*: Acquire lands and structures either by purchase or through the powers of eminent domain.
- Flood Proofing: Seal structures from water damage by waterproofing walls and floors and installing floodgates at entry points.
- Elevating Structures: Lift the building from its foundation and raise it above the flood level.
- Flood Warning System and Evacuation Routes: Provide accurate information to allow individuals and decision-makers to make informed decisions about whether to take

emergency action (e.g., evacuation) during a flood event, and document a plan identifying evacuation routes and temporary refuge facilities.
- Debris and Trash Removal: Remove debris and trash from the river channel to increase channel conveyance.
- Vegetation Management: Remove native or non-native vegetation from the river channel to increase channel conveyance.
- Education and/or Communication: Develop resilience-focused resources, tools, and/or education programs, designed for use by local communities and governments.
- Comprehensive Stormwater Management Plan: Develop a strategy for implementing a sustainable approach to managing stormwater runoff and protecting waterways.

Structural Measures
- Improve Existing Roadways, Bridges, and Culverts: actions directed at improving conveyance within the study area.
- Detention Basins (Surface and/or Sub-surface): Create temporary storage facilities to collect flood flows during larger storm events; operate to manage storm flow. This measure could also include natural and nature-based features (NNBF) like wetland creation or restoration, low flow swales, and/or utilizing impervious surfaces.
- Diversion / Bypass Structures*: Create diversion structures (weirs, etc.) to divert high flows to less densely populated areas.
- Infiltration System*: Construct shallow excavations lined with fabric and filled with stone to create underground reservoirs for stormwater runoff.
- Flood Barrier: Construct levees, berms, and/or flood walls.
- Ring Walls or Berms*: Construct small ring wall or berm around the exterior of a single structure or small group of structures.
- Grade Control Structure*: Install concrete- or boulder-filled trenches at changes in slope to manage bed erosion.
- Channel Improvements: Install lining, realign, widen, or deepen stream channels to increase flow capacities.

3.2.2 Screening of Measures

Screening is the process of eliminating, based on planning criteria, those measures that will not be carried forward for consideration. Completeness, effectiveness, efficiency, and acceptability are the four evaluation criteria specified in the CEQ Principles and Guidelines (Paragraph 1.6.2(c)) in the evaluation and screening of alternative plans. Measures 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 a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects.

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 workability and viability of an alternative plan with respect to acceptance by State and local entities, tribes, and the public and compatibility with existing laws, regulations, and public policies.

Table 5 provides the results of the screening evaluation based on the criteria described above. Additional detail is provided, following the table, summarizing the rationale for measure elimination.

Table 5: Measure screening evaluation

Measure	Retained/ Eliminated	Completeness	Effectiveness	Efficiency	Acceptability
Nonstructural					
Flood Warning System/Evacuation Routes	Retained	Low	Med	High	High
Property Buyouts or Relocations	*Eliminated*	*High*	*High*	*Low*	Low
Flood Proofing	Retained	Med	Med	Med	Med
Elevating Structures	Retained	Med	Med	Med	Med
Debris and Trash Removal	Retained	Med	Low	High	High
Vegetation Management	Retained	Med	Low	High	Med
Education and/or Communication	Retained	Low	Med	High	High
Comprehensive Stormwater Management Plan	*Eliminated*	Med	Med	High	Med
Structural					
Improve existing roadways, bridges, and culverts	Retained	Med	Med	Med	High
Detention Basins	Retained	Med	Med	High	Med
Diversion / Bypass Structures	*Eliminated*	Med	Low	Med	Med
Infiltration System	*Eliminated*	Low	Low	Med	Med
Flood Barrier	Retained	High	High	High	Med
Ring Walls or Berms	*Eliminated*	Low	Low	Med	Med
Grade Control Structure	*Eliminated*	Low	Low	Med	Med
Channel Improvements	Retained	Med	Med	Med	High

Buyouts and relocation of structures were screened out from further consideration because of the challenges of implementation. Due to the communal land ownership system, in many areas of the watershed clear delineation of property boundaries do not exist. Without the necessary parcel data to identify extents and useability, buyout or relocation analysis is problematic. It is likely more realistic and practical to elevate or floodproof. Buyouts and relocation of structures were screened out from further consideration because of the challenges of implementation and lack of economic feasibility. According to the American Samoa Government, approximately 90% of land in American Samoa is communal land. Communal land is an integral part of the social organization and is tied to both the kinship system and village organization. The cognatic descent group (‘âiga) are the “owners” of the land. Rights to land use come with membership in the descent group. Due to the communal land ownership system, in many areas of the watershed clear ownership and title records do not exist. Without the necessary ownership data to determine property owner consensus, buyout or relocation analysis is problematic. It is likely more realistic and practical to elevate or flood proof structures.

Comprehensive Stormwater Management Plan was screened out because it would require analysis on waterways which do not meet the 800 cfs requirement and are outside the scope of this study. Comprehensive Stormwater Management Plan, study and development is being recommended in the USACE American Samoa Post-disaster Watershed Assessment (anticipated final Watershed Plan available July 2022).

Education and/or Communication is carried forward but will not be considered as part of an alternative because it is inherent in all implemented Flood Risk Management projects constructed with USACE. As part of the Agreement to implement, education and communication such as a Floodplain Management Plan, participation in the National Flood Insurance Program, and mandatory communication requirements with the community are obligations of the nonfederal sponsor.

Ring walls/berms were screened out because they do not directly address the study objectives. They would help protect groundwater wells, but were deemed an ineffective solution, because flood water seeps underground and circumvents above-ground features.

An infiltration system was screened out for not meeting the planning objectives to reduce flood risk during rain events over the 50-year period of analysis, as well as reducing life safety risk during rain events. As a standalone measure, an infiltration system is more appropriate to facilitate groundwater recharge and is therefore not an FRM measure.

A diversion/bypass structure was screened out as it did not meet the planning objectives. There was no obvious area within, or within proximity to, the study area that would be a good site to detain or convey the diverted water. Without such a site, the flood risk would be transferred further down the watershed, potentially to a more densely populated built up area. The lack of defined channels also makes this measure a challenge to implement because of the additional flows associated with diversions and bypasses.

Grade control structures were also screened out for not meeting the planning objectives. Grade control structures are intended to control flows in areas with steep topography with well-defined channels. They would not be effective given the relatively flat and shallow stream channels within the study area.

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. For nonstructural measures, it was assumed that one or more nonstructural measures will likely be added to any alternative carried forward into the focused array. However, as both a nonstructural measure and a standalone alternative, the study team carried forward both dry flood proofing (non-residential structures) and elevating (residential structures).

The study team developed the Initial Array of Alternatives after a site visit in January 2020. Table 6 provides a both the Initial Array of Alternatives (August 2021) and a reformulated list of alternatives (August 2021) that was developed as the study evolved. Then, the study team conducted a qualitative evaluation of the alternatives identified in Table 6 to get to the Final Array of Alternatives. Special consideration was given to alternatives that minimize real estate impacts (e.g., leveraging existing roads and FRM structures) due to anticipated challenges related to land ownership and the non-federal sponsor's ability to acquire the necessary Lands, Easements, Rights-of-Way, Relocations and Disposal (LERRDs).

Table 6: Tafuna Flood Risk Management Study initial array of alternatives

Initial Array of Alternatives (August 2020)	Reformulated Alternatives (August 2021)
A: No Action	**A:** No Action
B: Nonstructural	**B:** Leaveave Stream – Detention and Conveyance
C: Existing Roads and Structures	**C:** Taumata Stream – Conveyance
D: Detention Basin(s)	**D:** Combined Taumata and Leaveave streams (Structural)
E: Conveyance	**E:** Nonstructural (Dry Flood Proof, Only Commercial)
F: Conveyance/Detention Combination	**F:** Nonstructural Taumata (Elevate Residential/ Dry Flood Proof Commercial)
G: Structural/Nonstructural Combination	**G**: Nonstructural Leaveave (Elevate Residential/ Dry Flood Proof Commercial)
	H: Nonstructural combined Leaveave and Taumata (Elevate Residential/ Dry Flood Proof Commercial)

During early iterations of investigating structural measures, the study team evaluated the potential to include detention basins as a FRM measure and potential NNBF. NNBF are landscape features that are used to provide engineering functions relevant to FRM, while producing additional economic, environmental, and/or social benefits. Examples of NNBF include vegetated environments such as freshwater wetlands. It is recognized that a strategy that combines NNBF with nonstructural and structural measures represents an integrated approach to FRM that can deliver a broad array of ecosystem goods and services to local communities. Several “pilot” locations were explored in the Kokoland vicinity along the Leaveave Stream and select areas along Taumata Stream (Figure 11). However, when modeled in HEC-RAS, the it was concluded that detention basins were not effective measures, having limited ability to improve residual floodplains. There were also water quality concerns. It was noted that the soils in the study area tend to be highly porous and the water in the detention basins would eventually enter the productive Tafuna-Leone Plain groundwater wells and thus could be a potential health a safety issue. So, detention basins were not carried forward to the final array of alternatives. All other structural measures identified above were carried forward.

The reformulated alternatives (August 2021) took the approach of looking at each stream separately (Leaveave and Taumata streams) for potential federal interest. Based on initial HEC-

RAS modeling runs and economic analysis, it was concluded that the study area is relatively similar in its flooding characteristics (widespread shallow flooding with low velocities) and structure types and values were similar throughout. Thus, it did not make sense to proceed with the approach of evaluating each stream separately.

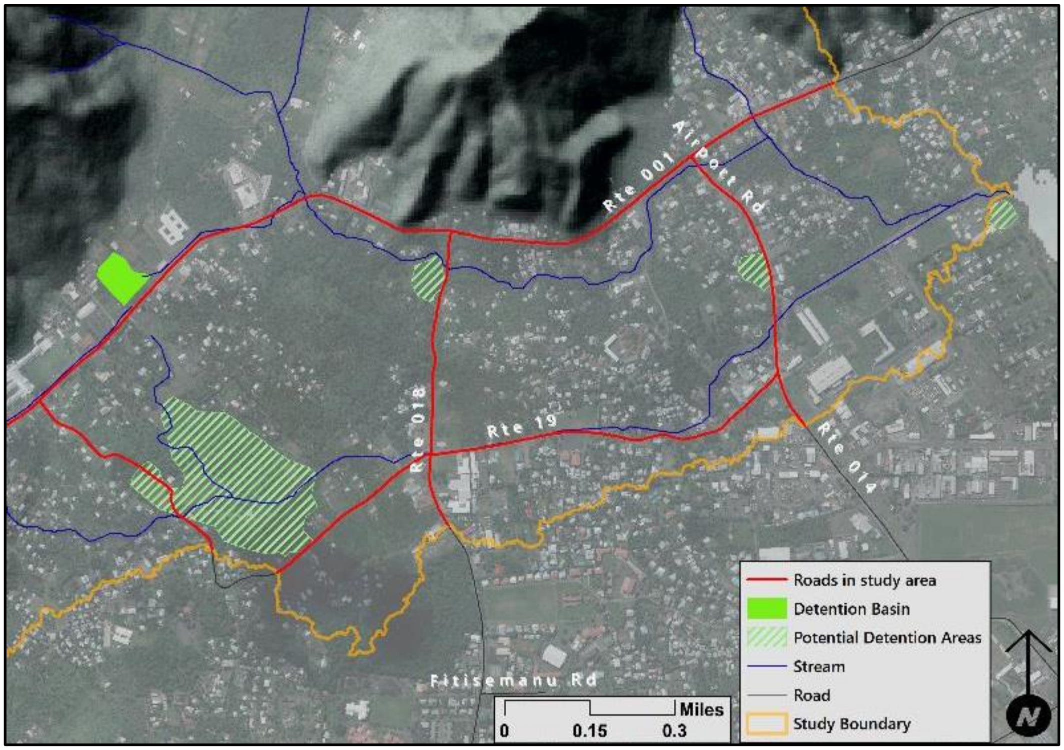

Figure 11: Detention basin alternative

The qualitative evaluation of the initial array of alternatives yielded the following conclusions:

- Flooding is widespread and shallow (particularly in areas of more dense population)
- Channel conveyance improvements were more effective than detention options
- Alternatives were not impacted by future changes in seal level rise as they are largely outside the tidal influence zone

3.4 Final Array of Alternatives

Based on the rationale and findings noted in Section 3.3, the Final Array of Alternatives were developed. Upon evaluation of the Final Array of Alternatives, it was concluded that channel conveyance improvements (e.g., channel widening, vegetation removal, etc.) yielded limited FRM benefits. Flood barriers were included as a potential measure in the Final Array of Alternatives, despite the known real estate challenges, because of the anticipated effectiveness in improving FRM in the study area. The final array of alternatives includes:

- Alternative A: No Action Alternative
- Alternative B: Channel Conveyance Improvements (Leaveave and Taumata Streams)
- Alternative B1: Channel Conveyance Improvements and Flood Barriers (Leaveave and Taumata Streams)
- Alternative C: Taumata Flood Barrier and Nonstructural Improvements

- Alternative D: Nonstructural Improvements

3.4.1 Alternative A: No Action Alternative

The No-Action Alternative is synonymous with no federal action. This alternative is analyzed as the future without-project condition for comparison with the action alternatives. Detailed discussion on FWOP can be found in Section 2 .

3.4.2 Alternative B: Channel Conveyance Improvements

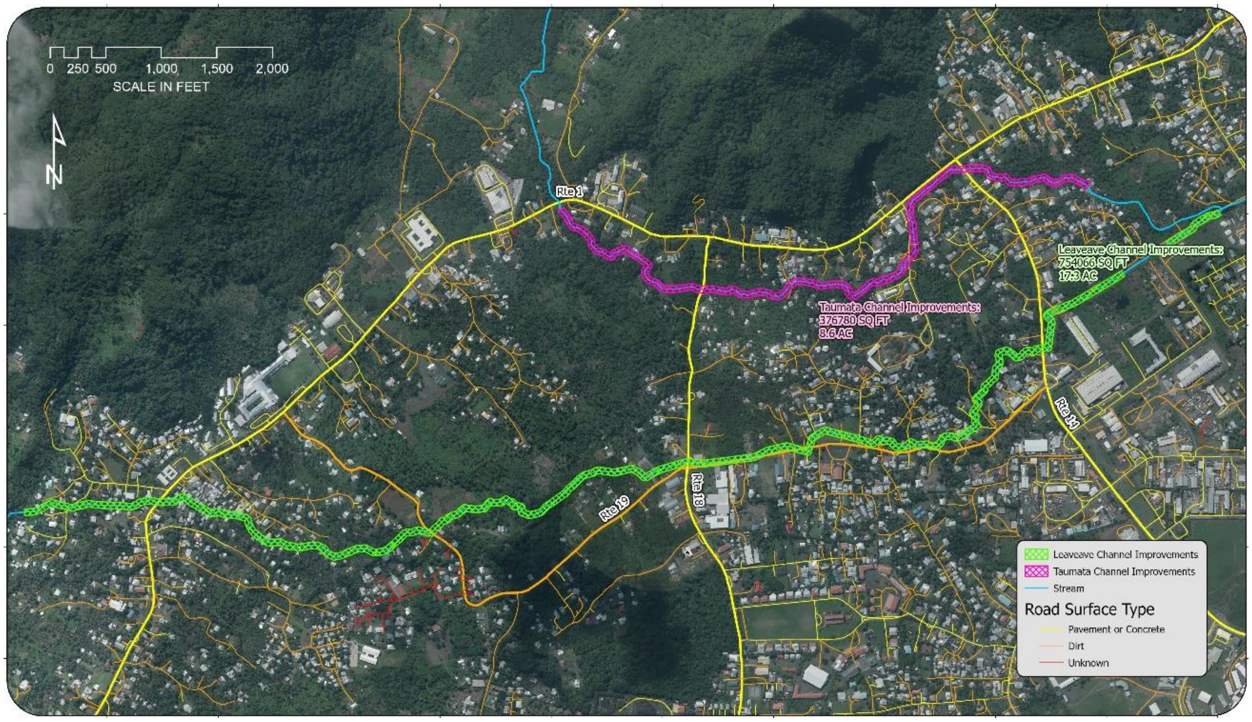

Figure 12: Alternative B channel conveyance improvements

Alternative B includes approximately 6,340 ft of channel conveyance on Taumata Stream and 13,120 ft of channel conveyance on Leaveave Stream. This alternative includes vegetation removal and conveyance improvements such as excavation of material to create a uniform channel with a varying bottom width of five to 20 ft and a two to one side slope.

The minimum estimated real estate requirements for Alternative B are:

- Leaveave Channel Improvements: 17.3 acres of channel improvement easements
- Taumata Channel Improvements: 8.6 aces of channel improvement easements
- Staging, access, construction: 11.2 acres of temporary work area easements (two years)

Figure 13 provides a floodplain comparison between the 4 percent AEP future without-project conditions and Alternative B. Based on the modeled results, channel conveyance improvements provided very little FRM benefits, as the future without-project and with-project floodplains are nearly identical.

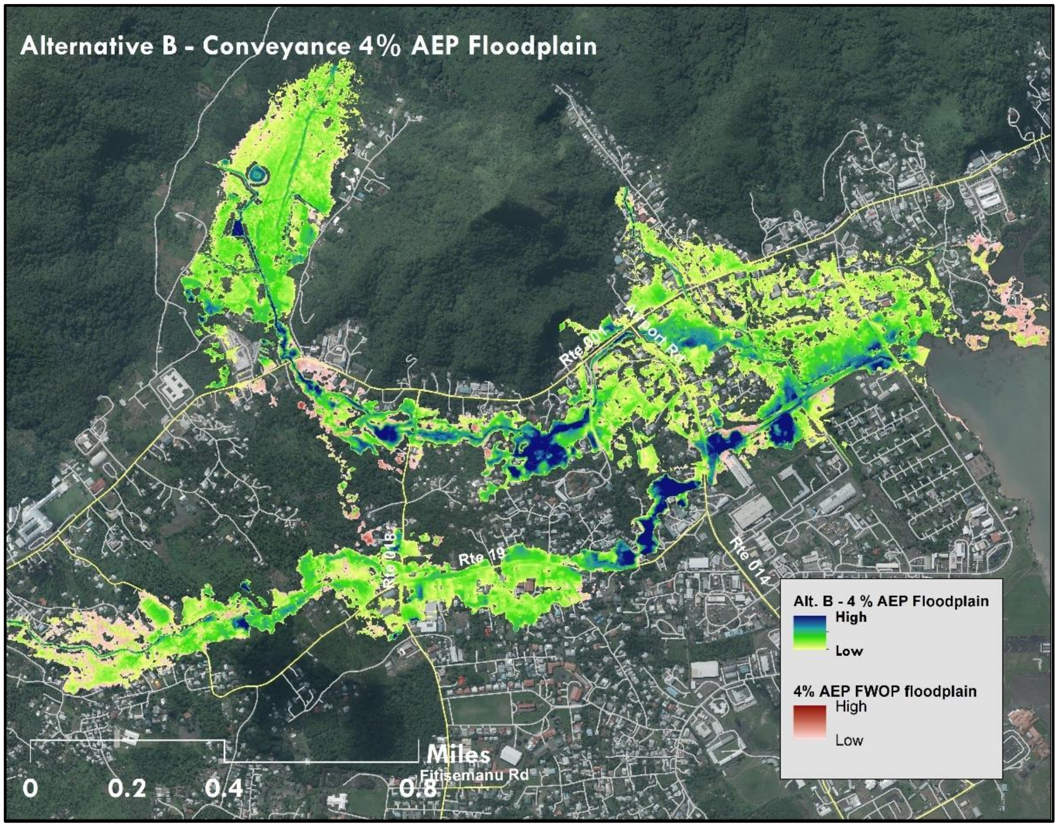

Figure 13: Alternative B: future without-project and with-project floodplain comparison

3.4.3 Alternative B1: Channel Conveyance Improvements and Flood Barriers

Alternative B1 (Figure 14) includes the conveyance improvements described in Alternative B above plus construction of a flood barrier. There is approximately 2,400 linear ft (lf) of barrier with an average height of seven ft (from ground elevation) on the Taumata stream and approximately 3,400 lf of barrier with an average height of five ft (from ground elevation) on Leaveave stream.

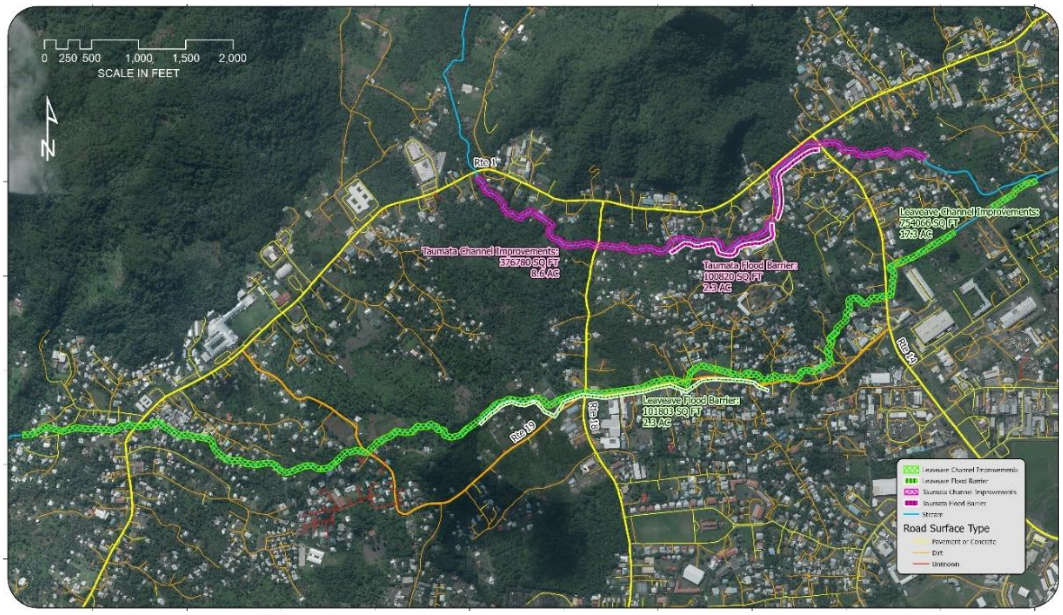

Figure 14: Alternative B1 channel conveyance improvements and flood barriers

The minimum estimated real estate requirements for Alternative B are:

- Leaveave Channel Improvements: 17.3 acres of channel improvement easements
- Leaveave Flood Barrier: 2.3 acres of flood protection levee easements
- Taumata Channel Improvements: 8.6 aces of channel improvement easements
- Taumata Flood Barrier: 2.3 acres of flood protection levee easements
- Staging, access, construction: 14.4 acres of temporary work area easements (two years)

Figure 15 provides a floodplain comparison between the 4 percent AEP future without-project conditions and Alternative B1. Alternative B1 is more effective at reducing flood risk, specifically in areas adjacent to the flood barriers. The flood barriers are expected to provide FRM for structures located along the right bank of Leaveave and Taumata streams.

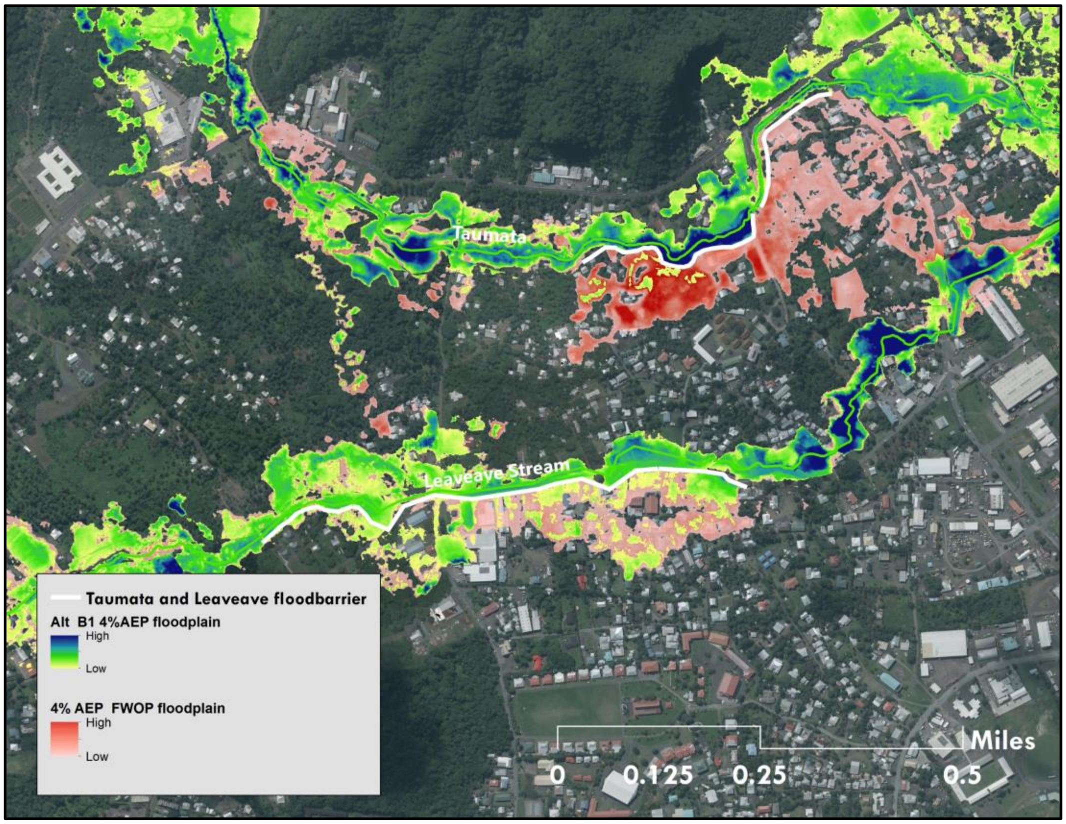

Figure 15: Alternative B1 future without-project and with-project floodplain comparison

3.4.4 Alternative C: Taumata Flood Barrier and Nonstructural Improvements

Alternative C (Figure 15) includes the construction of approximately 2,400 lf of barrier with an average height of seven ft (from ground), on Taumata Stream. The nonstructural component of this alternative will include dry floodproofing 38 nonresidential buildings and elevating 242 residential structures (assumes 100% participation rate) as these structures will not receive flood protection from the Taumata Stream flood barrier. Participation in the alternative will be voluntary for residences identified in the study area. For additional details about the nonstructural analysis or methodology, refer to Section 3.4.5.1.

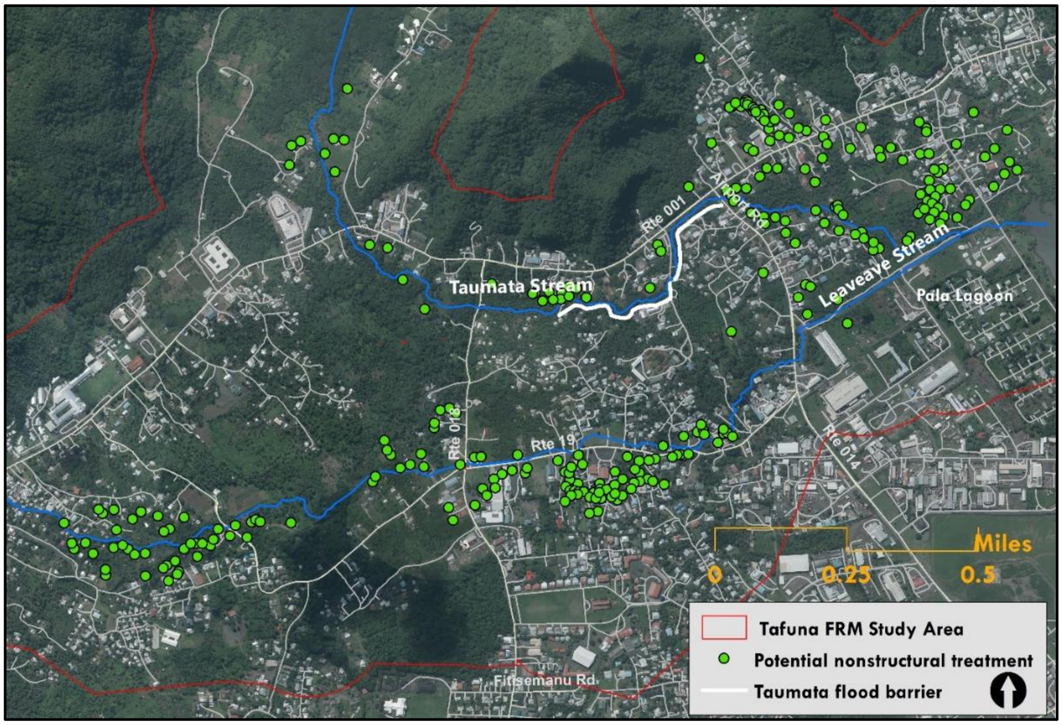

Figure 16: Alternative C Taumata flood barrier and nonstructural improvements

Alternative C includes the construction of approximately 2,400 lf of barrier with an average height of seven ft (from ground) on Taumata Stream. The nonstructural component will include dry floodproofing 38 nonresidential buildings and elevating 242 residential structures (assumes 100% participation rate) as these structures will not receive flood protection from the Taumata Stream flood barrier. For additional details about the nonstructural analysis or methodology, refer to Section 3.4.5.1.

The minimum estimated real estate requirements for Alternative C are:

- Taumata Flood Barrier: 2.3 acres of flood protection levee easements
- Staging, access, construction: 1.8 acres of temporary work area easements (two years)

Additional real estate requirement agreements associated with the voluntary participation include:

- Floodproofing: 38 structures, Right of Entry agreements and flood proofing agreements
- Elevating: 242 residences, Right of Entry agreements and flood proofing agreements

Figure 17 provides an illustration of the structures that will receive anticipated benefit from the construction of the Taumata flood barrier (labeled with white points) and the 280 candidate structures for either dry flood proofing (nonresidential structures) or elevating (residential structures) represented by the orange points.

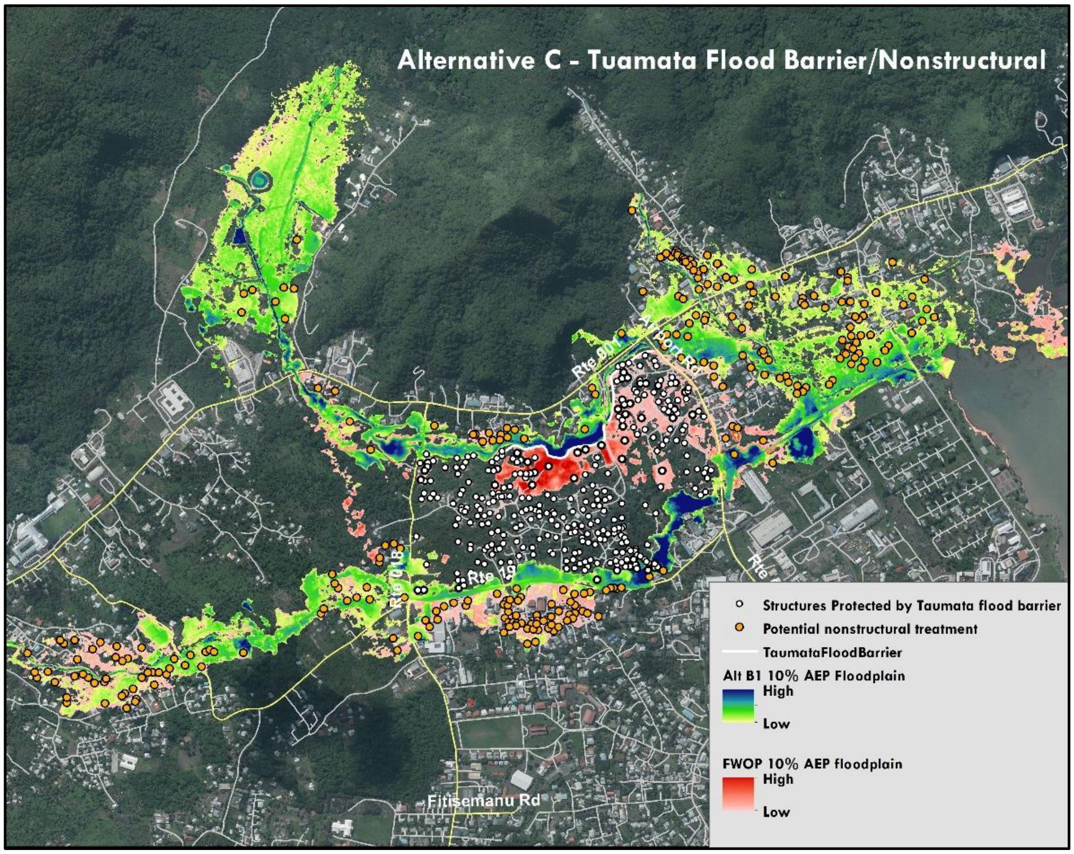

Figure 17: Alternative C candidate structures for nonstructural improvements

3.4.5 Alternative D: Nonstructural Improvements

Alternative D (Figure 17) includes only nonstructural measures. Preliminary benefit-cost analysis evaluations (see Section 3.4.5.2 for additional detail) show that nonstructural measures affecting 312 structures can provide FRM benefits comparable to a structural improvement plan. At this stage of the study, dry floodproofing 40 nonresidential structures and elevating 272 residential structures is assumed to be the most effective nonstructural solution given the frequency and depth of flooding. This alternative is different than Alternative C because it includes additional structures damaged as a result of not constructing the Taumata flood barrier. This number represents the maximum number of structures for planning purposes. Additional analysis is necessary on-site to identify eligibility, validate existing conditions of structures, as well as the need for nonstructural improvements. Participation in the alternative will be voluntary for residences identified in the study area. The aggregation methodology and participation rate sensitivity analysis for Alternate D are described below in Sections 3.4.5.1 and 3.4.5.2.

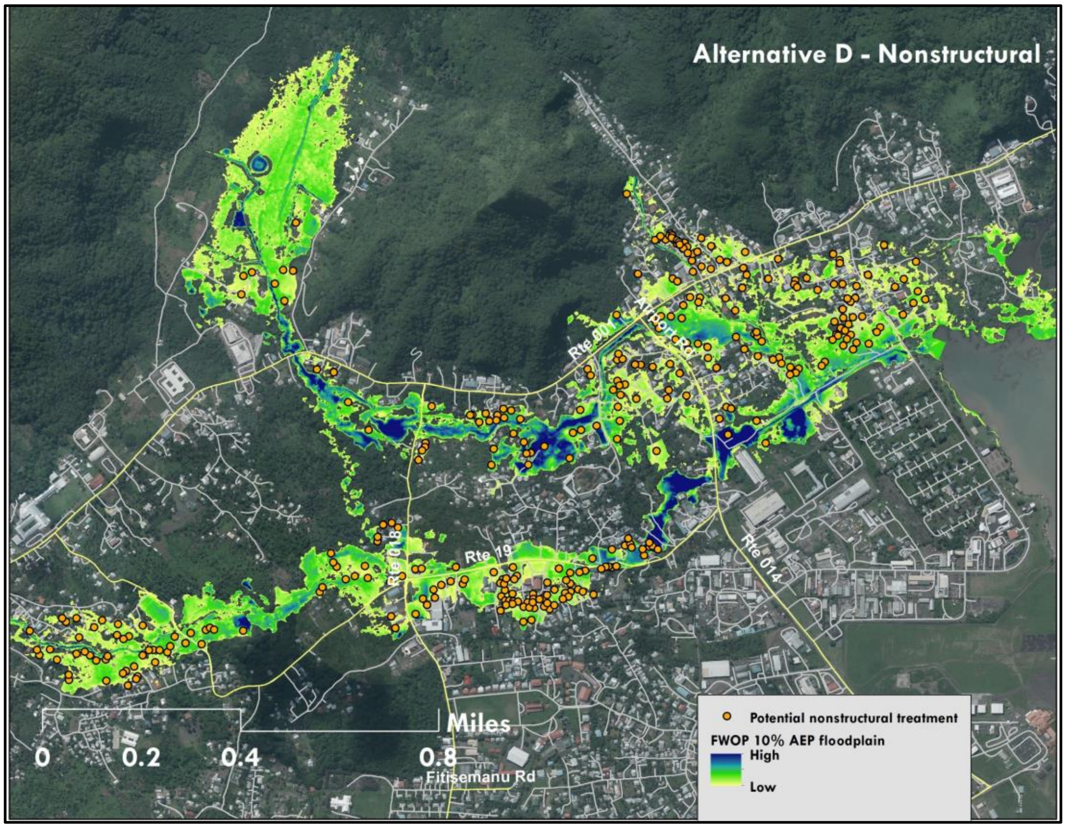

Figure 18: Alternative D nonstructural improvements

The minimum estimated real estate requirements for Alternative D are:

- Staging: 0.5 acres of temporary work area easements (two years)

Additional real estate requirements agreements associated with the voluntary participation include:

- Floodproofing: 40 structures, Right of Entry agreements and flood proofing agreements
- Elevating: 272 residences, Right of Entry agreements and flood proofing agreements

3.4.5.1 Nonstructural Analysis, Aggregation and Participation Rate

The nonstructural FRM measures considered for this study are: 1) dry floodproofing nonresidential structures and 2) elevation of residential structures. Dry floodproofing consists of waterproofing the structure to prevent flood waters from entering. Only dry floodproofing was considered for non-residential structures, while elevation was considered for residential structures. Elevation is a measure that raises a structure's first floor elevation to an elevation that is at least equal or greater than a design water surface elevation.

The nonstructural aggregation methodology was determined by grouping structures based on their potential flood risk and then selecting the grouping that reasonably maximizes net-benefits. The nonstructural aggregation analysis consisted of grouping the study's structure inventory into four groups based on flood risk associated with the ten, four, two and one percent AEP event floodplains. A benefit-cost analysis was performed on each of the four AEP event floodplains listed above. Table 7 shows the results of this aggregation analysis. The 10 percent AEP floodplain grouping maximized net-benefits. As such, it was carried forward for all nonstructural alternatives (Alternatives C and D).

Table 7: Nonstructural aggregation analysis results

Assumes 100% participation rate, Oct 2020 price level in $1000's				
	10% AEP	**4% AEP**	**2% AEP**	**1% AEP**
First Cost	131,346	163,925	180,059	191,874
Equivalent Annual Benefits	6,643	7,023	7,194	7,266
Average Annual Cost	4,631	5,780	6,349	6,765s
Net Benefits	2,012	1,244	846	501
BCR	1.4	1.2	1.1	1.1
Total Number of Structures	312	388	429	465
Residential	272	335	367	396
Non-Residential	40	53	62	69

3.4.5.2 Participation Rate Sensitivity Analysis

A sensitivity analysis for the participation rates was completed to determine how benefit-cost metrics will be affected by changes in participation rates. The sensitivity analysis evaluated 50,000 combinations of the 312 structures using three participation rate scenarios (25, 50 and 75 percent). Table 8 shows the range of benefit-cost metrics and results of the sensitivity analysis. The results demonstrate that for all three of the assumed participation rates, nonstructural measures have positive net benefits for most summary statistics; the exception is the minimum estimated net benefit value for the 25 percent participation rate. It is assumed that if the exception scenario is realized neither the federal or nonfederal partner will invest in the project as it is cost prohibitive and clearly not supported by the community. The BCR and/or Net Benefits will change with each additional scenario run under the different rates, however, they will remain within the range of minimum to maximum. Under this particular set of combinations the hlighted cells indicate the highest value for that statistic.

Table 8: Results of the nonstructural participation rate sensitivity analysis on 10% AEP floodplain

Oct 2020 price level in $1000's						
Participation Rate	**Metric**	**Minimum**	**25% Percentile**	**Median**	**75% Percentile**	**Maximum**
25%	BCR	0.71	1.26	1.37	1.49	2.16
	Net Benefits	-247	$291	$426	$566	$1,365
50%	BCR	1.01	1.31	1.38	1.45	1.74
	Net Benefits	18	$706	$865	$1,025	$1,761
75%	BCR	1.13	1.34	1.38	1.42	1.62
	Net Benefits	$428	$1,164	$1,305	$1,437	$2,020

Alternative C and D each have a nonstructural component which requires comparison for NED benefit-cost analysis. For purposes of this analyses and evaluating federal interest (Section 3.5.1 Federal Objective), a 100 percent participation rate was used to compare Alternatives C and D. It was assumed that if the participation rate is less than 100 percent, consistent evaluation was a concern because there was no identical way to identify non-participating structures that would be left out of the analysis. Given the issues associated with basing the analysis on a lower participation rate, using the 100 percent rate is preferable, particularly for the Tafuna FRM study, where the sensitivity analysis shows (Table 8) the project is justified, and NED Plan determination is not significantly impacted under the lower participation rates.

All nonstructural results presented in the subsequent sections of this report assume that 100 percent of the structures contained in the 10 percent AEP floodplain will receive dry flood roofing protection (non-residential structures) or will be elevated (residential structures). This assumption will be refined as the study moves into feasibility level design.

Plan Evaluation and Selection

3.5 Plan Evaluation

The following sections describe the evaluation and comparison of the final array of alternatives.

3.5.1 Federal Objective

The NED analysis reflects FRM benefits associated with reduced flood damages to structures, their contents, vehicles, and the avoidance of post-flood clean-up costs. Table 9 shows a summary of results for Alternatives B, B1, C, and D. Alternative C reasonably maximizes net-benefits at $2.78 million (highlighted in grey).

Table 9: Summary results of final array of alternatives (Oct 2021 price level, $1,000)

Item	ALTERNATIVE				
	A	B	B1	C	D
Expected Annual Damages 2030 Base Year	8,961	9,178	7,233	1,677	1,922
Expected Annual Damages 2079 Future Year	9,494	9,154	6,861	1,777	2,001
Equivalent Annual Damages, 50-Year Period of Analysis, 2.25% Discount Rate	9,178	9,168	7,081	1,718	1,954
Equivalent Average Annual Benefits (AAB), 50-Year Period of Analysis, 2.25% Discount Rate	0	10	2,097	7,461	7,224
Project First Costs	0	27,641	47,345	136,628	141,272
Interest During Construction	0	154	665	1,531	394
Total Economic Costs	0	27,795	48,010	138,159	141,665
Average Annual Costs @ 50-year period of analysis and 2.25%	0	932	1,609	4,631	4,748
Annual operations, maintenance, repair, replacement, and rehabilitation (OMRRR)	0	146	244	46	0*
Total Average Annual Costs	0	1,078	1,853	4,677	4,748
Net Benefits	--	-1,068	244	2,784	2,476
Benefit-to-Cost Ratio (BCR)	--	0.01	1.1	1.6	1.5

** no OMRRR cost was included for nonstructural measures*

3.5.2 Contribution to Objectives and Avoid Constraints

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

- Alternative B is not effective at reducing damages and induces damages in certain reaches when compared to Alternative A (no action).
- Alternatives B1, C, and D are effective in reducing damages in most study reaches when compared to Alternative A.
- The Taumata Stream flood barrier in Alternatives B1 and C is effective at reducing damages along the right bank in close proximity to the flood barrier's extent, where damages only occur at the 0.2 percent AEP event.
- The nonstructural alternatives (Alternative C and D) are the most effective alternatives in terms of preventing damages throughout the study area.
- Alternative B1 which combines channel conveyance and flood barrier along Taumata and Leaveave streams is expected to best reduce flooding on the roads, significantly improving physical safety in the residential communities along both streams.
- Alternative C minimizes negative impacts to mangroves. The Taumata flood barrier improves water quality by limiting amount of water flowing through residential and commercial areas; Construction could result in short-term water quality impacts, but these would be minimized through BMPs.

Table 10: Assessment of achieving the study's objectives and constraints

Alternative	Property	Critical Infrastructure (roads)	Life safety	Minimize water quality impacts to mangroves
Alternative A: No Action	Low	Low	Low	Low
Alternative B: Channel Conveyance Improvements	Low	Low	Low	Low
Alternative B1: Channel Conveyance Improvements and Flood Barriers	Medium	High	High	Low
Alternative C: Taumata Flood Barrier and Nonstructural Improvements	High	Medium	Medium	High
Alternative D: Nonstructural Improvements	High	Low	Low	Low

3.5.3 Principles and Guidelines Criteria

Completeness, effectiveness, efficiency, and acceptability are the four evaluation criteria specified in the CEQ Principles and Guidelines (Paragraph 1.6.2(c)) in the evaluation and screening of alternative plans. 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 a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects.

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 workability and viability of an alternative plan with respect to acceptance by State and local entities, tribes, and the public and compatibility with existing laws, regulations, and public policies.

Table 11 compares the focused of alternatives against these criteria using qualitative (e.g., high, medium, and low) criteria.

Table 11: Planning and Guidelines criteria evaluation of alternatives

Alternative	Completeness	Effectiveness	Efficiency	Acceptability
Alternative A: No Action	Low	Low	Low	Low
Alternative B: Channel Conveyance Improvements	Medium	Low	High	Medium
Alternative B1: Channel Conveyance Improvements and Flood Barriers	High	High	Medium	Low
Alternative C: Taumata Flood Barrier and Nonstructural Improvements	High	High	Low	High
Alternative D: Nonstructural Improvements	Medium	Medium	Low	High

The No Action Alternative is not complete, effective, efficient, or acceptable. This plan does not alleviate specified problems, does not meet study objectives, and is not a cost-effective solution to address the problem.

Alternative B is a complete and efficient plan. However, it less effectively addresses FRM problems compared to other structural alternatives with minimal reduction of annual damages and significant residual damages under the future with-project condition compared to other structural alternatives. A significant amount of residual flooding/damages still occurs even with the project in place, and the chance of flooding in any given year, as represented by AEP, is not significantly reduced as compared to the without-project condition (e.g., there is a 20 percent AEP floodplain with Alternative B in place, indicating flooding from a 20 percent AEP event or smaller). In addition, there are some acceptability concerns, particularly regarding in-stream improvements, which may have negative environmental impacts and be less acceptable in terms of compatibility with existing environmental compliance regulations. Finally, Alternative B is less efficient at reducing flood risk compared to other alternatives, with fewer net benefits compared to Alternative B1, C, and D.

Alternative B1 is a complete and effective plan. It is more effective than Alternative B because of the addition flood barriers along both Leaveave and Taumata streams. In addition, this plan is less acceptable due to the instream improvements noted above, as well as that the construction of a flood barrier along Leaveave (Route 19) a major thoroughfare. There would also be relatively high amounts of private property impacts associated with construction of the flood barrier. This plan has a positive benefit to cost ratio; however, for the reasons noted above, the study team screened out Alternative B1 from further analysis.

Alternative C is a complete, effective, and acceptable plan. This plan reduces damages by approximately 81 percent with fewer residual damages compared to other alternatives and has higher NED benefits compared to other alternatives as well. As a result of this analysis, Alternative C was carried forward for further evaluation.

Alternative D is a complete and effective plan. Significant residual flooding/damages still exists with the project in place and the chance of flooding in any given year (i.e., AEP) is not reduced as compared to the without-project. Structures would be protected (either dry flood proofed or elevated); however, residual flooding of the roads and community would still exist. This plan has a positive benefit to cost ratio and was carried forward for further evaluation.

3.5.4 System of Accounts

In January 2021, a policy memorandum was issued by the Assistant Secretary of the Army for Civil Works (ASA(CW)) directing study teams to identify and analyze benefits in total and equally across a full range of benefit categories. The intent of this directive is for teams to comprehensively evaluate benefits including equal consideration of economic, environmental, and social categories. To meet the intent of this memo, the final array of alternatives was assessed to identify benefits across four categories: NED, Regional Economic Development (RED), Other Social Effects (OSE), and Environmental Quality (EQ).

The **NED** account displays changes in the economic value of the national output of goods and services.

The **RED** account registers changes in the distribution of regional economic activity that result from each alternative plan. Evaluations of regional effects are to be carried out using nationally consistent projections of income, employment, output, and population.

The **OSE** account registers plan effects from perspectives that are relevant to the planning process, but are not reflected in the other three accounts.

The **EQ** account displays non-monetary effects on significant natural and cultural resources.

3.5.4.1 National Economic Development

The NED plan is the plan that reasonably maximizes NED benefits, consistent with the federal objective described in Section 1.7.1 Planning Objective.**Error! Reference source not found.** Table 12 summarizes the results, which include expected annual damages and benefits for both the base year and most likely future year conditions, and equivalent annual damages and benefits.

Table 12: Summary of results, final array of alternatives (October 2021 price level, $1000)

Item	Alternative				
	Alt. A: No Action	Alt. B: Channel Conveyance	Alt. B1: Channel Conveyance, Flood Barriers	Alt. C: Taumata Flood Barrier, Nonstructural	Alt D. Nonstructural
Expected Annual Damages	8,961	9,178	7,233	1,677	1,922

Item	Alternative				
	Alt. A: No Action	**Alt. B: Channel Conveyance**	**Alt. B1: Channel Conveyance, Flood Barriers**	**Alt. C: Taumata Flood Barrier, Nonstructural**	**Alt D. Nonstructural**
2030 Base Year					
Expected Annual Damages 2079 Future Year	9,494	9,154	6,861	1,777	2,001
Equivalent Annual Damages, 50-Year Period of Analysis, 2.50% Discount Rate	9,178	9,168	7,081	1,718	1,954
Equivalent Average Annual Benefits, 50-Year Period of Analysis, 2.50% Discount Rate	0	10	2,097	7,461	7,224
Project First Costs	0	29,126	49,087	138,386	143,072
Interest During Construction @ 2.25%	0	163	689	1,551	399
Total Economic Costs	0	29,289	49,776	139,937	143,470
Average Annual Costs @ 50-year period of analysis and 2.25%	0	982	1,668	4,690	4,809
Annual OMRR&R	0	146	244	46	TBD
Total Average Annual Costs	0	1,128	1,912	4,736	4,809
Net Benefits	--	-1,118	185	2,724	2,415
BCR	--	0.01	1.1	1.6	1.5

Based on the analysis presented above, Alternative C: Taumata Flood Barrier and Nonstructural Improvements is the NED plan that maximizes NED benefits.

3.5.4.2 Regional Economic Development

USACE's Regional Economic System (RECONS) is a certified regional economic modeling tool designed to provide estimates of regional economic impacts and contributions associated with USACE projects and programs. Regional impacts and contributions are measured as economic output, jobs, income, and value added. Estimates are provided simultaneously for three geographic impact areas: local, state, and national. While the RECONS software can be used for the American Territories (e.g., Guam, Saipan, and American Samoa) located within the Pacific Ocean Division region, the software does not include the built-in data/input parameters required to actually perform the RED assessment for these areas. However, RECONS does cover the State of Hawaii. As such, the study team used the Big Island of Hawaii (Hawaii County) as a proxy area for the Tutuila Island (American Samoa). These two islands have similar population numbers to assess regional impacts associated with each alternative. Table 13**Error! Reference source not found.** presents the RED benefits for the final array based on RECONS modeling. Based on the RECONS results, Alternative D has the highest RED benefits for the final array of alternatives. Nearly 970 full-time equivalent jobs would be produced for American Samoa with a local direct impact of approximately $93.6 million. Based on the analysis presented above, Alternative D maximizes benefits in the RED category.

Table 13: RED benefits for the final array of alternatives

Category	Alternative				
	No Action	Alt. B: Channel Conveyance	Alt. B1: Channel Conveyance, Flood Barriers	Alt. C: Taumata Flood Barrier, Nonstructural	Alt D. Nonstructural
Full-Time Equivalent Jobs	0	190	325	941	972
Local Direct Impact	$0	$18.3M	$31.4M	$90.5M	$93.6M

3.5.4.3 Other Social Effects

The OSE analysis is one of the four accounts evaluated in USACE water resource planning. The OSE account displays the effects of a proposed intervention, such as a FRM project, on social aspects such as well-being that are integral to personal and community definitions of satisfaction and happiness (Dunning/Master Day LLC & Durden/USACE,2009). The OSE account evaluates the beneficial and adverse effects water resource plans have on social well-being (USACE, Appendix D, 2004). This section begins with a discussion of aspects that highlight the social profiles within the study area followed by a consideration of social effects of a project and a matrix that compares the social effects across the alternatives.

3.5.4.3.1 Social Landscape of the Area

The study area consists of a mix of traditional villages and non-traditional settlements, presenting some nuances for considering social effects of a FRM project. The Tafuna-Leone Plain commonly refers to the flat region nestled in the mountains and stretches towards the coast in south-western Tutuila Island. Tafuna was initially a village established on the coast with most of the land acreage left untouched. Traditional knowledge holds that it was at the Tafuna coast where the Sa’o (high chief) Fonoti arrived in his va’a (canoe) and founded the village (Personal Comm. , 2021). The village was relocated inland during World War II (WWII) to accommodate the construction of the Pago Pago International Airport on the coast. The airport construction was accompanied by the cutting of roads and clearing of acres of bush for material storage at the airport site (Stover, 1999).

The events of WWII and the designated location of the airport not only altered the physical landscape but also the social landscape of Tafuna village and the greater Tafuna-Leone Plain. Widespread interest for developing the area for homes, gardens and churches soon followed. Tafuna also attracted commercial interests to set up businesses. Some local government services either relocated from the capital of Pago Pago or set up a branch in Tafuna. The land rush in the years following WWII coincided with the application of adverse possession land rights first introduced in 1901 by US Naval Administration (Kruse, 2019). Tracts of communal land were transferred from the fa'amatai (chiefly institution) to individually owned land. This, in part, led to the emergence of settlements in areas that were previously under the jurisdiction of traditional Tafuna village, an anomaly to American Samoa. More information on the land tenure system is discussed in the next section. For the purposes of this report, "settlements" refer to neighborhoods that are without a village governing structure. Settlements include Ottoville where Trade Winds Hotel (one of the two main hotels in the Territory) is located. In 2002, the Pele U.S. Army Reserve Center broke ground just outside the airport (Overson, 2019). Today, the village of Tafuna still exists within the sub-urban settlements of greater Tafuna area. Characteristics of traditional villages and settlements affect the evaluation of social effects in the study area. An assessment of these characteristics is consistent with the policy directive on the comprehensive documentation of benefits which directs study teams to consider urban, rural and community impacts (SACW, 2021).

For the purposes of this analysis, traditional villages have four foundational characteristics: a village council (Fono a Matai/Fono), an appointed mayor (Pulenu'u), a central field that serves similar functions to a town-hall (Malae). The fourth characteristic of a traditional village is a set of salutations of the chiefly titles, historic traditions or "charter" summarized in Fa'alupega (Meleisea, 1987 p. 6). Settlements are areas of individually owned land without the four characteristics of a traditional village. The study area consists of the following villages along Route 1 road from west to east: Pavai'a'i, Faleniu, Mesepa, Malaeimi to a part of Nu'uuli. Along Route 19 from the west to east are settlement of Koko Land, Tafuna village and settlement of Ottoville along the south-bound Route 18.

3.5.4.3.2 Land Tenure

The preceding sub-section mentioned two categories of land ownership: communal lands and individually owned lands. Historically, all lands in the Territory were native (communal) lands (Crocombe, 1987; Kruse, 2019). Kruse further describes communal lands as specific tracts of large, medium and small lands collectively owned by an extended family ('aiga) within a village (nu'u) that were demarcated by settlement, cultivation and virgin bush lands where natural features of rivers and hills were understood as boundary markers (p.75). Family clans, descendants of family lines and successors to the chief (matai) title have direct interest in the communal lands as they would be considered as part-owners.

Individually owned lands evolved out of the adverse land possession land rights instituted by the Naval Administration. Individually owned lands was subsequently established as a land tenure classification by the court. These individually owned lands are not subject to authority nor the stewardship of the matai and family clans. Moreover, the individually owned land registrants are not bound to any cultural obligation to communal sharing, distribution and as mentioned above, village governance. The differences between communal and individually owned lands influence social factors: social connectedness and cultural identity. The OSE analysis assumes to the reasonable extent that social connectedness and cultural identity is more present in communal lands than areas of individually owned lands. Freehold land are those lands that may be sold or transferred. This land tenure classification at present, remains a small portion of registered lands because freehold land was granted by the International Claims Commission in Apia (capital of present-day independent Samoa) prior to the U.S. taking possession of eastern Samoa.

There are five land ownership categories currently recognized by the Office of the Territorial Registrar. These are: 1) Communal Land, 2) Individually Owned Land, 3) Government-Owned Land, 4) Church Owned Land and 5) Freehold Land. About 8,000 acres of land in the Territory are registered, of which 27 percent is Communal Land, 25.7 percent is individually owned land, 21 percent is government owned followed by church owned and freehold lands representing 13 percent each (American Samoa DOC, 2019, p. 86).

The majority of individually owned lands are in the Tafuna-Leone Plain. Compared to the rest of Tutuila Island, the Tafuna-Leone Plain is flat and favorable for residential and commercial development. In the absence of FRM measures, the potential for future development and growth is limited. Residents would be subjected to future floods and damages.

3.5.4.3.3 Life Safety

The study team assessed and identified potential risks to life safety in the initial stages of the study in accordance with USACE guidance for incorporation of life safety into flood and coastal storm risk management studies (Planning Bulletin 2019-04). A qualitative review of historical reports and discussions with the local sponsor determined that historical and existing flooding do not significantly impact life safety. Results of the existing conditions run on LifeSim 2.0 showed no significant life loss. LifeSim modeling for the alternatives to evaluate breaching and overtopping scenarios will be conducted and incorporated into the final report.

3.5.4.3.4 Health Safety

An important basic human need is for personal and group safety (Maslow 1943). While flooding events in the existing conditions have reported a low significant impact on life loss, flooding still negatively impacts health and safety. Flooding damages that result in unsafe or unhealthy conditions, can cause stress and dissatisfaction among those affected.

Flooding events pose threats to the physical health and safety of residents. Road closures due to flooding cut access to essential services and places of employment. In some cases, people would decide to walk the flooded roads to avoid missing work or to get to an area less flooded and still accessible by public transportation. These conditions negatively impact mental and physical health. Alternatives B1 and C are expected to reduce the duration and depth of flooding can reduce these negative impacts on health and safety.

3.5.4.3.5 Social Connectedness

Social connectedness refers to the intricate social networks within which individuals interact; these networks provide meaning and structure to life (Dunning and Durden, 2009). These social networks comprise of families and community members cultivating an array of diverse voluntary associations the World Bank call "civic infrastructures." These civic infrastructures can provide individuals with greater opportunities for connectedness, communication, and reciprocity, as well as support for times of need. These civic infrastructures are simply known as villages in American Samoa. For the non-traditional settlements, these civic infrastructures take form within the church congregations. Alternatives that reduce flooding at key places for these community gatherings such as the malae and churches can support social connectedness.

When social connectedness is strengthened, community members are more active in aiding those vulnerable individuals or groups, thereby increasing community resilience. Social connectedness is typically on display during post-disaster recovery efforts when churches assist their congregation members and when village council selects a group of men as labor to rebuild homes of those affected.

3.5.4.3.6 Cultural Identity

A FRM project that reduces disruptions to daily life and cultural activities in villages supports retaining or enhancing cultural identity in the study area. It should also be noted that family clans build graves for their relatives on their lands. This is true for both communal and individually owned lands. Senior matai are laid to rest in communal land and their graves serve as a cultural monument in the village. While nonstructural alternatives would not alleviate damages to these graves, the structural alternatives are expected to reduce damages and contribute to preserving grave sites.

3.5.4.3.7 Other Social Effects Comparison

This analysis adapts a practical framework developed by Weiss, Prakash and Amarakoon for OSE evaluation. The framework consists of a scoring system and planning matrix to aid in the evaluation of OSE impacts of the formulated alternatives on the communities in the study area. The social factors considered are reflective of issues that are important to communities in the study area and the impacts of the alternatives. From each of these social factors, metrics are developed. Social factors are not easily quantified; therefore, a scoring system with a scale of -3 to +3 is developed. Where -3 indicates significant negative effects on a particular metric, and +3 indicates a significant positive effect. Figure 19**Error! Reference source not found.** below presents the scores and associated description in relation to the without-project alternative (future without-project or no action). The score is an assessment of the relative impact an alternative would have on a particular metric in relation to the No Action Alternative.

Score	In Relation to the Without Project Alternative, the With Project Alternative Has ...
-3	Significant negative effects (showstopper)
-2	Moderate negative effects
-1	Minor negative effects
0	Negligible effects (no impact)
1	Minor beneficial effects
2	Moderate beneficial effects
3	Significant beneficial effects

Figure 19. Key to scoring metrics (Weiss et al. 2013)

Weiss et. Al. propose that it may be appropriate for FRM studies to modify the evaluation of metrics to assess OSE impacts to a community both during a flood event and in daily (non-event) life. While acknowledging the rationale for this delineation, this analysis currently evaluates the OSE impacts during flood events only (Table 14**Error! Reference source not found.**). Modifications to the evaluation will be revisited following the public review period of the draft report and will be incorporated into the final report. For the purposes of this matrix, the future without-project condition is considered a neutral point and is, therefore, omitted from the scoring evaluation. To be clear, the OSE impacts in the future without-project condition are discussed qualitatively in preceding sub-sections. The OSE matrix is presented below with preliminary scoring based upon the study team's judgement and subject to modification following stakeholder meetings anticipated in early 2022.

Table 14: Other Social Effects matrix

Social Factor and Metrics	Alt B: Channel Conveyance	Alt B1: Flood Barrier and Channel Conveyance	Alt C: Combined Structural and Non-Structural	Alt D: Non-Structural
Health and Safety				
Mental Health	1	1	1	1
Physical Health	2	2	1	1
Physical Safety	1	3	2	1
Social Connectedness				
Community Cohesion	1	1	0	0
Community Facilities	1	2	1	0
Identity				
Cultural Identity	1	2	1	0
Community Identity	1	2	1	0
Social Vulnerability and Resiliency				
Residents of Study Area	1	1	1	1
Socially Vulnerable Groups	0	1	-1	-1
Total Score	8	15	7	3

3.5.4.3.7.1 Other Social Effects Summary

From an OSE perspective, alternative B1 has the highest score of 15 followed by alternatives B and C with total scores of 8 and 7 respectively. Alternative D scored the lowest with a score of 3. Alternative B1, which combines channel conveyance and flood barrier along Taumata and Leaveave streams is expected to reduce flooding on the roads and, therefore, significantly improving physical safety in the residential communities along both streams. Alternative B1 is also expected to moderately strengthen cultural identity because the flood barriers are expected to reduce flooding to grave sites that have cultural value to residents. Moreover, the reduced flooding to roads and areas like malae would reduce disruption to cultural events and, therefore, support cultural identity.

3.5.4.4 Environmental Quality

The purpose of the Environmental Quality (EQ) evaluation process is to identify significant beneficial and adverse effects of alternative plans on significant EQ resources. Beneficial effects in the EQ account are favorable changes in the ecological, aesthetic, and cultural attributes of natural and cultural resources. Adverse effects in the EQ account are unfavorable changes in the ecological, aesthetic, and cultural attributes of natural and cultural resources. Consideration of EQ effects is required by the NEPA (*42 USC § 4321 et seq*.) and requires federal agencies to integrate environmental values into their decision-making processes by considering the environmental impacts of their proposed actions and reasonable alternatives to those actions.

The analyses provided in Chapter 4 provides an assessment of the resources in the affected environment. This includes a comparison of the effects (or impacts) of each alternative plan relative to the No Action (future without-project) conditions. For those resources that may be adversely affected, measures that would be implemented to mitigate the potential effects are then described. The approach taken for mitigation follows the recommended steps set forth by the President's CEQ in the NEPA regulations (40 CFR Part 1508.20 [a-e]), and includes (in order of preference) avoidance, minimization, and compensation.

Chapter 4 focuses evaluation and analysis on the following 14 resource categories in the affected environment (in order):

- Hydrology, Hydraulics, Geomorphology
- Terrestrial Habitats and Species
- Aquatic Habitats and Species
- Threatened and Endangered Species
- Cultural, Historic, and Archaeological Resources
- Water Resources and Quality
- Air Quality
- Public Health and Environmental Hazards
- Noise and Vibration
- Socioeconomics and Environmental Justice
- Land Use, Utilities and Public Services
- Traffic and Circulation
- Recreation
- Aesthetics

A summary of potential effects for the four action alternatives is below.

Table 15: Alternative B summary of potential effects

	Significant adverse effect	Insignificant effects due to mitigation	Insignificant effects	Resource unaffected by action
Aesthetics	☐	☒	☐	☐
Air quality	☐	☐	☒	☐
Aquatic resources/wetlands/hydrology	☒	☐	☐	☐
Fish and wildlife habitat	☐	☒	☒	☐
Threatened/Endangered species	☐	☐	☒	☒
Historic properties/cultural resources	☐	☒	☐	☐
Hazardous, toxic & radioactive waste	☐	☒	☐	☐
Land use	☐	☐	☒	☐
Noise levels	☐	☒	☐	☐
Traffic	☐	☒	☒	☐
Environmental justice	☐	☐	☒	☐
Geological Hazards	☐	☐	☐	☒
Water quality	☒	☐	☐	☐
Climate change	☐	☐	☒	☐

Table 16: Alternative B1 summary of potential effects

	Significant adverse effect	Insignificant effects due to mitigation	Insignificant effects	Resource unaffected by action
Aesthetics	☐	☒	☐	☐
Air quality	☐	☐	☒	☐
Aquatic resources/wetlands/hydrology	☒	☐	☐	☐
Fish and wildlife habitat	☐	☒	☐	☐
Threatened/Endangered species	☐	☐	☒	☒
Historic properties/cultural resources	☐	☒	☐	☐
Hazardous, toxic & radioactive waste	☐	☒	☐	☐
Land use	☐	☒	☐	☐
Noise levels	☐	☒	☐	☐
Traffic	☐	☒	☐	☐
Environmental justice	☐	☐	☒	☐
Geological Hazards	☐	☐	☐	☒
Water quality	☒	☐	☐	☐
Climate change	☐	☐	☒	☐

Table 17: Alternative C summary of potential effects

	Significant adverse effect	Insignificant effects due to mitigation	Insignificant effects	Resource unaffected by action
Aesthetics	☐	☒	☐	☐
Air quality	☐	☐	☒	☐
Aquatic resources/wetlands/hydrology	☐	☒	☐	☐
Fish and wildlife habitat	☐	☐	☒	☐
Threatened/Endangered species	☐	☐	☒	☐
Historic properties/cultural resources	☐	☒	☐	☐
Hazardous, toxic & radioactive waste	☐	☒	☐	☐
Land use	☐	☐	☒	☐
Noise levels	☐	☒	☐	☐
Traffic	☐	☒	☐	☐
Environmental justice	☐	☐	☒	☐
Geological Hazards	☐	☐	☐	☒
Water quality	☐	☒	☐	☐
Climate change	☐	☐	☒	☐

Table 18: Alternative D summary of potential effects

	Significant adverse effect	Insignificant effects due to mitigation	Insignificant effects	Resource unaffected by action
Aesthetics	☐	☒	☐	☐
Air quality	☐	☐	☒	☐
Aquatic resources/wetlands/hydrology	☐	☐	☐	☒
Fish and wildlife habitat	☐	☐	☐	☒
Threatened/Endangered species	☐	☐	☐	☒
Historic properties/cultural resources	☐	☐	☒	☐
Hazardous, toxic & radioactive waste	☐	☐	☒	☐
Land use	☐	☐	☒	☐
Noise levels	☐	☐	☒	☐
Traffic	☐	☐	☒	☐
Environmental justice	☐	☐	☒	☐
Geological Hazards	☐	☐	☐	☒
Water quality	☐	☐	☐	☒
Climate change	☐	☐	☒	☐

Alternative C maximizes benefits in the EQ account. The Taumata flood barrier would improve water quality by limiting the amount of water flowing through residential and commercial areas; and indirectly providing positive benefits to aquatic species in Pala Lagoon. Alternative C also has the smallest footprint compared to the other structural alternatives (Alternatives B and B1) and has the smallest potential impact on cultural resources and minimal aesthetics impacts.

3.5.4.5 Summary of Comprehensive Benefits

Table 19**Error! Reference source not found.** presents a summary of the comprehensive benefits evaluation across these four categories. The NED and RED accounts include quantitative evaluation of each alternative using traditional NED and RED evaluation criteria (e.g., net benefits, number of full-time equivalent jobs, etc.), while the OSE and EQ accounts include a qualitative ranking for the final array.

The following alternatives maximize benefits in each of the respective accounts (i.e., NED, RED, OSE, and EQ):

- Alternative C maximizes benefits under the NED account
- Alternative D maximizes benefits under the RED account
- Alternative B1 maximizes benefits under the OSE account
- Alternative C maximizes benefits under EQ account

Alternative C maximizes benefits across all four accounts, as it is the leader in both the NED and EQ accounts and ranks second in both the RED and OSE accounts. Floodwall could potentially affect traditional cultural properties and historic properties; there is also a potential for inadvertent discoveries; and has a much smaller footprint than Alt B and B1 which could reduce impacts to cultural resources.

Table 19: Comprehensive benefits for final array of alternatives

Benefits Category	Alternative				
	No Action	Alt. B: Channel Conveyance	Alt. B1: Channel Conveyance, Flood Barriers	Alt. C: Taumata Flood Barrier, Nonstructural	Alt D. Nonstructural
NED					
Net Benefits	$0	$-1,118	$185,000	$2.7M	$2.4M
BCR	N/A	0.01	1.1	1.6	1.5
Total Project First Cost	$0	$27.6M	$47.3M	$136M	$141M
RED					
Full-Time Equivalent Jobs	0	190	325	941	972
Local Direct Impact	$0	$18.3M	$31.4M	$90.5M	$93.6M
OSE					
Health and Safety Social Connectedness and Identify Social Vulnerability and Environmental Justice	No benefit	Minimal benefits, and alternative induces flooding in areas	Moderately strengthen cultural identity (reduce flooding to grave sites, malae and main roads)	Minimally strengthen cultural identity (reduce flooding to grave sites, malae and main roads) with construction Taumata flood barrier	Minimal benefit
EQ					
Ecological – Physical					
Air Quality Floodplains Water Quality Water Resources Soil Resources	No benefit	Conveyance improvements could affect water discharge volumes and affect water quality of Pala Lagoon; water quality impacts could be longer-term that Alt C.	Largest footprint; any water quality benefit of floodwall as for Alt C negated by conveyance improvements; water quality impacts could be longer term than Alt C	Flood barrier improves water quality by limiting amount of water flowing through residential and commercial areas; Construction could result in short-term water quality impacts, but these would be minimized through BMPs	No benefit
Ecological – Biological					
Aquatic Habitats and Species Terrestrial Habitats and Species	No benefit	No benefit	No benefit	Flood barrier may provide some degree of water quality improvement to benefit indirectly	No benefit

Threatened and Endangered Species				aquatic species in Pala Lagoon.	
Long-Term Productivity					
Cultural Resources	No benefit	Conveyance improvements could potentially affect traditional cultural properties (TCPs) and historic properties, but less than Alt B1	Has the largest footprint of all alternatives which could increase impacts to cultural resources	Floodwall could potentially affect traditional cultural properties and historic properties; there is also a potential for inadvertent discoveries; has a much smaller footprint than Alt B and B1, which could reduce impacts to cultural resources.	No benefit, floodproofing and raising could potentially involve historic structures.
Aesthetic	No benefit	No benefit	Has largest floodwall footprint and most aesthetic impact	Floodwall only on one stream which would reduce aesthetic impact compared to Alt B1	Could negatively affect aesthetics of existing structures.

3.6 Environmental Effects and Consequences *

3.6.1 Affected Environment (40 CFR 1502.15) and Environmental Consequences (40 CFR 1502.16

3.6.2 Introduction

This chapter provides the existing conditions for each of the resources that could be affected by implementing any of the final array of alternatives proposed (i.e., the affected environment). Existing conditions are the physical, chemical, biological, and sociological characteristics of the study area. The spatial scale of analysis focuses on the Nu'uuli Pala Watershed and surrounding environment. The assessment of environmental effects is based on a comparison of conditions with and without implementation of the TSP and a reasonable range of alternatives; in this case, the final array of alternatives are formulated through the alternative analysis process (summarized in Section 3) and are compared to the No-Action Alternative. The time scale for analysis is a 50-year period starting in 2030. The information presented was derived primarily from government data, reports and scientific literature.

3.6.2.1 Determining Significance Under NEPA

The NEPA is a Federal law applicable to all Federal agencies, including USACE. NEPA review is required if the proposed activity meets the NEPA thresholds at 40 CFR 1501.1. The NEPA process is intended to promote better agency decisions by ensuring high-quality environmental information is available to agency officials and the public before the agency decides whether and how to undertake a federal action. While NEPA does not require an agency to achieve particular environmental results, it does require an agency to take a hard look at the potential environmental impacts of a proposed federal action.

Under NEPA, USACE works closely with other Federal agencies and Territorial, and local governments; public and private organizations; and the public to better understand these potential environmental impacts. The USACE enacted its own NEPA implementing regulations to review a proposed action for impacts and effects. The level of appropriate NEPA review is dependent on the significance of effects. Under NEPA many different factors are evaluated to determine the significance of effects in the natural, economic, and social environments such as:

- Endangered or sensitive species and their habitats
- Cultural resources
- Floodplains and wetlands
- Noise levels, water quality and air quality
- Human health and safety
- Social and economic impacts to communities

The appropriate NEPA documentation for a particular proposed project or action depends largely on the significance, in terms of context and intensity, of the project's potential environmental impacts. For the proposed project, an Environmental Assessment (EA) will be prepared because the significance of environmental impact is not clear. An EA is a document that provides sufficient information on the potential environmental effects of the proposed action and any alternatives, if necessary. If after preparing the EA, it is determined that the impact of the proposed project will be significant, an Environmental Impact Statement (EIS) will be prepared. If a finding of no significant impact (FONSI) is determined after completion of the EA, the EA will be considered sufficient documentation under NEPA. A draft FONSI is included in the Environmental Appendix to document the draft EA, if the final EA identifies significant impacts, a record of decision (ROD) will accompany a final EIS.

3.6.2.2 Effect Determinations Used in This Report

The analysis of project effects or impacts (i.e., environmental consequences) involves the comparison and assessment of the effects of each alternative plan relative to the No Action (future without-project) conditions in accordance with 40 CFR 1501.3(b) and 1508.1(g). Project impacts may be permanent or temporary (Table 20), adverse or beneficial, and include both direct and indirect effects. 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. For those resources that may be adversely affected, measures that would be implemented to mitigate the potential impacts are described. The approach taken for mitigation follows the recommended steps set forth by the President's CEQ in the NEPA regulations (40 CFR Part 40 CFR 1508.1), and includes (in order of preference) avoidance, minimization, and compensation.

Criteria were identified for each resource to assist with evaluation of the potential for significant adverse effects; the criteria are based on the definitions of significance and the specific considerations identified for NEPA (40 CFR 1508.1), as well as other standards of professional practice.

Table 20: Summary of permanent and temporary impacts (in acres) by action alternative

Alternative Plan	***Alternative B: Channel Conveyance Improvements***		**Alternative B1: Channel Conveyance Improvements + Flood Barriers**	***Alternative C: Taumata Stream Flood Barrier + Non-structural Improvements***	***Alternative D: Non-structural Improvements***
Permanent Impacts (acres)	17.3 (Leaveave) 8.6 (Taumata)		17.3 (Leaveave) 8.6 (Taumata) 2.3 (Leaveave barrier) 2.3 (Taumata barrier)	2.3 (Taumata barrier)	NA
Temporary Impacts (acres)	11.2 (staging, access, construction)	11.2 (staging, access, construction)	14.4 (staging, access, construction)	1.3 (access) 0.5 (staging)	0.5 (staging)

3.6.2.3 Chapter Structure

This chapter focuses on evaluation and analysis of the following 14 resource categories in the Affected Environment (in order):

- Hydrology, Hydraulics, Geomorphology
- Terrestrial Habitats and Species
- Aquatic Habitats and Species
- Threatened and Endangered Species
- Cultural, Historic, and Archaeological Resources
- Water Resources and Quality
- Air Quality
- Public Health and Environmental Hazards
- Noise and Vibration
- Socioeconomics and Environmental Justice
- Land Use, Utilities and Public Services
- Traffic and Circulation
- Recreation
- Aesthetics

For each resource in the Affected Environment, the existing conditions within the study area are described with a summary of historic conditions where applicable. This is followed by comparison of the effects (or impacts) of each alternative plan relative to the No Action (future without-project) conditions. For those resources that may be adversely affected, measures that would be implemented to mitigate the potential effects are then described. The approach taken for mitigation follows the recommended steps set forth by the President's CEQ in the NEPA regulations (40 CFR Part 40 CFR 1508.1), and includes (in order of preference) avoidance, minimization, and compensation.

In addition to the Affected Environment description, this chapter also describes the regulatory setting, as appropriate. Key regulatory compliance activities are described in the subsections below, as appropriate. Additional detail regarding applicable regulations, policies, and compliance is provided in Section 5 Environmental Compliance * of this integrated report, as well as Appendix C Environmental Resources.

3.6.2.4 Scope of Environmental Analysis

The analysis of effects uses the Affected Environment description as the baseline to identify changes to the resource under future with- and without-project conditions. For most resources, the area of concern is generally limited to the construction limits or area where environmental resources may be directly affected by project-related activities. However, for some resources, the indirect project-related effects must be considered within the context of the surrounding area. For example, the evaluation of land use, aesthetics, noise, traffic, and socioeconomics also includes the surrounding area. Potential effects relative to resources that occur across a broader area, climate, geology, and air quality, were considered at a regional scale. Although environmental conditions are generally subject to some change over time, most of these resources are not expected to change significantly under the without-project condition over the period of analysis. However, any changes expected in the future-without-project condition are described.

The comparison of the effects of each alternative plan relative to the No Action (future without-project) conditions considers adverse or beneficial effects, as well as both direct and indirect effects. 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 distance, but are still reasonably foreseeable.

3.6.2.5 Summary of Significance Determinations

Based on the significance criteria presented for each resource, the analysis presented for each resource concludes the degree of potential impact as one of the following:

- 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; in general, no mitigation would be required (but in some cases may be incorporated as a best practice or 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. Effects determined to be significant fall into two categories: those for which there is feasible mitigation available that would avoid or reduce the environmental effects to less-than-significant levels, and those for which there is either no feasible mitigation available or for which, even with implementation of feasible mitigation measures, there would remain a significant adverse effect on the environment. Those effects that cannot be reduced to a less-than-significant by mitigation are identified as significant and unavoidable.

3.6.3 Resources Screened from Detailed Analysis

No resource categories were screened from a detailed data 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 alternative, focuses only on significant resources that are potentially affected by the alternatives, and have the most material bearing on the decision-making process.

3.6.4 Hydrology, Hydraulics, Geomorphology

3.6.4.1 Affected Environment

3.6.4.1.1 Geology and Soils

The study area is situated mostly in the geological formation known as the Tafuna-Leone Plain (Figure 20) the largest area on the island with relatively flat slopes. The Tafuna-Leone Plain is a basaltic lava delta on the southern side of western Tutuila that originates from the final period of volcanism on the island, probably during the early Holocene (Clark & Wright 1995; Stearns 1944), positioned between the older interior mountains and the Pacific Ocean. At this particular location on Tutuila, the interior mountains relate to Pago Volcanics that date to the Pleistocene (Stearns 1944; McDougall 1985), between 1.01 and 1.54 million years ago (Nunn 1998). The formation of the Tafuna-Leone Plain occurred probably less than 100,000 years ago and is considered to be part of the Leone Volcanics series in American Samoa (Stearns 1944).

The Tafuna-Leone Plain is composed of highly permeable lava flows inter-laced with ash beds (Stearns 1944). It is believed to have been created by a late-stage eruption, which covered a former barrier reef. The predominant rock types are basaltic with lesser amounts of trachyte and andesite. Recent-appearing basaltic tuffs and lava have formed a broad, flat plain on the southwest side of the island from calcareous sand, coralline gravel, and reef rock that is considered to be very permeable (Izuka et al. 2007). The soils of the valleys and coastal fringe are classified as clayey to sandy and vary from poorly drained to excessively drained. The soils on the Tafuna-Leone Plain are generally considered well drained and are predominantly gently sloping (POD 1994).

The volcanic rocks that cover the surface of the Tafuna-Leone Plain and overlie parts of the southern flank of the mountains to the north include lava flows and pyroclastic deposits (ash, cinder, and breccia). Most of the pyroclastic deposits form a line of cones that extend from the coast to the crest of the mountains in the north. Because of the relatively recent formation of the Tafuna-Leone Plain, soil development is not as advanced as in other parts of the island. Typically, deposits range from 60 to 155 centimeters (cm) in depth below the ground surface, and often include large quantities of rock. Rock outcrops are also common. Deposits are of volcanic origin and, therefore, clayey.

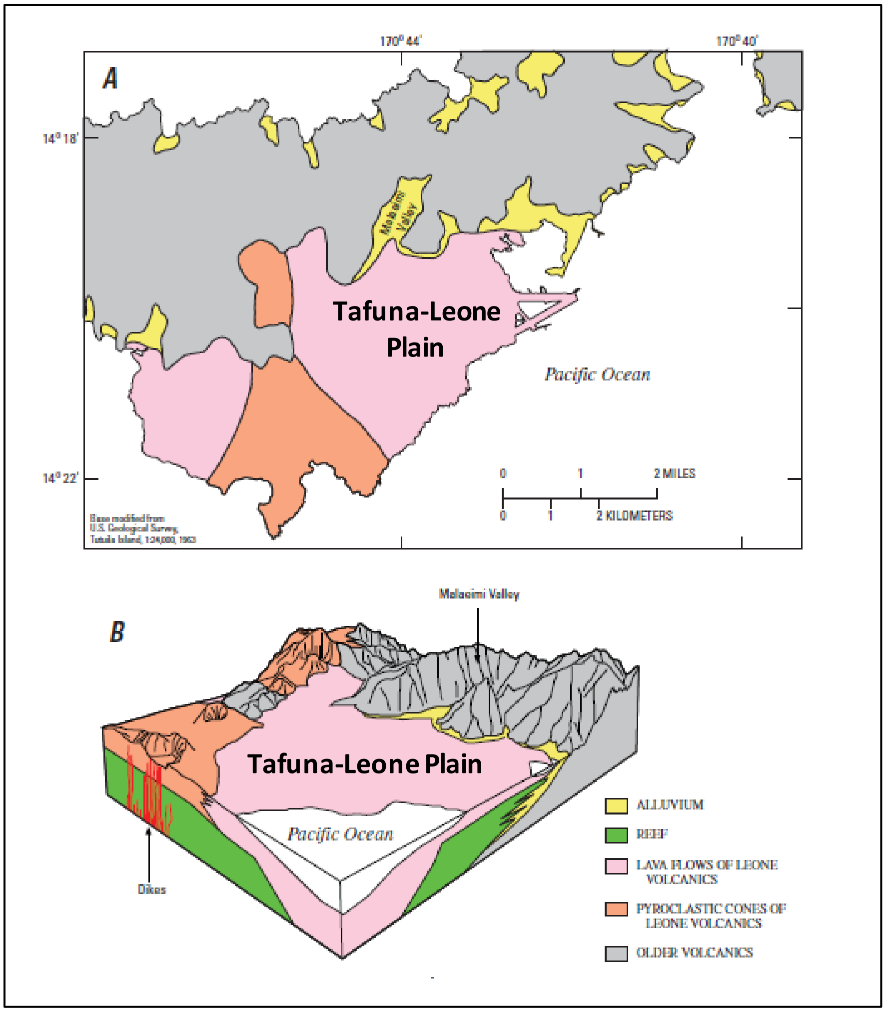

Figure 20: Simplified Geologic Map (A) and Diagram (B) of the Tafuna-Leone Plain (Izuka et al. 2007)

This aquifer below the plain holds a fresh groundwater body (or basal lens) that floats on top of salt water within the underlying rock due to the density contrast between fresh and salt water. The plain's aquifers make the region favorable for groundwater development, and about half of the island's total water production is sourced from about thirty wells on the plain. However, the high permeability also makes the basal lens in this area thin and susceptible to saltwater intrusion if over-exploited.

3.6.4.1.2 Geologic Hazard

Geologic hazards on Tutuila include landslides, volcanic eruptions, earthquakes, cyclones, and tsunamis. Landslides are primarily caused by gravity acting on overly steep slopes. However, many other factors, such as saturation by rainfall, removal of deep-rooted vegetation, and erosion by water channels, contribute to the occurrence of landslides. On Tutuila, landslides often occur when heavy rainfall saturates unstable earth on the island's steep slopes (FEMA 2008).

The only active volcano in the American Samoa region is the volcanic seamount Vanilulu'u located approximately 100 miles east of Tutuila. The Ofu-Olosega volcano last erupted in 1866, and other volcanoes in the region have been silent for thousands of years. No active volcanoes exist on the island; however, many craters are still visible on the landscape (FEMA 2008).

Earthquakes in American Samoa mainly originate from the Tonga Trench, approximately 120 miles southwest of Tutuila. Earthquakes can be precursors to volcanic activity but generally do not present a seismic threat to the islands (FEMA 2008). Tsunamis (huge water waves) that affect Tutuila are generated by earthquakes from fault movements along the Tonga Trench, the Pacific Rim in the Aleutian Islands, South America, and other locations.

3.6.4.1.3 Hydrology

Hydrologic and hydraulic modeling studies were conducted to estimate a range of peak stream flow discharges and associated water surface elevations that could occur in the study area as a result of potential storm events. These models built upon previous models and incorporated up-to-date topographic and hydro-meteorological data. Per ER-1165-2-21, only the area that met the 800 cfs requirement were analyzed, which included the Taumata, Leaveave and Vaitele streams that are located within the larger Nu'uuli Pala Watershed (Figure 21). Hydrologic and hydraulic models were updated for those reaches. More detailed information regarding the hydrologic modeling can be found in Appendix A Hydrology and Hydraulics.

Figure 21: Taumata, Leaveave, and Vaitele streams

Discharge-frequency relationships at key points in the study area were determined by developing rainfall-runoff models using the HEC-HMS. The HEC-HMS model was used to simulate various storm events. The resulting peak discharges at each sub-basin within the Leaveave Drainageway are presented in Table 21.

Table 21. 2016 computed flow discharges at sub-basins in the Leaveave drainageway

Sub-Basin Element	Peak Flow Discharges (cfs)							
	50% ACE	20% ACE	10% ACE	4% ACE	2% ACE	1% ACE	0.5% ACE	0.2% ACE
Leaveave 1	209	329	426	568	682	801	924	1,100
Leaveave 2	30.0	57.7	82.3	119	149	181	214	261

Sub-Basin Element	Peak Flow Discharges (cfs)							
	50% ACE	20% ACE	10% ACE	4% ACE	2% ACE	1% ACE	0.5% ACE	0.2% ACE
Leaveave 3	178	290	379	508	612	724	840	1,000
Leaveave 4	100	148	187	242	286	332	379	445
Leaveave 5	50.8	73.1	90.6	115	135	155	176	205
Leaveave 6	27.7	51.8	73.0	105	132	161	191	235
Leaveave 7	53.2	88.4	118	163	198	237	277	334
Leaveave 8	106	153	190	244	286	329	374	435
Mapusagatuai 1	107	162	205	266	314	366	420	494
Mapusagatuai 2	102	146	180	227	264	303	342	396
Mapusagatuai 3	63.5	100	129	172	206	243	280	332
Taumata 1	296	523	709	981	1,210	1,450	1,700	2,050
Taumata 2	191	356	497	709	883	1,070	1,260	1,540
Taumata 3	77.1	105	127	157	181	205	230	264
Taumata 3b	48.0	72.3	91.8	120	143	166	190	224
Taumata 4	8.8	16.4	23.0	32.9	41.0	49.7	58.8	71.6
Taumata 5	52.6	83.9	109	145	174	205	237	282
Taumata 6	78.6	122	156	205	244	284	326	385
Taumata 7	37.7	53.1	65.3	82.1	95.5	110	124	144
Vaitele 1	200	317	410	544	650	762	879	1,040
Vaitele 2	90.5	143	185	245	293	345	398	473
Vaitele 3	40.5	65.9	86.2	115	139	163	188	224
Vaitele 4	36.2	52.4	65.5	83.8	98.3	113	129	150
Vaitele 5	10.7	16.9	22.0	29.2	34.9	40.9	47.2	55.9
Vaitele 6	33.7	47.2	58.1	73.2	85.0	97.3	110	127

3.6.4.1.4 Hydraulics

Hydraulic models using both one-dimensional (1D) and two-dimensional (2D) unsteady flow analysis were created for this study using HEC-RAS software (version 5.0.7). Peak flow rates were used to represent the amount of water in the system for the 50, 20, ten, four, two, one, 0.5 and 0.2 percent AEP events (8 profiles), and the corresponding flow data was input to the appropriate cross sections as lateral inflow or uniform lateral flow.

Consistent with ER 1100-2-8162, sea level rise was incorporated into the downstream boundary condition. A downstream stage hydrograph of 4.28 ft was used as the downstream boundary condition in all future without- and with-project conditions model runs. This was determined using the low-rate estimate at the 50-year period of analysis and taking into the account the high margin of error on the user entry rate, which was more conservative than the rates built into the USACE calculator.

Consistent with the USACE Engineering Circular (EC) 1165-2-212 and Engineering and Construction Bulletin (ECB) 2013-27, three scenarios (low, intermediate, and high) were modeled to define the future without-project hydrologic and hydraulic conditions, with each scenario defined based on the corresponding rate of change in the input conditions. Low is considered the best-case scenario (with a continuation in the current trends for sea-level rise and rainfall intensity), intermediate is the most probable scenario, and high is considered the worst-case scenario. The modeling inputs for these three scenarios are summarized in Appendix A Hydrology and Hydraulics.

3.6.4.2 Alternative A: No Action Alternative

As no features would be constructed, there would be no project-related activities that would affect geomorphology. The physical conditions within each of the measure locations would be expected to be generally commensurate with the current onsite conditions. Erosional processes are expected to continue across the watershed, especially in areas of potential hazards, including steep slopes and high annual rainfall. Given the potential for more intense episodes of rainfall, these events could potentially occur on a more frequent basis.

The upper watersheds of the streams that contribute to the study area are primarily comprised of undeveloped, steep mountainous terrain. No significant changes to land use in the upper watershed (e.g., logging, large-scale agriculture) are expected in these areas that would alter flood hydrology to significantly influence the study area.

Because of increased precipitation due to climate change, these contributing watersheds are forecast to experience greater impacts from flooding under future conditions, increasing the risk to life safety, existing structures, critical infrastructure, and development expected to occupy the floodplain in the future. Traffic delays, school closures, decreased public service, and commercial and industrial business closures are also forecast to occur for events more frequent than roughly the ten percent AEP flood event. No effects to geomorphology, hydrology, or hydraulics and are expected under the No Action Alternative.

3.6.4.3 Alternative B: Channel Conveyance Improvements (Taumata and Leaveave Streams)

This alternative would involve work within both Leaveave and Taumata streams and proposed measures are designed to improve conveyance on these streams so as to reduce the risk of flooding This alternative is not expected to significantly affect drainage patterns. None of these measures would permanently obstruct or change the course of a waterway or substantially modify the existing floodplain. However, they would involve placement of fill material (e.g., compacted fill, grouted riprap) within the stream channels, which are Waters of the U.S. (refer to draft 404(b)(1) analysis in Appendix C Environmental Resources). Because Leaveave and Taumata streams are tributary to Vaitele Stream, which drains to the Pala Lagoon, water volumes and peak water velocities entering Pala Lagoon could be expected to increase temporarily during rain events.

The HEC-RAS hydraulic modeling results demonstrate the beneficial impact of the flood-reduction measures for this alternative; however, this alternative can be expected to measurably affect hydrologic conditions within the watershed by affecting peak flow discharges during flood events (i.e., peak flow discharges are expected to be greater than with those described for the No Action Alternative), but these effects would be temporally episodic in nature and would cause no substantial adverse change in the environment as measured by the applicable significance criteria. As such, a less than significant effect to hydrology, hydraulics, and geomorphology would be expected under Alternative B.

3.6.4.4 Alternative B1: Channel Conveyance Improvements and Flood Barriers (Leaveave and Taumata Streams)

Alternative B1 would have the same effect of improved conveyance and have the same requirements for construction as described for Alternative B. In comparison to Alternative B, addition of flood barriers along Taumata and Leaveave streams would be expected to contain even more floodwaters within the Leaveave and Taumata channels, increase localized water surface elevations, and temporarily increase localized stream velocities and water volumes when water is flowing over the no action alternative. Effects would generally be as described for Alternative B but presumably would be greater due the addition of the flood barriers.

3.6.4.5 Alternative C: Taumata Flood Barrier and Nonstructural Improvements

Alternative C would involve implementation of both structural (i.e., flood barrier along Taumata Stream) and nonstructural measures (i.e., dry floodproofing and elevating structures). The HEC-RAS hydraulic modeling results demonstrate the beneficial impact of the flood-reduction measures for this alternative to the 1-percent ACE floodplain. Although the overall potential for flood damage reduction associated with Alternative C is not expected to be as great as that associated with Alternative B and B1, Alternative C is still expected to provide a significant beneficial impact relative to reduced potential for flooding in the watershed.

A flood barrier would contain more flood waters within the Taumata channel where the depth of flooding is most severe, increasing water surface elevations over the no action alternative and increase stream velocities. Alternative C is not expected to measurably affect hydrologic conditions within the watershed; as such, peak flow discharges are expected to be commensurate with those described for the No Action Alternative. To the extent possible, Alternative C takes advantage of existing cleared areas that can be used for staging and access for project activities. Construction of the flood barrier that would involve ground disturbance, but the site is located in a highly disturbed environment. Nonstructural measures would not affect the geomorphology, hydrology, and hydraulics within the study area.

As such, a less than significant effect to hydraulics and hydrology would be expected under Alternative C. Alternative C is expected to reduce losses due to flooding; however, residual risks still exist within the watershed. While sea level changes were considered during the plan formulation process, uncertainty with those projections exist and risk remains, specifically due to the potential for a changing climate (see the Climate Risk Register Appendix A Hydrology and Hydraulics).

3.6.4.6 Alternative D: Nonstructural Improvements

Alternative D is a completely non-structural solution; therefore, there are no effects to geomorphology, hydrology, and hydraulics and are expected under Alternative D as this is a fully nonstructural solution.

3.6.4.7 Mitigation

Effects on geomorphology (including geology, seismicity, and soil conditions) were considered to be significant if implementation of an alternative would result in any of the following:

- Substantially alter an important natural geologic feature
- Cause substantial soil erosion
- Increase exposure of people or structures to seismic-related hazards
- Substantially contribute to an increased potential for (or otherwise be affected by) an onsite or offsite landslide/debris flow, subsidence, liquefaction, or collapse

Because the potential effects to geomorphology (including geology, seismicity, and soil conditions) that could result from implementation of the alternatives would be less than significant and cause no substantial adverse change in the environment as measured by the applicable significance criteria, no mitigation would be required.

Effects on hydrology and hydraulics were considered to be significant if implementation of an alternative would result in any of the following

- Significantly change drainage patterns within the watershed
- Substantially increase the extent, frequency or duration of flooding
- Create or contribute to runoff that would exceed the capacity of existing or planned stormwater drainage system

The potential effects to hydrology and hydraulics that could result from implementation of the alternatives would be less than significant and cause no substantial adverse change in the environment as measured by the applicable significance criteria, and no mitigation would be required.

3.6.5 Terrestrial Habitats and Species

3.6.5.1 Affected Environment

The overall diversity of terrestrial species in American Samoa is relatively low due to the Territory's small total land area and the remote location of the archipelago. The general absence of species radiations are characteristic of most isolated archipelagoes of the central and eastern Pacific (Craig 2002). Despite this, and with the exception of Hawai'i, the native Samoan flora is the largest in Polynesia consisting of 550 angiosperm species in 300 genera and 228 pteridophyte species (Whistler 2002).

The terrestrial flora and fauna in American Samoa are mostly indigenous, with representatives on nearby archipelagoes. The flora of these islands is similar to, but less diverse than, the flora of continental areas of Southeast Asia. Endemic species in the Samoan Archipelago include one bird (Samoan Starling, *Aplonis atrifusca*), a few species of land snails, and about 32 percent of local plant species.

3.6.5.1.1 Vegetation and Land Use

The study area is a complex mosaic of vegetation and land use types that are a result of natural characteristics (e.g., topography, soil type, distance from the sea), natural disturbance events (e.g., weather), and anthropogenic activities. Tropical cyclones are common in American Samoa, often inflicting significant damage to the landscape, especially the vegetation. Other natural disturbances include prehistoric volcanic eruptions. Soil erosion is prevalent on steep volcanic soil slopes and areas cleared by humans for agricultural production and roads (Cole et al., 1988; Mueller-Dombois & Fosberg, 1998; Donnegan et al., 2004). Almost all vegetation in American Samoa has been altered after several thousand years of subsistence agriculture greatly reducing the area of native forests (Mueller-Dombois and Fosberg 1998).

The Tafuna-Leone Plain, like nearly the entire Samoan archipelago, was historically covered by tropical rainforest vegetation (montane and lowland) before the arrival of the Polynesians some 3,000 years ago (Liu et al. 2011; Mueller-Dombois and Fosberg 1998). Tropical rainforest is characterized by irregularly closed canopies. Montane rain forest is found at high elevations, often on steep slopes (>1,640 feet elevation), and in areas with high precipitation. The dominant canopy species is the native *Dysoxylum huntii* (maota mea). The higher-elevation montane forests tend to be less impacted by severe weather events and the steep slopes inhibit cultivation. Montane forest and lowland forest tend to form a continuum, blending into each other along gradual environmental gradients. The main distinction between montane and lowland rainforest is that the former is typically dominated by a single species (*Dysoxylum huntii*), while the latter is dominated by several other species (Whistler 2002).

Lowland rain forest can occur on mountain ridges, slopes, in valleys, and on lowland lava flows. The lava flow lowland rainforest is characterized by tree species in adapted to rocky lava flow areas with little soil and low water-holding capacity. Lava flow lowland rainforests sit directly above important aquifers from which present-day communities in American Samoa receive most of their drinking water. These forests highlighted by tall and enormous giant banyan (*Ficus* spp.) and tava (*Pometia pinnata*) trees. Extensive lowland lava flow forest once existed on the Tafuna-Leone Plain, but has been largely replaced by urban development and coconut plantations (Donnegan et al. 2001). As the market for coconut has declined, former plantations have been abandoned and are slowly converting to secondary vegetation with mixed agro-forest.

Today, the Tafuna-Leone Plain is best classified as a managed landscape and is either used for residential activities or subsistence farming. Vegetation is primarily a mix of agriculture, urban cultivated land, and urban built-up areas, with smaller areas of secondary scrub (Liu et al. 2011). The occasional large banyan tree *(aoa; Ficus obliqua* or *Ficus prolixa)* is still also encountered. Despite the rocky and clayey deposits on the Tafuna-Leone Plain, the vegetation is dense, but has been highly influenced by recent human activities. Urban cultivated land includes all vegetated areas within a general urban boundary (e.g., simple gardens, parks, sports fields, and lawns). Urban built-up land refers to impervious urban surfaces such as houses and paved roads. Commercial enterprises have dramatically increased on the Tafuna-Leone Plain to serve the needs of the increasing number of residents.

Vegetation types in the study area include secondary forest and scrub, agriculture, urban cultivated land, and urban built-up areas (Liu et al. 2011). The upper watersheds of Leaveave, Taumata, Mapusagatuai, and Vaitele streams that originate in the mountains that line the northern edge of the Tafuna-Leone Plain are a mix of secondary forest and scrub on the steeper slopes interspersed with agriculture on the valley floors. Secondary forest is classified as a disturbed vegetation class. The most characteristic tree of these forests, which cover much of Tutuila, especially on the south-facing slopes on the south side of the island, is tavai (*Rhus taitensis*). Other common species include toi (*Alphitonia zizyphoides*), maota (*Dysoxylum maota*), lopa (*Adenanthera pavonina*), and moso'oi (*Cananga odorata*). Rhus secondary forest can often be identified by its smooth, even canopy (Figure 22). In comparison, primary rainforest tends to be dominated by a mixture of species and an uneven canopy.

Figure 22: Typical Rhus-dominated secondary forest canopy structure in American Samoa (C. Solek)

Secondary scrub is generally an intermediate type of vegetation that occurs when cultivated land is abandoned and allowed to revert to natural forest (Figure 23). It is usually dominated by laupata (*Macaranga harveyana*), soga (*Pipturus argenteus*), fau (*Hibiscus tiliaceus*), and other small trees that require sunlight for establishment and growth. It can be very difficult to distinguish secondary scrub from agriculture in some cases due to the overlap of plant species. Agricultural lands refer to vegetated land used for agricultural purposes at a relatively large scale for commercial production, such as coconut (niu; *Cocos nucifera),* banana *(*fa'i*; Musa paradisiaca)*, breadfruit *(*'ulu; *Artocarpus sp.),* papaya *(*esi; *Carica papaya),* and ta'amu *(Alocasia macrorrhiza).* In American Samoa, abandoned agricultural land quickly becomes overrun by secondary scrub type vegetation, but coconuts, bananas, and breadfruit often persist. Similarly, secondary scrub vegetation, most common around villages and farms, can quickly be converted to agriculture or other uses, but may retain some secondary scrub vegetation, vegetable plantations, and cow pasture (Liu et al. 2011). In American Samoa, abandoned agriculture land, if left undisturbed for a long period, eventually reverts to a taller canopy forest that in its early stages is dominated by tall secondary forest species.

Figure 23: Typical secondary scrub vegetation in American Samoa (C. Solek)

3.6.5.1.2 Terrestrial Wildlife

Due to American Samoa's small size and remote location in the Pacific Ocean, the diversity of terrestrial flora and fauna is naturally very low to include 25 resident or migratory land and water birds, 20 resident seabirds, three native mammals (all bats), three skinks, and one gecko. The native terrestrial invertebrate fauna of American Samoa, including insects, is far less known than other taxa. All other terrestrial species present have been either historically introduced by early Polynesians (e.g., Polynesian rat, chickens, and pigs) or are considered modern introductions (i.e., after western colonization).

Two species of native fruit bats, the White-naped fruit bat or *pe'a fanua* (*Pteropus tonganus)* and the endemic Samoan fruit bat or *pe'a vao* (*Pteropus samoensis),* are found in American Samoa. Neither species is currently listed as endangered or threatened by the USFWS. The Tongan fruit bat has a wide range and presumed large population in the Pacific. The population of the Samoan fruit bat in American Samoa has increased following a ban on hunting, but reliance on mature forest makes long-term species survival dependent on protection of the limited mature forest remaining and continued hunting restrictions. The small insect-eating sheath-tailed bat or *pe'ape'avai* (*Emballonura semicaudata*) is cave dwelling species listed as an endangered (USFS 2016). The species is perhaps locally extinct due to the effects of Cyclone Ofa in 1990 and known caves that formerly supported this species on Tutuila are almost deserted. None of these bat species would not be expected within the project area due to lack of (mature) primary forest habitat and close proximity to human presence.

As in other Pacific islands, the native land snail biodiversity is high in American Samoa. There are reportedly 42 species of native land snails and 15 non-native species recorded from American Samoa (Cowie 1998), of which many of the native species are endemic. Invasive, non-native plants can modify native habitat and render it unsuitable for native snail species (Hadfield 1986). Few native snails have been observed in disturbed areas of habitat outside of protected area boundaries (Cowie 2001; Cowie, personal communication). A discussion of threatened and endangered land snails is included in Section 3.6.7.1.1 Land Snails.

Introduced terrestrial species that are common on Tutuila includes the two invertebrates, the giant African snail or *sisi aferika (Achatina fulica*) and the predatory land snail (*Euglandina rosea*), one amphibian, the cane or marine toad (*Rhinella marinus*), and three introduced species of birds: red-vented bulbul or *manu palagi* (*Pycnonotus cafer)*, common myna or *maina fanua (Acridotheres tristis)*, and jungle myna or *maina vao (Acridotheres fuscus).* These species are now abundant all over Tutuila and common in nearly every village. Another non-native bird, the *rock* dove or *lupe palagi* (*Columba livia)* is occasionally reported as a vagrant to Tutuila (i.e., a species that appears outside its normal range).

Introduced terrestrial mammals include three species of rats, Polynesian rat (*Rattus exulans*), Roof rat (*Rattus rattus*), Norway rat (*Rattus norvegicus*), the house mouse (*Mus musculus),* and domestic pigs, dogs and cats. All are modern introductions with the exception of Polynesian rats, dogs, and pigs which are considered Polynesian introductions. Domestic pigs that have gone feral are especially destructive to native habitats by rooting for food and creating wallows, facilitating the spread of non-native plants.

The project area can be expected to provide habitat for a variety of terrestrial wildlife; however, given the highly disturbed nature of the landscape and vegetation, introduced (non-native) species, especially birds and plants, are expected to dominate due to the lack of native primary forest, residential and commercial development, and ubiquitous human presence. Human development is intimately tied to habitat modification and can lead to increased encroachment of disturbed habitats, increased spread of non-native plant and animal species (e.g., rats), and increased human activity, all of which tend not to benefit native species.

3.6.5.2 Alternative A: No Action Alternative

Under the No Action Alternative, no FRM measures would be implemented and as such, project-related impacts to biological resources would not occur. In the absence of FRM measures, it is anticipated that areas adjacent to the stream would continue to be subject to periodic flooding.

In general, future climate changes are expected to result in habitat loss and degradation, decreased biodiversity (including extinction of endangered species and loss or migration of native species), and spread of invasive species. However, these conditions are already prolific within the watershed; therefore, it is expected that the future without-project conditions would be commensurate with existing conditions. Specifically, it is expected that the study area would continue to be characterized by a suite of non-native (including invasive) species that typically occur in disturbed habitats on Tutuila. While there may be some changes in localized conditions over time, the overall species composition and habitat structure is not expected to change dramatically over the period of analysis.

Based on the extent of private land holdings, existing urbanization, and developments within the Nu'uuli Pala Watershed, and more specifically along its streams, it is expected that further development would be minimal. Although some limited re-development may occur in the neighborhoods throughout the watershed, it is not expected to substantially affect current biological resources. With respect to instream habitat, it is assumed that there would be no significant changes in the extent and degree of channel modifications.

No significant negative effects to terrestrial vegetation or wildlife species are expected under the No Action Alternative. It is expected that non-native species will continue to predominate within the study area, and perhaps increase as development continues.

3.6.5.3 Alternative B: Channel Conveyance Improvements (Taumata and Leaveave Streams)

Implementation of Alternative B would result in 17.3 acres and 8.6 acres of permanent impacts from channel conveyance improvements made to Leaveave and Taumata streams, respectively. Staging and access for construction work areas would result in 11.2 acres of temporary impacts. Modification to channels through conveyance improvements and trimming of riparian vegetation within the construction limits (including any associated staging and access roads) would result in direct loss of instream and riparian vegetation at both the Leaveave and Taumata stream sites. Vegetation would be permanently displaced within the footprint of the conveyance improvement area and access roads (as needed to provide long-term operations and maintenance (O&M).

The study areas along Leaveave and Taumata streams are located in a developed and populated area of the Tafuna-Leone Plain. Vegetation types include secondary forest, secondary scrub, agriculture, urban cultivated land, and urban built-up areas. Introduced terrestrial wildlife species are expected to dominate. Construction activities related to Alternative B would temporarily affect the presence of terrestrial wildlife in terms of noise, vibration, and human presence. This may cause wildlife to leave the study area during construction activities. Species could move to other available areas during the construction.

Effects to terrestrial vegetation and wildlife under Alternative B would be less than significant and would cause no substantial adverse change in the environment as measured by the applicable significance criteria; in general, no mitigation would be required (but in some cases, best management practices (BMPs) would need to be incorporated to meet other regulatory requirements.)

3.6.5.4 Alternative B1: Channel Conveyance Improvements and Flood Barriers (Leaveave and Taumata Streams)

Same as Alternative B, Alternative B1 would result in 17.3 acres and 8.6 acres of permanent impacts from channel conveyance improvements made to Leaveave and Taumata Stream, respectively. In addition, Alternative B1 would result in an additional 2.3 acres of permanent impacts at each site due to construction of the respective flood barrier (4.6 acres total). Temporary impacts would require 14.4 acres for staging, access, and construction activities.

Modification to channels through conveyance improvements and trimming of riparian vegetation within the construction limits (including any associated staging and access roads) would result in direct loss of instream and riparian vegetation at both the Leaveave and Taumata Stream sites. Vegetation would be permanently displaced within the footprint of the conveyance improvement area and access roads (as needed to provide long-term O&M). Vegetation would be permanently displaced within the footprint of the flood barrier) and access road (as needed to provide long-term O&M). The addition of the flood barriers along Leaveave and Taumata streams would require the removal of a larger quantity more vegetation than compared to Alternative B.

The study areas along Leaveave and Taumata streams are in a developed and populated area of the Tafuna-Leone Plain. Vegetation types include secondary forest and scrub, agriculture, urban cultivated land, and urban built-up areas. Introduced terrestrial wildlife species are expected to dominate. Construction activities related to Alternative B would temporarily affect the presence of terrestrial wildlife in terms of noise, vibration, and human presence. This may cause wildlife to leave the study area during construction activities. Species could move to other available areas during the construction. Effects to terrestrial vegetation and wildlife species under Alternative B would be less than significant and would cause no substantial adverse change in the environment.

3.6.5.5 Alternative C: Taumata Flood Barrier and Nonstructural Improvements

Alternative C would result in 2.3 acres of permanent impacts from construction of a flood barrier along Taumata Stream. Temporary impacts would require 1.8 acres for staging, access, and construction activities. The effects of Alternative C on terrestrial vegetation and wildlife are expected to be less than Alternatives B and B1 as only a flood barrier would be constructed along Taumata Stream under this alternative (no conveyance capacity improvements would be made). A smaller area of vegetation would be removed in total (only along the footprint of the barrier placed along Taumata Stream), resulting in a reduced effect on terrestrial species. Effects to terrestrial vegetation and wildlife species under Alternative C would be less than significant and would cause no substantial adverse change in the environment.

3.6.5.6 Alternative D: Nonstructural Improvements

No effects to terrestrial vegetation and wildlife species are expected under Alternative D as this is a fully non-structural solution.

3.6.5.7 Mitigation

Effects on terrestrial biological resources were considered significant if implementation of an alternative plan would result in any of the following:

- Substantial loss of native species
- Reduced habitat availability or degradation of habitat suitability of a magnitude and/or duration that could substantially affect a native species population
- Substantial interference with the movement of migratory species
- Introduction or contribute to the substantial spread of an invasive species

Because the potential effects to terrestrial biological resources that could result from implementation of the alternatives would be less than significant and cause no substantial adverse change in the environment as measured by the applicable significance criteria, no mitigation would be required. Any areas temporarily disturbed or where terrestrial vegetation is removed (e.g., staging areas) would be expected to quickly recover given the climate, long growing season, and available seed bank.

However, as alternative B, B1, and C could each result in some loss of terrestrial vegetation from clearing and grubbing activities, especially at staging areas, a best management practice could include revegetation of any temporarily impacted area with landscaped vegetation replaced in-kind and any non-native species replaced with suitable native species (where practicable).

3.6.6 Aquatic Habitats and Species

3.6.6.1 Affected Environment

Aquatic habitats include freshwater and marine environments and cover wetland and riparian habitat. In American Samoa, the diversity of aquatic marine species is remarkably high relative to terrestrial habitats, with 890 species of coral reef fish, over 200 coral species, and a rich assemblage of other invertebrates (Craig et al. 2005).

3.6.6.1.1 Wetlands

Jurisdictional wetland Waters of the US (WoUS), as defined by the Clean Water Act (CWA), are found within the study area. Wetlands include various vegetation communities that grow within saturated conditions. Wetlands are areas where water covers the soil or is present either at or near the surface of the soil all year or for varying periods of time during the year, including during the growing season (USEPA 2021). The prolonged presence of water creates conditions that favor the growth of specially adapted plants (hydrophytes) and promote the development of characteristic wetland (hydric) soils. Wetlands may support both aquatic and terrestrial species.

Mangrove wetlands in American Samoa are found only on Tutuila and Aunu'u Islands and include tidal fringing and interior/partially enclosed basin forests. They are typically found in sheltered coastal lagoons and protected areas near stream mouths where freshwater enters the ocean. The Nu'uuli Pala Lagoon contains the largest mangrove wetland on Tutuila. In American Samoa, mangrove wetlands are considered a threatened vegetation type. Mangrove systems are a source of energy for food chains that occur within the forest as well as adjacent lagoons (Lugo and Snedaker 1974). Mangrove leaf detritus is an important source of energy as bacteria and fungi that consume detritus are in turn, consumed by mixed trophic herbivores and carnivores (Odum and Heald 1975). Maintaining water quality conditions within the mangrove forest and lagoon contributes to ensuring the pathways of mangrove leaf-litter energy flow would remain stable.

The Nu'uuli Pala Lagoon (lagoon) is a shallow estuarine body of water and the only large, enclosed lagoon on Tutuila. The lagoon is roughly circular, approximately one mile in diameter, and has a surface area of approximately 1.2 square miles. Two-thirds of the lagoon is relatively flat and shallow, with depths ranging from 1 to 5 ft, depending on the tidal stage. The bottom is a muddy, coral sand to silty mud, and the water column is usually turbid. Three mangrove species occur: oriental mangrove (*Bruguiera gymnorrhiza*) is the dominant species, red mangrove (*Rhizophora mangle*) can be found along seaward margins, and the puzzlenut tree (*Xylocarpus moluccensis*) is rare. Other mangrove forest associates include beach hibiscus (*Hibiscus tiliaceus*), fish-poison tree (*Barringtonia asiatica*), and Tahitian chesnut (*Inocarpus fagifer*). Mangrove forests thrive in brackish water conditions, and provide critical habitat for a variety of fish, invertebrate, and mollusk species.

Figure 24. Nu'uuli Pala Lagoon on Tutuila (view to North and Matafao Peak, C. Solek)

Estuarine conditions in the lagoon are created by the influx of water from two main streams and from numerous springs near its western and northern shores. The lagoon receives surface runoff from a large portion of the Tafuna Plain, including the village of Nu'uuli, and parts of Tafuna, Faleniu, Malaeimi, and Mesepa among other areas. The combined population of these villages as of 2011 was estimated at 15,424, or approximately 28 percent of the total population of American Samoa (ASG 2011). During the 1960s, the lagoon's natural circulation patterns were heavily altered through the creation of the airport (Scott 1993). Prior to construction of the airport, the Lagoon reportedly supported American Samoa's most productive shellfish beds (Clark 2018).

The construction of the runways directly affected the Pala Lagoon through the removal of dredge material to create new land and the artificial restriction of ocean water exchange through the narrow channel between the airport runway and Coconut Point (Figure 25). Subsequent dredging and filling also disrupted longshore drift, prevented sand replenishment along the coast, and contributed to possible erosion at Coconut Point (Clark 2018). The lagoon was further impacted in the 1960s by the conversion of approximately 33% of the original mangrove vegetation to upland through dewatering (NOAA 2009).

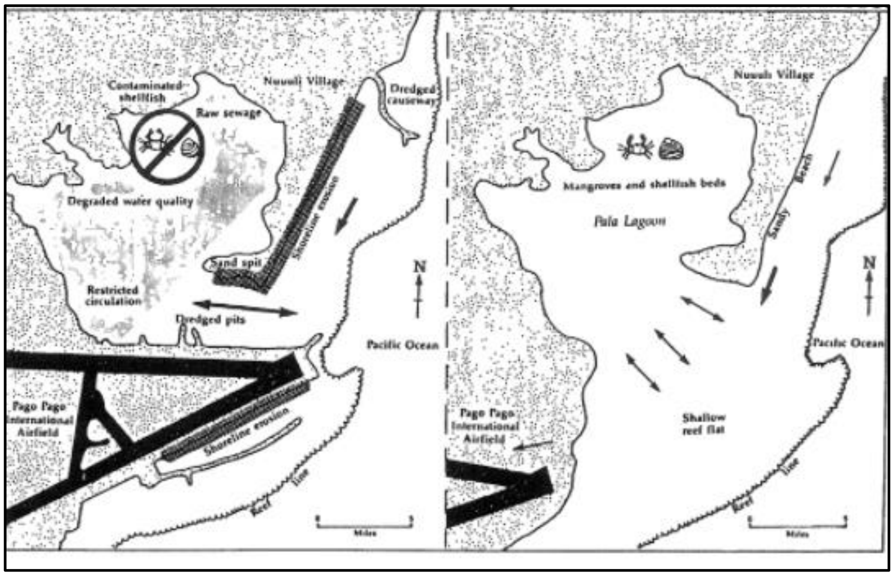

Figure 25. (Left) Pala Lagoon in 1973 After Airport Construction and (Right) How impacts Could Have Been Avoided if the Runway Had Been Located Inland from the Coast (Clark 2018)

The Nu'uuli Pala Lagoon was designated a Special Management Area (SMA) and is comprised of, 77 percent un-colonized sediments, 13 percent emergent wetland vegetation (including mangroves), and two percent coral (NOAA 2009; Figure 26). Excluding open water areas, the lagoon covers 123 acres of which approximately 100 acres are Oriental mangrove (*Bruguiera gymnorrhiza* (L.) Lam) and Red mangrove (*Rhizophora mangle*). There is also a narrow strip of saltwater marsh within the lagoon. The puzzlenut tree or e'ile'i (*Xylocarpus moluccensisor*) is reported in small numbers on the lagoon edge of Coconut Point. It is speculated that this species also exists along the northern shore of the lagoon (Sustainable Forestry Initiative Inc. 2019).

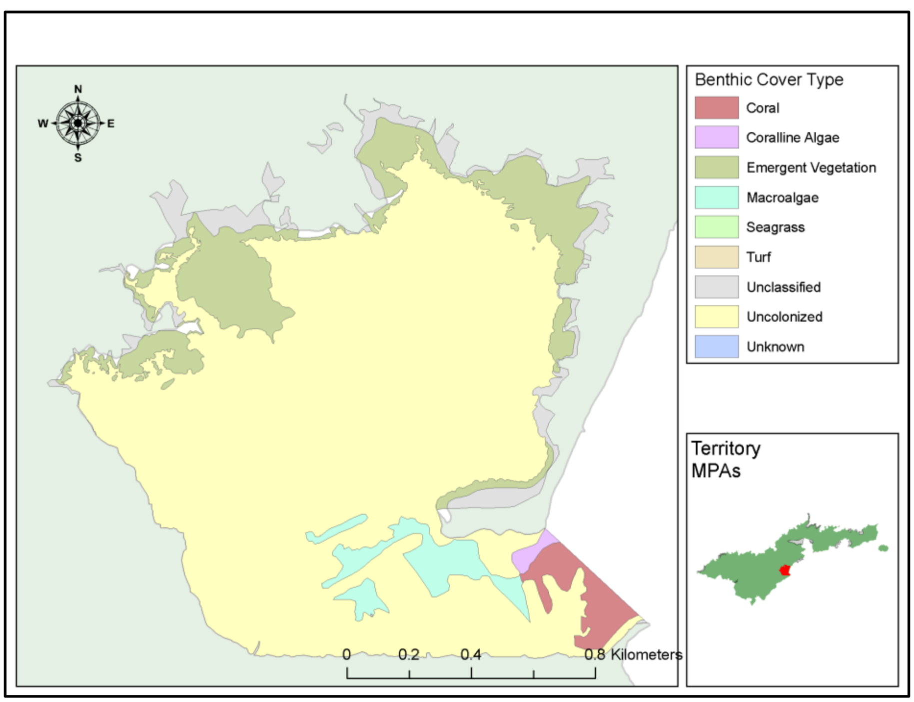

Figure 26. Benthic Cover Types in the Nu'uuli Pala Lagoon (NOAA 2019)

3.6.6.1.2 Riparian Vegetation

Riparian areas are considered transitional zones between wetland and upland (terrestrial) vegetation types. Riparian typically refers to the zone of vegetation adjacent to rivers and streams, including the vegetation found along riverbanks and adjacent floodplains. Riparian habitats are generally characterized by soils and vegetation that require free and unbound water. Riparian areas can include wetland and upland species (NRC 2002).

The riparian areas associated with streams in American Samoa are of very limited extent, being restricted to the margins of the streams and to channels of intermittent streams. Falaga (*Barringtonia samoensis*), a medium-sized tree closely related to the dominant coastal forest tree, the fish-poison tree or futu (*Barringtonia asiatica*), is commonly found along mountain streams (Whistler 1976).

The riparian vegetation in virtually all lowlands areas adjacent to streams on Tutuila, including all streams with the study area, has been affected by human activities and are highly managed habitats. Lowland riparian areas support both native and nonnative trees, many of which were planted by humans and are maintained for food, shade, beauty, wind breaks, building materials, medicine, shoreline protection, boundary markers, etc. Most lowland riparian areas tend to be dominated by non-native para grass (*Brachiaria mutica*, Coix sp.) and canna lily (*Canna sp*.), as well as many other weedy species found in wetland taro patches. In most cases, the terminal and lower reaches of streams have been partially cleared of riparian growth, particularly where the stream flows through a village or populated area (USACE 1981).

3.6.6.1.3 Aquatic Freshwater Invertebrates

The biota of streams and other waterbodies in American Samoa include freshwater mollusks, crustaceans, insects, and fish. Current threats to the native freshwater biota of Tutuila include 1) clearing of land for additional agricultural production, particularly on steep slopes, which results in increased sedimentation; 2) stream channel alteration as a result of road construction activities, which can result in impaired connectivity for diadromous species; and 3) relatively lax biosecurity protocols at the ports and airport, which may allow future introduction of new aquatic invasive species.

3.6.6.1.3.1 Freshwater Mollusks, Shrimp and Crabs

No comprehensive survey of freshwater mollusks has been conducted in American Samoa in at least 15 years, the most recent survey being that of Haynes (2001). Of the native freshwater mollusks known in the Samoan archipelago, only 23 occur in American Samoa, six of which are found on Tutuila. There is only one endemic freshwater mollusk, the freshwater snail *Melanoides brenchleyi delicatula,* currently documented from Tutuila *(*Polhemus 2020). Freshwater shrimps are common elements of stream communities, and overall, the freshwater shrimp assemblage found in American Samoa consists entirely of widespread, diadromous species, none of which appear to be at risk within the Territory. No endemic species are present. Freshwater shrimps are represented by two families, containing four genera and nine species. The family Atyidae is composed of small-sized species that largely inhabit the stream benthos, and Palaemonidae, which are much larger species that forage in the water column in stream pools.

Freshwater crabs have been only sporadically collected from streams in American Samoa and their overall distribution is likely to be underestimated. Two species in the family Varunidae, *Ptychognathus pusillus* Heller and *Ptychognathus reidelii* (Milne Edwards) have been reported from streams on Tutuila (USACE 1981).

3.6.6.1.3.2 Freshwater Fish

The freshwater fishes occurring in American Samoa streams include diadromous species that spend their adult stages in freshwater and their immature stages in marine environments and euryhaline species that are predominantly marine, but able to move up streams for varying distances at any life stage, depending on barriers and flow stage. The euryhaline species are all widespread forms that are not strictly linked to stream environments.

Twenty-nine species of freshwater fish are known from Tutuila, with three species in the family Anguillidae (freshwater eels), four species in the family Eleotridae (sleepers), ten species in the species in the family Gobiidae (gobies), two species in the family Syngnathidae (pipefishes), and two species in the family Kuhliidae (flagtails) in as well as seven other itinerant species. The flagtail *Kuhlia salelea* Schultz appears to be the only freshwater fish species endemic to the Samoa archipelago (Randall & Randall 2001).

There are currently five introduced freshwater fish species known from streams on Tutuila, consisting of three species of mosquitofishes, one cyprinid (goldfish), and one cichlid (Mozambique tilapia).

3.6.6.1.3.3 Freshwater Aquatic Insects

The documented freshwater aquatic insect biota of American Samoa consists of 30 species, including two species of flies (Diptera), nine species of aquatic true bugs (Heteroptera), and 19 species of dragonflies and damselflies (Odonata). Of these 30 species, nine are endemic to the Samoan Islands and three are strictly endemic to the island of Tutuila. Because they have been extensively surveyed, the majority of the known locally endemic freshwater insect species in American Samoa are dragonflies and damselflies. In many cases, the endemic species inhabit only a particular section of a watershed, often the upper reaches.

3.6.6.1.3.4 Aquatic Marine Species

In contrast to terrestrial species, the diversity of marine species in American Samoa is high to include 961 species of coral reef fishes, over 250 species of corals, two species of marine sea turtles, and several species of marine mammals, including whales and dolphins. Most native species are closely related to those in Indonesia.

The Nu'uuli Pala Lagoon supports an abundance of fish and aquatic invertebrates, some of which are still occasionally harvested for food. Survey data indicate a general gradient of all species, with the greatest diversity of organisms found at the outer coral reef edge at the mouth of the lagoon and the lowest diversity on the mud flats and inner lagoon shore. Although the biota of the inner lagoon is generally lacking in diversity, the inner lagoon does serve as an important nursery and spawning ground for various fish and invertebrate species.

Common invertebrates include various species of bivalve mollusks and echinoderms (e.g., starfish, sea urchins, sea cucumbers). The scyphozoan (jellyfish) *Cassiopeia sp*., the holothurians (sea cucumbers) *Stichopus sp*. and *Actinopyga sp*., the gastropods *Littorina sp.* and *Nerita plicata*, the mangrove oyster *Isogamon sp*., the edible clam *Gafrarium tumidum,* abundant in the muddy bottom along the north shore (Glude 1972), mantis shrimps Lysiosquilla sp., fiddler crabs Uca sp., land crabs Cardisoma sp., and the mangrove crab Scylla serrata (Yamasaki et al. 1985). These species are generally distributed in a similar pattern as corals, with diversity greatest found on the reef flats at the mouth of the lagoon at Coconut Point and the fewest species found the inner lagoon.

Due to the low salinity and high turbidity of the lagoon water, corals are virtually non-existent within the inner lagoon, although there is some live coral in and around the entrance channel. Reef corals, dominated by thickets of staghorn *Acropora sp*., flourish in most areas at the outer Airport-Coconut Point region at all depths and cover large areas near the mouth of the lagoon, presumably due to the good circulation and exchange of water and the proximity to more favorable open ocean conditions. The large fringing reef flat adjacent to the outer Airport-Coconut Point is perhaps the largest and widest reef in American Samoa and extends for some distance down the coast to the east from Pala Lagoon. This reef probably extended west from the present lagoon entrance prior to the construction of the airport.

The bathymetric features of the lagoon are largely responsible for the restrictive circulation patterns in the shallow basin, which likely accounts for the distribution patterns and abundance of corals within the lagoon. Runoff to this portion of the lagoon from villages adjacent to the shoreline, in addition to poor water circulation, may have some limiting effect. However, the lack of hard substrate in this area may be the most limiting factor and inhibits recruitment by larval corals that are not able colonize finer sediment substrates, like sand or silty mud.

The inner basin is shallower, larger, and more isolated from ocean circulation than areas close to the lagoon's the open ocean mouth. The mean depth of this mostly sediment covered flat is less than three ft deep. The flora here is dominated by the red algae Acanthophora spicifera, which covers much of the muddy and sandy bottom of the lagoon. Other algae include the green algae Caulerpa sp. and the brown algae Dictyota sp. and Padina sp (Volk 1993). The calcareous green algae Halimeda sp. and the sea grass Halophila minor occur on the sandflats bordering Coconut Point (at the lagoon mouth). Small springs along the rocky western shore of the lagoon support dense mats of the filamentous algae Enteromorpha sp. (Yamasaki et al. 1985).

Yamasaki et al. (1985) found a surprisingly high diversity of fish species in the inner lagoon and a great abundance of mullet (Mugilidae). These authors also found an abundance of small predatory fish, notably juvenile Sphyraena barracuda (great barracuda) and *Caranx ignobilis* (giant trevally).

3.6.6.1.3.5 Other aquatic species

Marine turtles are occasionally reported in the Lagoon, probably Hawksbill (*Eretmochelys imbricata*). See Section 3.6.7 Threatened and Endangered Species.

3.6.6.2 Alternative A: No Action Alternative

Under the No Action Alternative, no FRM measures would be implemented and as such, project-related impacts to aquatic habitat or species would not occur. In the absence of FRM measures, it is anticipated that areas adjacent to the stream would continue to periodically flood.

Under the No Action Alternative, continued development within the floodplain could exacerbate loss or degradation of existing wetlands and riparian areas within the study area. Habitat restoration and conservation efforts by local and federal agencies may offset some of these impacts but are limited due to floodplain development and private property or communal land tenure restrictions.

Overall, wetland and riparian vegetation is expected to remain stable or slightly decline under this alternative if development in the watershed continues on current pace. Similar to the effects on terrestrial species, future climate changes are expected to result in habitat loss and degradation, decreased biodiversity (including extinction of endangered species and loss or migration of native species), and spread of invasive species. However, these conditions are presumably already occurring within the watershed; therefore, it is expected that the future without-project conditions would be commensurate with existing conditions. No significant negative effects to aquatic habitat or species are expected under the No Action Alternative.

3.6.6.3 Alternative B: Channel Conveyance Improvements (Taumata and Leaveave Streams)

Under Alternative B, instream alternations in the form of channel conveyance improvements would be conducted along 6,340 ft of Taumata Stream and 13,120 ft of Leaveave Stream to result in 17.3 acres and 8.6 acres of permanent impacts to Taumata and Leaveave streams, respectively. Staging and access for construction work areas would result in 11.2 acres of temporary impacts.

Alternative B would require work within the active stream channels and impact both aquatic instream (in channel) and riparian habitat, both of which could directly and indirectly affect aquatic biota (primarily to freshwater fish, amphibians, and aquatic insects). Both Taumata and Leaveave Stream are non-perennial streams and do not support a perennial stream biota (presumably fewer species diversity and abundance are expected). In addition, as previously discussed, most of the vegetation along these streams is highly disturbed and comprised of non-native species (both flora and fauna), some native species presumably still exist in the proposed study area and could be impacted by project activities.

Direct potential impacts to aquatic species as a result of instream construction activities could include injury, death, or possible entrainment. Habitat impacts are primarily expected to occur as a result of instream channel excavation work and any associated vegetation removal, permanently increasing the extent of vegetation removal adjacent to both streams where it provides habitat and water quality benefits. Vegetation would presumably need to be removed along both banks of each stream, impacting approximately 2.2 acres of riparian habitat adjacent to Taumata Stream and approximately 3.6 acres of riparian habitat along Leaveave streams.

Riparian trees provide downed wood and roots to the stream that provide habitat aquatic organisms. Loss of this vegetative cover can impact both breeding and feeding habitat. Alteration to stream channels can also result in impaired connectivity for diadromous species *(*Polhemus 2020) and contribute to the spread of aquatic invasive species. Removal of riparian vegetation and compaction of soil by heavy equipment can contribute to increased surface runoff and lead to water quality issues.

The preconstruction, engineering and design (PED) and construction phases for the proposed Project will need to incorporate measures and/or best practices to avoid and minimize potential impacts to aquatic vegetation. Design-related efforts could include reduction of the project footprint (including temporary impact and staging areas) to the greatest extent practicable and incorporation of design features that maintain passage for native stream biota (especially at transition points). For example, any scour protection features proposed at transitions could be designed in such a way as to avoid the creation of potential barriers to the longitudinal (upstream-downstream) movement of aquatic biota along the stream channel.

BMPs implemented during design and construction would align with the American Samoa Erosion and Sediment Control (ESC) Field Guide ver. 2.0 (Horsley Witten Group, Inc. 2019) and could include, but are not limited to, proper construction sequencing, installation of sediment barriers (e.g., silt fencing, turbidity curtains), tree protection methods, and implementation of bank stabilization practices (e.g., erosion control blankets). Implementation of the practices ensure compliance with the Territorial Environmental Quality Act, Title 24 Water Quality Standards, Pollution Control (A.S.A.C. § 24.0208). Under these regulations, the American Samoa Environmental protection Agency (ASEPA) is required to "prevent negative impacts to receiving waters and ground waters as a result of disruption in natural drainage patterns caused by development."

Additional recommended protocols and BMPs are expected to include the following:

- Minimize the extent and duration of instream work to the extent practicable
- Limit construction activities within the stream channels to periods when they do not contain flowing water
- Although not anticipated, should dewatering of the construction area be required at any time, proper dewatering techniques would be implemented. (Ex. sandbags or cofferdam could be used to isolate the work area and to concentrate upstream flows)
- If pumps are to be used to dewater the construction area, it would need to be properly screened to preclude entrapment of fish and the area would need to be adequately inspected to ensure no fish or other aquatic organisms are stranded.

However, even with these avoidance and minimization efforts, the proposed project would still result in some unavoidable impacts to aquatic habitat. Disturbed locations, such as temporary construction areas, would need to be restored to as close as possible to their previous condition. All exposed soils would be expected to revegetate quickly through natural recruitment processes over time due to the tropical climate and existing seed bank. However, some of the most disturbed areas may need to be planted with native vegetation or an appropriate species to reduce immediate soil erosion and protect/stabilize any exposed slopes from subsequent flow events. Native vegetation to be planted may include herbs, shrubs and trees. Performance criteria, performance monitoring, and adaptive management would be required over time to ensure successful establishment of any planted materials.

Reduced water quality conditions in the form of temporarily elevated turbidity levels. We anticipate that a limited amount of suspended sediments may be mobilized during project dam removal construction activities, including coffer dam installation and removal.

As part of the long-term project O&M activities would be required to keep the FRM infrastructure in proper working order; in-stream O&M activities would include periodic sediment/debris removal from the channels. BMPs would be implemented (as appropriate), such that impacts are expected to be less than significant.

The non-federal sponsor would operate and maintain the project. Depending on the level of vegetation maintenance conducted, stream banks may become revegetated with native shrubs and trees over time. However, mitigation would still be necessary because removing the stream bank vegetation would potentially have negative effects to water quality. With mitigation, the effect of Alternative B on aquatic vegetation would be less than significant.

3.6.6.4 Alternative B1: Channel Conveyance Improvements and Flood Barriers (Leaveave and Taumata Streams)

Impacts to aquatic vegetation and organisms from Alternative B1 would be as described Alternative B. In addition, Alternative B1 would add approximately 2,400 lf of flood barrier with an average height of seven ft (from ground elevation) on the Taumata Stream and approximately 3,400 lf of barrier with an average height of five ft (from ground elevation) on the Leaveeave Stream. The addition of a flood barrier along both Leaveave and Taumata streams would result in a larger project footprint and the removal of a larger area (approximately 0.7 additional acres) of riparian vegetation than in comparison to Alternative B. With mitigation (as described for Alternative B), effects to aquatic habitat and species under Alternative B1 would be less than significant and would cause no substantial adverse change in the environment.

3.6.6.5 Alternative C: Taumata Flood Barrier and Nonstructural Improvements

Alternative C result in a much smaller project footprint that either Alternative B or B1. No instream improvements would be made to either Leaveave or Taumata Stream and no flood barrier would be constructed along Leaveave Stream under Alternative C. This would result in a smaller area of impact (approximately 2.4 acres) and fewer impacts to aquatic vegetation in terms of removal. With mitigation, as described for Alternative B in terms of revegetation and returning the area to its previous condition, effects to aquatic habitat and species under Alternative C would be less than significant and would cause no substantial adverse change in the environment.

3.6.6.6 Alternative D: Nonstructural Improvements

No effects to aquatic habitat or species are expected under Alternative D as this is a fully non-structural solution.

3.6.6.7 Mitigation

Effects on aquatic habitats and species were considered significant if implementation of an alternative plan would result in any of the following:

- Substantial loss of native species
- Reduction of habitat availability or degradation of habitat suitability of a magnitude and/or duration that could substantially affect a native species population
- Substantially interference with the movement of migratory species
- Introduction of or contribution to the substantial spread of an invasive species

The potential effects to aquatic habitat and species that could result from implementation of Alternative B and B1 would cause substantial adverse change in the environment in terms of reduced habitat availability from loss of vegetation from instream conveyance improvements (for both alternatives) and installation of flood barriers for alternative B1. There is also the possibility of indirect impacts to upstream or downstream aquatic faunal passage, particularly if obstructions to the stream channel are created with conveyance improvements and floodwall construction

Mitigation requirements or commitments would need to be undertaken to avoid significant impacts. These would be in the form of best management practices (mostly in the form of revegetation) to offset aquatic habitat loss. Other best management practices could include, but are not limited to, proper construction sequencing, installation of sediment barriers (e.g., silt fencing, turbidity curtains), tree protection methods, implementation of bank stabilization practices (e.g., erosion control blankets) would be needed to offset indirect impacts to downstream habitats (i.e., Pala Lagoon). Also see Polhemus 2022 in Appendix C Environmental Resources.

Alternative C as currently proposed poses minimal threat to aquatic organisms provided that similar best management practices are followed during construction of all project elements. However, given the presence of native diadromous fish and prawn species in this system, any obstructions to the stream channel created during the course of floodwall construction for Alternative C would need to be avoided.

3.6.7 Threatened and Endangered Species

Plant and animal species are designated as threatened or endangered because of their overall rarity, endangerment, unique habitat requirements, and/or restricted distribution as defined by the USFWS or NMFS. In general, it is a combination of these factors that leads to this designation. Threatened and endangered species include those listed by the NMFS and USFWS (Skinner and Pavlik 1994).

3.6.7.1 Affected Environment

Pursuant to Section 7 of the Endangered Species Act (ESA) of 1973 (16 U.S.C. 1531 et seq.), USACE requested technical assistance from the U.S. Fish and Wildlife Service (USFWS) on April 2, 2020 and received the following list of species listed or proposed for listing under both National Marine Fisheries Service (NMFS) and USFWS jurisdiction (Table 22) that may be present on or in the vicinity of the proposed project location, as well as confirmation that there is no designated or proposed federally designated critical habitat occurring within the immediate vicinity of the proposed study area (Reference Number: 01EPIF00-2020-SL-0253). This list has been recently been verified by the USFWS.

Table 22: Federally listed and proposed species within the study area

Common Name	Scientific Name	Status	USACE Determination
striped Eua snail or Tutuila tree snail	*Eua zebrina**	E	No Effect
Land snail	*Ostodes strigatus**	E	No Effect
green sea turtle (lauamei ena`ena)	*Chelonia mydas*	E	May Effect
hawksbill sea turtle (laumei uga)	*Eretmochelys imbricata*	E	May Effect
E = endangered, T = threatened * endemic to American Samoa			

The proposed study area includes all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action. For this reason, the proposed study area includes a portion of the Nu'uli Pala Lagoon.

3.6.7.1.1 Land Snails

Two species of endemic land snails (sisi totolo in Samoan) on American Samoa are listed as endangered. Neither of these species are expected to occur within the study area due to lack of habitat or presumed extinction.

- *Eua zebrina* Gould 1847 is a tree snail known from mature, native forest areas on Tutuila and Ofu Island in the Manua Group in American Samoa (Figure 27). The species was once considered abundant in the Territory, but now known only from a few locations. It is still considered the most common species of the native land snails in American Samoa.

- *Ostodes strigatus* Gould 1847 is an endemic land snail to Tutuila found on the ground in forest areas with heavy tree cover. The species is now presumed extinct on Tutuila (Cowie, personal communication)

Habitat destruction and modification are probably the greatest threats to native land snails in American Samoa. Urban and suburban habitats (like the study area) are unsuitable for most native snail species that have evolved in the absence of humans. Deforestation and clearing of land have destroyed native forests that support native snails. The spread of invasive plants and predation by introduced predators (e.g., rats, non-native predatory snails, introduced ants) have also contributed to the decline of the native snail fauna of American Samoa.

Figure 27: Tutuila tree snail (Eua zebriana)

3.6.7.1.2 Sea Turtles

Sea turtles (or Laumei in Samoan) in American Samoa include the endangered hawksbill sea turtle (*Eretmochelys imbricata*) (US DOC NOAA ONMS 2012) and the endangered green sea turtle (*Chelonia mydas)* (81 FR 20058). Both species are globally distributed throughout tropical and sub-tropical zones. Locally, juveniles of both species are commonly found in near-shore coral reef habitats in American Samoa. It has been assumed that only hawksbills nest on beaches of Tutuila, Aunu'u and the Manua Islands (Craig 2009); however, recent tagging work by American Samoa Department of Marine and Wildlife Resources between and the National Park of American Samoa have confirmed that substantial proportions of turtles nesting on Ofu are green turtles. There is no designated critical habitat for either species in American Samoa.

3.6.7.1.2.1 Hawksbill Sea Turtle

Hawksbill sea turtles have been documented throughout the Pacific. A relatively small number of hawksbill turtles live year-round in American Samoa. The sandy beaches on American Samoa provide nesting habitat, including approximately 10 miles of sandy beaches on Tutuila Island (Tuato'o-Bartley et al. 1993). Tutuila supported an estimated 50 nesting female per year through the 1990s (NMFS and USFWS 1998). However, recent monitoring studies conducted by the American Samoa Department of Marine and Wildlife Resources between 2005 and 2010 indicate that fewer than 30 females nest on the beaches of American Samoa (NMFS and USFWS 2013). No nesting of the species has been reported from the vicinity of the study area, although sea turtles, presumably hawksbill, were historically reported in the lagoon (Volk 1993).

3.6.7.1.2.2 Green Sea Turtle

NOAA Fisheries and the U.S. Fish and Wildlife Service list 11 distinct population segments of the green sea turtle ESA. The population in American Samoa belongs to the central South Pacific distinct population segments. Green sea turtles occasionally forage in the open ocean and coastal waters off American Samoa and low-level nesting may occur on sandy beaches Tutuila and the Manua Group (NMFS and USFWS 1998b), but apparently not in great numbers. The species tends to be associated with deep-water coral and seagrass beds. Seagrasses are absent in American Samoa (although some seagrass may occur in nearby Western Samoa). This may be one reason the species is not common in less common in American Samoa.

The major nesting site for green sea turtles in American Samoa is Rose Atoll, located approximately 170 miles east of the study area (Tuato'o- Bartley et al. 1993). NMFS estimates as many as 300 individuals nest there (Oram et al 2016), making Rose Atoll a significant source populations for the central South Pacific distinct population segments of the species. Nesting turtles from Rose Atoll have been tracked returning to forage areas in Samoa, American Samoa, Fiji, Cook Islands, Vanuatu, Tahiti, Papua New Guinea, and French Polynesia (NMFS 2015). The green turtles that nest at Rose Atoll likely feed elsewhere in the central South Pacific where sea grasses and algae are abundant. No nesting or sighting of the species has been reported from the vicinity of the study area (i.e., Pala Lagoon).

3.6.7.2 Alternative A: No Action Alternative

Under the No Action Alternative, no FRM measures would be implemented and as such, project-related impacts to threatened and endangered species would not occur. In the absence of FRM measures, it is anticipated that areas adjacent to the Leaveave and Taumata streams (including vegetated areas in the urbanized zone) would be subject to periodic flooding.

In general, future climate changes are expected to result in additional habitat loss and degradation, decreased biodiversity (including extinction of endangered species and loss of native species), and continued spread of invasive species. However, these conditions are already present within the Nu’uuli Pala watershed; therefore, it is expected that the future without-project conditions would be commensurate with existing conditions. Specifically, it is expected that the alternatives’ sites would continue to be characterized by a suite of non-native (including invasive) species that typically occur in disturbed urban environments. While there may be some slight changes in localized conditions, the overall species composition and habitat structure is not expected to change dramatically over the period of analysis.

Based on the current urbanization and development patterns within the Nu’uuli Pala Watershed, and more specifically along its streams, it is expected that further development and redevelopment within the watershed will continue, but this is not expected to substantially affect the status of any threatened and endangered species in the Territory. No effects to threatened and endangered species are expected under the No Action Alternative.

3.6.7.3 Alternative B: Channel Conveyance Improvements (Taumata and Leaveave Streams)

Implementation of this alternative would involve clearing and trimming of vegetation within the construction limits (including any associated staging and access roads) at each of the structural measure sites. Of this area, vegetation would be permanently displaced within the footprint of the structural feature (e.g., flood barrier) and access road (as needed to provide long-term O&M). However, none of these activities would impact threatened or endangered species.

The two species of endangered native land snails are not expected to occur in the secondary forest and agricultural habitats that characterize the study area. Green sea turtles have not been reported foraging in the Pala Lagoon and would not be affected by any project activities. Hawksbill turtles are reported to occasionally enter the Pala Lagoon and could be indirectly affected by changing conditions within the lagoon, mostly in terms of water quality impacts induced by a changed hydrology (episodic increases in water volume delivered to the Pala Lagoon via Vaitele Stream). However, this effect would cause no substantial adverse change in the environment as measured by the applicable significance criteria. Due to potential indirect impacts (albeit very unlikely) to hawksbill turtles in the Pala Lagoon, a less than significant effect to threatened and endangered species is expected under the Alternative B.

3.6.7.4 Alternative B1: Channel Conveyance Improvements and Flood Barriers (Leaveave and Taumata Streams)

Same analysis as for Alternative B. Due to potential indirect (albeit very unlikely) impacts to hawksbill turtles in the Pala Lagoon, a less than significant effect to threatened and endangered species is expected under the Alternative B1.

3.6.7.5 Alternative C: Taumata Flood Barrier and Nonstructural Improvements

Construction of a flood barrier along 2,400 ft of Taumata Stream would not be expected to measurably affect conditions in the Pala Lagoon and impact Hawksbill turtles. A temporary increase in sedimentation can be expected during the construction of the flood barrier, which could indirectly (though temporarily) affect conditions within the lagoon, mostly in terms of water quality impacts from increased sediment delivery to downstream areas. However, this effect would cause no substantial adverse change in the environment as measured by the applicable significance criteria. Due to potential indirect and temporary impacts to hawksbill turtles in the Pala Lagoon, a less than significant effect to threatened and endangered species is expected under the Alternative C.

3.6.7.6 Alternative D: Nonstructural Improvements

No effect to threatened and endangered species is expected under Alternative D.

3.6.7.7 Mitigation

Effects on biological resources were considered significant if implementation of an alternative plan would result in any of the following:

- Substantial loss of native species
- Reduction of habitat availability or degradation of habitat suitability of a magnitude and/or duration that could substantially affect a native species population
- Substantially interference with the movement of migratory species
- Introduction of or contribution to the substantial spread of an invasive species

No aquatic species listed under the ESA as Threatened or Endangered occur in the proposed direct project footprint. However, the proposed study area includes all areas to be affected directly or indirectly by the proposed Federal action and not merely the immediate area involved in the action. For this reason, the proposed study area includes a portion of the Nu'uuli Pala Lagoon.

Foe either species of listed native land snails, none of the proposed alternatives would be expected to have a significant effect, as one of the species is presumed extinct on Tutuila and the project area lacks the suitable habitat to support either species.

Although hawkskbill and green sea turtles are not found within proposed direct project footprint, indirect effects to both species in the form of water quality impacts are possible through the implementation of Alternatives B, B1, and C. Because green sea turtles have not been reported from the lagoon, a less than significant effect is expected. A less than significant effect on hawksbill sea turtles is also expected as this species is very uncommon in the lagoon based on available data. As the potential effects to Threatened and Endangered species that could result from implementation of any of the alternatives would have a less than significant effect, and no mitigation would be required. However, indirect effects can be minimized through the implementation best management practices to protect water quality (see Polhemus 2022).

3.6.8 Cultural, Historic, and Archaeological Resources

3.6.8.1 Affected Environment

Per 36 CFR 800.16, the affected environment for cultural, historic, and archaeological resources includes all resources in those categories which are present within: 1) the immediate area of implementation of structural or nonstructural improvements and 2) the broader area which would be affected by the implementation (or non-implementation) of the improvements. The first set of effects are direct and short-term, while the second set are indirect and long-term. The direct and indirect areas of effect for the project have only been partially surveyed for cultural, historic, and archaeological resources. This work has primarily been done in the course of National Historic Preservation Act (NHPA) compliance for the federally funded or permitted undertaking associated with utilities improvements in and around Tafuna. Large portions of the study area have no available cultural resource information available. Based on what we know from regional NHPA compliance findings, cultural, historic, and archaeological resources are present throughout the area, which is known to have a long history of occupation dating well into the pre-Contact Era. American Samoa State Historic Preservation Office (SHPO) Site No. AS-31-39 is an example of the types of large-scale site complexes that might be expected. This site consists of a variety of traditional Samoan built surface features and associated surface archaeological deposits, indicating it was once the locale of a small community or village. Because most of the area under consideration for this project has a very long history of residential occupation, it is expected that cultural resources with surface components are known to community members. An inventory of cultural resources within the direct area of structural improvements, especially flood barriers, would be necessary to evaluate with high resolution, the impacts of the various alternatives.

Because the effects on historic properties cannot be fully determined prior due to the lack of archaeological survey data, the Corps intends to meet its section 106 obligations through execution of a programmatic agreement (PA) with the SHPO in accordance with 36 CFR 800.14. The information at hand, based on previous work in the study area, however, is sufficient for general comparative purposes.

3.6.8.2 Alternative A: No Action Alternative

Under the No Action Alternative, there would be no physical alteration of the landscape or alteration of the built environment (retro-flood-proofing of buildings and structures). Cultural, historical, and archaeological resources will, therefore, not be directly impacted. However, any impacts associated with periodic flooding of Taumata and Leaveave streams will continue unabated. Given that the historical flooding events typically consist of stream bank overtopping followed by sheet flow inundation of the relatively level Tafuna landscape, it is expected that significant impacts to cultural and historical resources would remain under the No Action Alternative. Subsurface archaeological deposits along Taumata and Leaveave streams will continue to be subject to normal erosional effects. Surface features associated with sites such as American Samoa SHPO Site No. AS-31-39 will continue to be affected by stream overtopping, with effects proportional to water velocity and turbulence.

3.6.8.3 Alternative B: Channel Conveyance Improvements (Taumata and Leaveave Streams)

In-stream conveyance improvements along Tuamata and Leaveave streams, to the extent that they decrease streambank erosion and periodic overtopping once implemented, will serve to minimize impacts to stream-side cultural, historic, and archaeological resources over the long-term. Implementing grading of stream channels, in the short-term, has the potential to adversely affect stream-side cultural and historic resources, although with proper planning, these potential effects can likely be minimized or mitigated. The actual risk level is uncertain since the areas adjacent to the streams have not been subject to intensive archaeological survey, so the number, distribution, and significance of potential cultural and historic resources is not known.

3.6.8.4 Alternative B1: Channel Conveyance Improvements and Flood Barriers (Leaveave and Taumata Streams)

In-stream conveyance improvements along Tuamata and Leaveave streams plus flood barrier have the same level of concern for impacts to cultural, historic and archaeological resources as Alternative B (no flood barrier). To this is added the potential for adverse effects to cultural and historical resources associated with construction of the flood barriers along Tuamata and Leaveave streams. Mitigation planning for flood barrier construction can likely minimize direct construction-related impacts to known sites, such as American Samoa SHPO Site No. AS-31-39. In the long-term, the flood barriers and other improvements will serve to further minimize adverse erosional effects associated with periodic inundation.

Any specific mitigation required for Alt B1 will be identified through the programmatic agreement with the SHPO being developed because the effects of the undertaking on historical properties are currently unknown.

3.6.8.5 Alternative C: Taumata Flood Barrier and Nonstructural Improvements

Alternative C, consisting of a flood barrier along Tuamata Stream and various non-structural improvements, produces the same level of concern for impacts to cultural, historic, and archaeological resources as Alternative B1 (with flood barrier). Mitigation planning for flood barrier construction can likely minimize impacts to known sites, such as American Samoa SHPO Site No. AS-31-39. In the long-term, the flood barrier and other improvements will serve to further minimize adverse erosional effects associated with periodic inundation along a portion of Tuamata Stream. It will not produce beneficial barrier-related long-term effects for Leaveave Stream, as is found in Alternative B1.

Any specific mitigation required for Alt C will be identified through the programmatic agreement with the SHPO being developed because the effects of the undertaking on historical properties are currently unknown.

3.6.8.6 Alternative D: Nonstructural Improvements

Alternative D, nonstructural improvements would have beneficial long-term impacts to cultural, historic, and archaeological resources to the extent that periodic inundation and associated erosional effects are minimized. Short-term direct impacts associated with implementation of floodproofing, and other measures may possibly affect historic architectural resources, if present within the implementation area. The study area has not been surveyed for historic architectural resources and, therefore, the magnitude of the concern cannot be quantified. There is, however, no record of adverse impacts to historic architectural resources associated with periodic inundation in the study area.

3.6.8.7 Mitigation

Impacts to historical resources fall into three general categories: 1) subsurface archaeological deposits, 2) surface archaeological features, and 3) historic architecture. Mitigation measures appropriate to these categories are as follows:

- Subsurface archaeological deposits
  - Archaeological Data Recovery (excavation)
  - Archaeological Monitoring during floor barrier construction
- Surface archaeological features
  - Archaeological Data Recovery (mapping, photo-documentation, Global Positioning System)
  - Installation of buffer zones around features in conjunction with archaeological monitoring during floor barrier construction
  - Flood barrier design changes (avoidance of features)
- Historic architecture
  - Historic American Building Survey/Historic American Engineering Regulations documentation of National Register of Historic Places-eligible historic buildings and/or structures
  - Creative flood proofing designs/approaches that minimize changes to publicly visible portions of buildings and/or structures

Any specific mitigation required for any alternative will be identified through the programmatic agreement with the SHPO because the effects of the undertaking on historical properties are currently unknown.

3.6.9 Water Resources and Quality

3.6.9.1 Affected Environment

Regulations and policies that protect water quality and are being considered as part of the proposed project include Clean Water Act, Sections 401, 402, and 404. In accordance with the Clean Water Act Section 401, the American Samoa Environmental Protection Agency administers the Territory's Water Quality Certification Program. The objective of the program is to ensure that any Federally permitted activity will not adversely impact the existing uses, designated uses, and applicable water quality criteria of the receiving State waters. Based on the analysis provided above, Section 401 Water Quality Certification will be requested from the American Samoa Environmental Protection Agency, if a Water Quality Certification is not able to be be attained during feasibility, a letter of confirmation will be coordinated with American Samoa Environmental Protection Agency.

3.6.9.1.1 Surface Water Resources

Surface waters on American Samoa include rivers, streams and ponds. The surface area of American Samoa is 76.1 square miles, which is divided into 41 watersheds (Tuitele et al. 2014), with an average size of 1.5 square miles per watershed (ASEPA 2018). Most streams originate in the interior and drain to the coast. The steep topography of Tutuila affects localized rainfall amounts, which can range from 125 to 200 inches annually across the island. Streams generally are small and have steep gradients within their upper portions, and the pattern of streamflow over time is very much dependent on rainfall. These rainfall-fed streams often have a flashy hydrograph due to limited water storage in the small, steep watersheds and the intensity of rainfall (Wong 1996). The amount of water in any surface water system is dependent upon quantity and timing of precipitation, storage in the watershed, soil permeability, climate and evaporation rates, and watershed land cover.

3.6.9.1.1.1 Nu'uuli Pala Watershed

The study area is within the Nu'uuli Pala watershed, located along the southern coast of Tutuila. The entire Nu'uuli Pala watershed comprises approximately 6.7 square miles of land area and approximately 13 freshwater streams. The inland boundary of the watershed represents a series of mountain peaks and ridges that include Matafao Peak, Leele Mountain, Taumata Mountain, Tuasivitasi Ridge, and Olotele Mountain. Amaile Ridge delineates the upper, east boundary of the watershed. The southeast slopes of Olotele Mountain represents the northwest boundary of the Nu'uuli Pala watershed. Along the shoreline, the Nu'uuli Pala watershed extends between the east side of Coconut Point to the south side of the Pago Pago International Airport terminal and adjacent to the airport runway. Pala Lagoon and the adjoining Avatele Passage are important water bodies situated between the watershed's shoreline boundaries.

The study area includes the largest sub-drainage within the Nu'uuli Pala watershed, the Vaitele-Taumata Stream drainage that lies near the center of the watershed. The Vaitele-Taumata Stream drainage includes Mapusagatuai, Leaveave, and Puna streams that drain the southwest slopes of Tuasivitasi Ridge, located on the northwest side of the watershed.

The streams and drainage basins within the study area are typical of those found on other volcanic islands in the Pacific Ocean. For individual basins originating from volcanic ridges, the divides are closely spaced, but well defined. In general, the stream beds are rough, and the gradients are steep, except for a short distance near their mouths where alluvial deposits have formed stretches of coastal flats. None of the streams within the study area are considered perennial and only Vaitele, Taumata, Leaveave, and Mapusagatuai streams have clearly defined main streams within the upper watershed (upstream or north of Route 1 Highway) with characteristic riffle and pool systems. Once these steams leave the mountains and enter the lower alluvial coastal plains (downstream of Route 1 Highway), they generally lack defined stream channels, and sheet flow overland due to relatively flat topographic elevations, heavy vegetative growth, and development encroachments (Figure 28).

Streams within the proposed project area, including Vaitele, Taumata, Leaveave, and Mapusagatuai streams, are considered Water of the U.S. (WoUS).

Figure 28: (Left) Typical vegetation and topography of streams in the Tafuna Plain; (Right) Typical stream channel bottom with thick vegetation (C. Solek)

In addition to the high intensity rainfall, flooding problems in Tafuna are attributed to either the steep gradient stream channels in the upper watersheds that have insufficient flood-carrying capacities or the flatter slope drainage channels in the lower watersheds that are small or ill-defined. Flooding is intensified due to small channel sizes obstructed by thick vegetation, flat areas, constrictions from bridges and culverts, and encroaching development into the floodplain (POH 2013).

3.6.9.1.1.1.1 Hydrology and Circulation of the Nu'uuli Pala Lagoon

The Nu'uuli Pala Lagoon (lagoon) is a shallow estuarine body of water and the only large, enclosed lagoon on Tutuila. This lagoon receives direct surface runoff from a large portion of the Tafuna Plain, including the village of Nu'uuli, and parts of Tafuna, Faleniu, Malaeimi, and Mesepa, among other areas. The western side of the lagoon is largely commercial and residential development, being drained primarily by Vaitele Steam. Although Pala Lagoon is not within the proposed project footprint, both Taumata and Leaveave streams (within the study area) are tributaries to Vaitele Stream, which enters the lagoon at its northwest corner. The Nu'uuli Pala Lagoon is considered a Water of the U.S. (WoUS). For these reasons, a detailed description of the hydrology of the lagoon is provided.

Pala Lagoon is subject to typical tropical rain conditions and regularly experiences large, rapid fluctuations in the freshwater input. Freshwater enters from about six streams (including Vaitele Stream), all draining relatively small watersheds. The outlet of Vaitele stream is located at the northwest corner of the lagoon. When flowing, Vaitele Stream can deliver 950 to 1,350 gallons/minute of freshwater on average to the lagoon. Papa Stream at the northeast corner of the lagoon (although not within the study area) drains approximately 0.8 square miles and contributes the greatest volume of runoff to the lagoon, about 1,760 gallons/minute of freshwater runoff, when it is flowing (USDOI 1971). Therefore, the northern region of the lagoon receives much of this local runoff directly. Low surface water salinity levels recorded near the mouth for Vaitele Stream are indicative that subsurface freshwater inputs (e.g., springs) also occur here.

Pala Lagoon is classified as a stratified estuary but has some unusual features that set it apart from continental estuaries and its response to ocean tides is a function of its area, the geometry of the communicating channel with the ocean, and the character of the ocean tide itself. Over half the lagoon is three ft deep or less; solar effects are large; and the tidal inflow is about 40 percent of the lagoon volume. All of this contributes to a highly variable environment within the lagoon. In addition, the lagoon's connection to the ocean is restricted. The existing entrance to the lagoon is only about 1,200 ft wide, with most of that width covered by a reef flat with a very shallow (~1.6 ft) shoal sill that is partly uncovered at low tide. This, coupled with the bottom topography inside the sill, forces a significant vertical circulation to occur in the outer third of the lagoon during each tidal cycle. The most important point about tidal circulation in Pala Lagoon is that water entering from the ocean on each tidal cycle cannot leave again without mixing extensively with resident lagoon water. This is due to the shallow entrance sill and the basin inside, which is large enough to contain the volume of tidal inflow. In contrast, seawater in most estuaries flows freely in and out underneath the estuarine water and much of this water leaving during ebb tide is merely the same water that entered during a flood event.

Tides in the Pala Lagoon are about 85 percent as large as the ocean tide and follow it slightly in time. The high tide lag is about 30 minutes. However, as low tide is approaches, the water level in the lagoon begins to fall more slowly than that of the ocean outside; low tide is somewhat attenuated and lags the ocean tide by about 1.5 hours. There is a sight amplification of the tide when proceeding from the entrance. Bottom topography and depth profiles play an important role in defining the circulation patterns of the lagoon, and two distinct "regions" are evident: 1) the area near the lagoon mouth and adjacent to the airport has mean depth of approximately 10 ft with very irregular topography, and 2) the remainder of the lagoon, while not uniformly flat, is basically a large, shallow shoal area with mean depth of three ft or less.

The mean residence time for water in the lagoon is about 30 hours. The mean total lagoon volume is approximately 70 million cubic feet (528 million gallons), a volume equal to about 40 percent exchanged during a semidiurnal tidal cycle. However, the lagoon is not completely mixed during a tidal exchange, and residence times vary from 12 hours near the lagoon entrance to two weeks at the western edges during dry periods. During a rain event, residence times, at least for surface waters, would be expected to decline even more. The prevailing easterly winds drive surface water toward the western side of the lagoon. Therefore, any surface water containing pollutants brought in by stream inputs will tend to collect in the northwest area of the lagoon and removal by tidal circulation will be slowed.

3.6.9.1.2 Water Quality

Water quality of surface waters in American Samoa is regulated according to the Clean Water Act (CWA). The Territory's inland drinking waters are assigned to a class, 1 (potable water), or 2 (non-potable water). For water that is not classified as potable, water quality standards are assigned based on the designated (beneficial) uses that are to be protected, including aquatic life or swimming (Tuitele et al. 2014), developed as part of the CWA Section 305(b) process.

The 305(b) process requires the Territory to evaluate whether designated uses assigned to waterbodies are supported. The determinations are based on ambient water chemistry, biological assessments, habitat assessments, fish tissue contaminant levels and sediment chemistry. Where designated uses are impaired, the Territory identifies the pollutants causing water quality impairments, and the sources of those pollutants. Specific criteria used to determine attainment of these individual designated uses are in accordance with Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the CWA (USEPA 2005) and 2006 Integrated Report Guidance (IRG), supplemented by EPA's 2008, 2010, 2012, 2014, and 2016 memorandums (ASEPA 2018). The Nu'uuli Pala Watershed (the watershed within which the proposed project is located) is considered an impaired waterbody by the American Samoa Environmental protection Agency (ASEPA) and does not support its designated uses due to bacteria impairments in stream and/or ocean shoreline reaches, i.e., beaches (ASEPA 2018).

Approximately 80 percent of American Samoa's drinking water comes from aquifers below the Malaeimi Valley and Tafuna Plain that are recharged from primarily by streams in the Nu'uuli Pala watershed (Izuka et al. 2007). Ground-water production from the Tafuna Plain is currently distributed among four main well fields: 1) Malaeloa, 2) Iliili, 3) Tafuna, and 4) Malaeimi. The Tafuna and Malaeimi well fields are located within the study area.

The aquifers are comprised of highly permeable volcanic soil and bedrock, which provide poor filtration of impurities. The Tafuna Plain is an area of high population, urban development, and agriculture. American Samoa uses a Watershed Classification system to rate the disturbance of its watersheds based on population density per square mile within a watershed. Based on 2010 census data, the disturbance classification for the Nu'uuli Pala Watershed was rated as "extensive" with a population > 750 per square mile (ASEPA 2018). These factors increase the likelihood of drinking water in the aquifers becoming contaminated with land-based sources of pollution. Previous studies have shown the presence of fecal coliform bacteria in the aquifers after heavy rains. The Pala Lagoon has also been shown to be influenced by multiple potential sources of land-based pollution, including runoff from roads, poorly functioning septic systems/cesspools, the airport, a jail, a history of piggeries, and low intensity agriculture, especially banana cultivation (Mason and Whitall 2019).

Mason and Whitall (2019) quantified the magnitude and distribution of pollution in the Pala Lagoon to serve as a baseline against which future impacts can be measured. Overall concentrations of organic contaminants in sediment from the lagoon are low compared to other studies conducted by NOAA's National Status and Trends Program. Levels of legacy organic contaminants, including polychlorinated biphenyls (PAH), polycyclic aromatic hydrocarbons (PCBs), and dichlorodiphenyltrichloroethane (DDT), appear to be low and not currently a concern for the Pala Lagoon. Levels of multi residue pesticides, human use pharmaceuticals, and perfluorinated compounds also appear to be low. Of particular note, organic and inorganic compound contaminants were consistently recorded at higher levels in proximity to sources of freshwater entering to the Pala Lagoon. For example, water quality data collected from near the mouth from Vaitele Stream near the north end of Lions Park represented 60 percent of all maximum contaminant values measured in the Pala Lagoon (Mason and Whitall 2019).

Relatively elevated levels of trace and major metals, including arsenic, chromium, copper, nickel, and zinc, have been recorded in Pala Lagoon (Whitall and Holst 2015; Whitall and Holst 2019). Trace and major element concentrations of heavy metals were highest at one location at the northeast side of the end of the Pago Pago airport runway, adjacent to the mouth of the Pala Lagoon. This location makes it one of the most likely sites to be well-flushed by tidal action and therefore contaminant loads would be expected to be at or near the lowest measured in the lagoon. While this pattern held true for organic contaminants and most metals, for chromium, nickel, and lead, measured concentrations were high. Chromium, nickel, and lead are all common components of lead-acid batteries that have been observed in large numbers and in various states of decomposition along the airport runway fence line and near the mouth of the lagoon. This strip of shoreline north of the airport is a popular spot for night fishing activities; the source of the batteries could be fishermen improperly discarding flashlight batteries into or adjacent to the marine environment (Whitall and Holst 2015).

Based on comparisons with crustal metals, such as aluminum and iron, it appears that although many of these metals are elevated in the lagoon, much of these measured concentrations may be attributed to naturally high rates of erosion (Mason and Whitall 2019). For example, zinc concentrations in the Pala Lagoon exceeded the Effects Range-Low at four locations, but concentrations were very highly correlated to aluminum. This high level of correlation points toward these elevated concentrations occurring naturally through erosion processes.

Polybrominated Diphenyl Ethers in the Pala Lagoon were found to be elevated as compared to other relatively lower population coastal U.S. areas. There are currently no established guidelines for the flame retardant class of chemicals that comprise Polybrominated Diphenyl Ethers. Because Polybrominated Diphenyl Ethers are often associated with flame retardants in furniture and other household goods, the reduction of bulk trash and other marine debris to the Pala Lagoon could potentially help mitigate future loading of these chemicals to the marine environment.

Lower salinity numbers recorded near the mouth of Vaitele streams point toward the potential for increased land-based runoff, though it is noteworthy that significant rainfall events occur regularly and could potentially affect the salinity results as only surface measurements were collected. The distribution of lower salinity sites is significantly correlated to distance from freshwater inputs into the Pala Lagoon suggesting that salinity values that were measured for this study are primarily driven by freshwater runoff and tidal influence instead of direct deposition of rainfall.

The bacterial indicator *Clostridium perfringens*, a surrogate for measuring human and animal waste inputs to the environment, was detected in every sediment sample collected from the Pala Lagoon. This points toward non-point source (i.e., stream runoff, ground water) based sources of potential human and animal waste entering the Pala Lagoon.

3.6.9.2 Alternative A: No Action Alternative

Under the No Action Alternative, no federally sponsored FRM measures would be constructed and potential construction-related impacts to water quality would not occur. Input of sediment (such as that caused by erosion of the near-stream) and transport of sediment-bound contaminants are generally expected to continue at the same rate, as the factors that influence erosion are already widespread. Given the persistence of fecal coliform (e.g., from piggeries and faulty septic systems) and legacy pollutants within contributing watersheds of the area, inputs are expected to continue over time. As such, significant reductions for the range of contaminants in the contributing watersheds are not expected for the future without-project conditions.

3.6.9.3 Alternative B: Channel Conveyance Improvements (Taumata and Leaveave Streams)

This alternative would require work (in the form of conveyance improvements) within WoUS and could involve placement of dredged or fill material to WoUS from project activities. This alternative would result in approximately 17.3 acres and 8.6 acres of permanent impacts to Taumata and Leaveave streams (considered WoUS), respectively. Staging and access for construction work areas would result in 11.2 acres of temporary impacts, but these would not be to WoUS.

In addition to impacting soil resources and channel stability, construction-related erosion from these activities could increase the delivery of sediment and associated pollutants via stormwater runoff, which could temporarily affect water quality in the streams and downstream receiving waters (i.e., Pala Lagoon). Although sediment-bound pollutants are known to occur throughout the watershed (particularly in the developed areas of the Tafuna Plain), none of the soils that would be exposed by construction are expected to contain excessive levels of contamination. In general, construction of the FRM measures would involve placement of imported materials, with only minimal amounts of excavation. All materials used to construct the measures would be from approved sources and would be clean and free of contaminants. Areas requiring excavation (e.g., Leaveave and Taumata Stream channels) are not subject to any known significant inputs of roadway sediments or other anthropogenic contaminants, such that a significant increase in pollutant delivery to the streams is not expected because of construction. None of the measure locations are known to contain hazardous or toxic waste.

Construction of the proposed Project would disturb land and soils and could have implications on water quality. Construction activities would also involve the use of heavy equipment, compactors, and other construction equipment that use petroleum products such as fuels, lubricants, hydraulic fluids, and coolants, all of which are detrimental to water quality. If handled inappropriately, these could result in an accidental spill or inadvertent discharge to the streams or groundwater project.

BMPs would be implemented to avoid and minimize impacts associated with sedimentation, erosion, and stormwater contamination.

Once constructed, the structures themselves (i.e., channel conveyance improvements) are not expected to contribute pollutants to the streams or otherwise measurably affect water quality. The channel conveyance improvements for scour protection and downstream energy dissipation features would be presumably comprised of stone riprap; All materials used to construct the measures would be from approved sources and would be clean and free of contaminants. Although the debris and detention basins may slightly reduce riparian shading (e.g., vegetation management as channels are excavated) they are not expected to contribute to any measurable changes in water temperature, nor pH or dissolved oxygen levels. As Leaveave and Taumata streams are episodic and only flow during heavy rain events, work would be conducted when the streams are not actively flowing.

Over the long-term, the project features are not expected to increase channel or bank erosion, or otherwise contribute to sediment and/or contaminant inputs to the streams, such that water quality conditions are generally expected to be commensurate with the existing condition. During flood conditions, the FRM measures are designed to contain stream flows within and directly adjacent to the waterways. The energy dissipation and scour protection features constructed in Leaveave and Taumata streams will serve to reduce the risk of channel or bank erosion and the mobilization of stream sediment during high flow periods. Therefore, these measures would not significantly alter the quality, quantity, or pattern of stormwater inputs to the streams.

Although none of the structures proposed would be designed or are intended to capture sediment, some degree of sediment deposition is expected to occur within the channels, particularly during periods of inundation associated with flood stage flows. Sediment and debris (including trash and other man-made debris) that accumulates within the channels would be removed as part of the routine O&M activities and properly disposed of at an approved, offsite location that is qualified to accept the material. Removal of these materials from the channels is anticipated to provide some degree of water quality benefit to downstream areas. As the structures are not explicitly designed to capture sediment, the quantity of sediment and any associated pollutants to be removed has not been quantified. However, the project is not expected to measurably increase sediment delivery to the nearshore waters if appropriate best practices and minimization measures are used.

3.6.9.4 Alternative B1: Channel Conveyance Improvements and Flood Barriers (Leaveave and Taumata Streams)

Under Alternative B1, potential impacts to water quality would be similar to those described for Alternative B. The location and overall extent of impacts are relatively similar based on the locations of the FRM measures. In addition, the channel conveyance improvements measures included in Alternative B1 would be constructed with the same type of materials as for Alternative B. However, Alternative B1, would result in a greater extent of ground disturbance, due to the inclusion of flood barriers along both Leaveave and Taumata streams, thus increasing the potential for construction-related water quality impacts.

This alternative may include an underground portion for construction of a floodwall footing. Exact design of the floodwall will be determined during preliminary engineering and design (PED) using the most recent USACE guidance and in consultation with a structural and geotechnical engineer. At this time, the total amount of dredged/fill material to WOTUS cannot be determined until site conditions can be assessed and final determination whether a levee, floodwall, or combination thereof, should be proposed. Additional detailed design will be conducted during the PED phase of the project and quantities are subject to change based on a refined design.

It is expected that BMPs would address the same range of pollutants and control measures, being a relatively developed area that could contain soils with higher levels of anthropogenically-derived pollutants. Flood barriers would be comprised of compacted, earthen berms or concrete walls, none of which are expected to contribute pollutants to the streams or otherwise measurably affect water quality if BMPs and minimization measures are used. Implementation of these BMPs would reduce the effects of any potential construction-related impacts to a less-than-significant level; no mitigation is required.

3.6.9.5 Alternative C: Taumata Flood Barrier and Nonstructural Improvements

Under Alternative C, inclusion of the one flood barrier along Taumata Stream would decrease the potential for construction-related water quality impacts. The location and overall extent of impacts from the FRM measures to water quality would be much less to those described for Alternative B and B1. The flood barrier for Taumata Stream has the same length, average height and would be comprised of the same materials as described in Alternative B1. Alternative C would result in a reduced extent of ground disturbance compared to the other alternatives. No bridge improvements are proposed as part of the plan. Interior drainage requirements will need to be considered as the pre-construction design is further developed.

This alternative would not require direct work within WoUS, but work could involve temporary placement of dredged or fill material to 2.3 acres of WoUS from project activities. However, with the implementation of BMPs as described for Alternative B and B1, effects to water quality would be less than significant.

3.6.9.6 Alternative D: Nonstructural Improvements

No effects to water quality are expected under Alternative D as this is a fully nonstructural solution.

3.6.9.7 Mitigation

Effects on water quality were considered to be significant if implementation of an alternative plan would result in any of the following:

- Substantially degrade surface water quality such that it would violate water quality standards, contribute to exceedance of aquatic life guidelines, or otherwise impair beneficial uses
- Substantially increase contaminant levels in the groundwater

The potential effects to water quality that could result from implementation of Alternatives B, B1, and C would be less than significant if appropriate BMPs and minimization measures are used to avoid and minimize impacts associated with sedimentation, erosion and stormwater contamination. These could include, but are not limited to, the following:

- Employee/subcontractor training; sequencing of activities to minimize exposure of cleared areas; timing construction to avoid periods of actively flowing water in episodic streams (to the extent possible)
- Minimize extent of clearing and grubbing; maintain existing vegetation (to the extent possible); provide temporary soil stabilization (e.g., mulching; hydroseeding; soil binders, geotextiles, etc.); provide dust control (but avoid excess dust control watering); implement and maintain proper dewatering techniques (if needed); protect and manage stockpiles; cover loose materials in haul trucks; stabilize construction entrance/exit and provide tire wash; revegetate temporarily disturbed areas
- Installation of sediment barriers (e.g., silt fencing, turbidity curtains), tree protection methods, and implementation of bank stabilization practices (e.g., erosion control blankets)
- Regular vehicle and equipment inspection; fueling and maintenance in designated areas; use of drip pans; proper storage and disposal techniques; implement spill controls
- Protection of stockpiles; provide watertight dumpsters, with regular waste removal and disposal; proper containment, labeling and disposal of hazardous materials, such as petroleum products, solvents, etc.); regular site inspection and litter collection; salvage and reuse of materials, as appropriate
- Proper storage and handling techniques for concrete-curing compounds; perform washout of concrete trucks in designated areas only; containment in wash water pits; proper disposal of material from washout facilities
- Equipment and vehicle washing in designated areas; provide containment of wash water
- Proper sanitary/septic waste management

BMPs implemented during design and construction would align with the American Samoa Erosion and Sediment Control (ESC) Field Guide ver. 2.0 (Horsley Witten Group, Inc. 2019) to ensure compliance with the Territorial Environmental Quality Act, Title 24 Water Quality Standards, Pollution Control (A.S.A.C. § 24.0208). Under these regulations, the ASEPA is required to “prevent negative impacts to receiving waters and ground waters as a result of disruption in natural drainage patterns caused by development.”.

Preparation and implementation of these BMPs would reduce the potential construction-related water quality impacts to a less-than-significant level. With implementation of these BMPs, the extent of water quality impacts is expected to be less than significant, and no mitigation would be required.

3.6.10 Air Quality

3.6.10.1 Affected Environment

Air quality in a geographic area is determined by the type and amount of pollutants emitted into the atmosphere, the size and topography of the area, and the prevailing weather and climate conditions. The levels of pollutants and pollutant concentrations in the atmosphere are typically expressed in units of parts per million (ppm) or micrograms per cubic meter (µg/m3) determined over various periods of time. The U.S. Environmental Protection Agency (USEPA) designates areas within the U.S. as attainment, nonattainment, maintenance, or unclassifiable, depending on the concentration of air pollution relative to ambient air quality standard.

Air quality and emissions of atmospheric pollutants are regulated under the Clean Air Act (CAA). The CAA establishes limits on how much air pollution can exist in an area at any given time, based on local climatological factors. These limits are known as the National Ambient Air Quality Standards (NAAQS). The USEPA established NAAQS for six common pollutants, known as criteria pollutants. These include carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter, and sulfur dioxide (USEPA 2013).

One of the key indicators of current ambient air quality in a state or territory is the compliance status of each region compared to the NAAQS. Compliance is typically evaluated by county or, in some cases, large cities. Based on the limited geographic size of American Samoa, the entire Territory is evaluated as a single air quality control region (AQCR): American Samoa AQCR 245 (40 CFR § 81, Appendix A). Local air quality protection and permitting in American Samoa is jointly the responsibility of the ASEPA and USEPA Region 9 (USEPA 2014c; USEPA 2014b). ASEPA enforces the federal NAAQS; the Territory AAQS (TAAQS) are the same as the NAAQS. Table 23 summarizes the NAAQS, which represent the TAAQS in American Samoa.

Table 23. Ambient air quality standards in American Samoa

Pollutant	Averaging Period	NAAQS (Primary Standard)[a]	NAAQS (Secondary Standard)[b]	TAAQS
Carbon monoxide	8-hour	9 ppm (10 mg/m^3)	None	Same as NAAQS
	1-hour	35 ppm (40 mg/m^3)	None	
Lead	3-month average	0.15 $\mu g/m^3$ (rolling 3-month)	Same as primary	
Nitrogen dioxide	Annual	0.053 ppm (100 $\mu g/m^3$)	Same as primary	
	1-hour	0.1 ppm (188 $\mu g/m^3$)	None	
Ozone	8-hour	0.075 ppm	Same as primary	
	24-hour	150 $\mu g/m^3$	Same as primary	
Particulate matter: $PM_{2.5}$	Annual	12 $\mu g/m^3$	15 $\mu g/m^3$	
	24-hour	35 $\mu g/m^3$	Same as primary	
Sulfur dioxide	3-hour	None	0.5 ppm (1,300 $\mu g/m^3$)	
	1-hour	0.075 ppm (196 $\mu g/m^3$)	None	

Sources: USEPA 2014a; American Samoa Administrative Code 24.0510(a).

Specific geographic areas or air basins are designated by USEPA as either in "attainment" if they are within or "nonattainment" if they exceed allowable NAAQS for each criteria pollutant, based on air quality monitoring data submitted to USEPA and the number of days in which standards were exceeded. Areas previously designated as nonattainment, but reclassified from nonattainment to attainment, are designated as “attainment/maintenance” areas. The CAA requires each State or Territory to develop a State Implementation Plan for areas in nonattainment of NAAQS. American Samoa is not designated as nonattainment or maintenance status for any of the AAQS (USEPA 2015a; USEPA 2015b). No specific type/class of air pollutant is considered a significant concern in American Samoa (ASEPA 2015). Pursuant to current USEPA listings, American Samoa is in attainment for all criteria pollutant NAAQS and, as a result, is not required to have an State Implementation Plan in place for any criteria pollutant.

Furthermore, American Samoa does not currently implement a permitting program for proposed new or modified major stationary sources. The Nonattainment New Source Review program is not currently applicable in American Samoa because the territory is not designated as nonattainment for any of the AAQS. Therefore, all proposed major sources would be addressed under the Prevention of Significant Deterioration program (40 CFR § 52.21), which for American Samoa is administered by USEPA Region 9. ASEPA implements minor source construction and operating permit programs (USEPA 2014b). The type of permit required in American Samoa is primarily based on: 1) the type of proposed stationary source; and 2) the potential amount of air pollutants that could be emitted per year from the proposed source. Prevention of Significant Deterioration review is triggered for new sources if facility-wide potential emissions of any criteria pollutant exceed 250 tons per year. For modified stationary sources, the Prevention of Significant Deterioration thresholds vary by pollutant (40 CFR § 51.166). Minor source permitting thresholds also vary by pollutant.

As mentioned above, the entirety of American Samoa is evaluated as one AQCR. In implementing the federal Prevention of Significant Deterioration program, USEPA Region 9 ensures that air quality throughout the Territory is not degraded by proposed major sources, specifically ensuring that a proposed major source would not cause ambient air concentrations to increase by more than allowable thresholds listed in Table 24.

Table 24: Prevention of Significant Deterioration allowable increase increments

Pollutant	Averaging Period	PSD Increment ($\mu g/m^3$)	
		Class I Area[a]	Class II Area[b]
Nitrogen dioxide	Annual	2.5	25
Particulate matter: PM_{10}	Annual	4	17
	24-hour	8	30
Particulate matter: $PM_{2.5}$	Annual	1	4
	24-hour	2	9
Sulfur dioxide	Annual	2	20
	24-hour	5	91
	3-hour	25	512

Source: 40 CFR § 51.166c.

$\mu g/m^3$ = micrograms per cubic meter; $PM_{2.5}$ = particulate matter up to 2.5 micrometers in diameter; PM_{10} = particulate matter up to 10 micrometers in diameter

[a] Class I areas are national parks and wilderness areas in attainment or unclassifiable areas that exceed 5,000 acres in size and were in existence on August 7, 1977.

[b] Class II areas are all other attainment or unclassifiable areas outside Class I areas.

3.6.10.1.1 Greenhouse Gas Emissions

In addition to criteria air pollutants of direct concern for human health, other air emissions are produced as a result of natural processes and human activities. Specifically, greenhouse gases (including carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O) are chemical compounds that trap heat in the atmosphere, thus affecting the earth's temperature. Scientific evidence indicates a trend of increasing global temperatures (i.e., global warming) over the past century due to an increase in global greenhouse gas emissions. EO 13514 (Federal Leadership in Environment, Energy and Economic Performance) first introduced greenhouse gas emissions management requirements for the Federal government. On December 18, 2014, the CEQ released Revised Draft Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in NEPA Reviews (CEQ 2014), which provides guidance for Federal agencies in considering climate change in their decision-making process. Relative to the need to disclose projected quantitative greenhouse gas emissions, the guidance provides a reference point of 25,000 metric tons of CO2 (carbon dioxide) equivalent emissions on an annual basis, below which a greenhouse gas emissions quantitative analysis is not warranted (unless quantification below that reference point is easily accomplished) (CEQ 2014).

The Governor of American Samoa issued EO 10A-2007 to address the issue of climate change in the territory. It identified the significant repercussions of global warming and climate change to American Samoa, including loss of land mass and shoreline from sea level rise, increased food cost and dependence on off-island food sources, potential need for population relocation and the resulting loss of spiritual connection to the land, and loss of coral reefs with the resulting increase in mortality and economic loss from lack of reef protection from cyclones.

3.6.10.2 Alternative A: No Action Alternative

Under the No Action Alternative, no federally funded FRM improvements would be implemented in the study area, such that no emissions of criteria pollutants would occur. The existing range of 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.

Alternative A would result in no significant effects to air quality resources.

3.6.10.3 Alternative B: Channel Conveyance Improvements (Taumata and Leaveave Streams)

Construction of the project would involve a variety of ground disturbing activities, including site preparation, excavation, and grading. Use of heavy equipment and earthmoving operations conducted as part of these activities would generate internal combustion engine emissions and fugitive dust; potential air pollutants associated with these emissions include hydrocarbons; carbon monoxide; nitrogen, carbon, and sulfur dioxide; and PM10 and PM2.5. In general, these emissions would be temporary and localized in nature.

In comparison to overall emissions in the region, the contribution by the proposed action is relatively small; this contribution would only negligibly affect regional air quality and would not be expected to affect attainment of the federal or Territory ambient air quality standards. BMPs that would be implemented to reduce construction-related impacts to air quality are expected to include use and proper maintenance of diesel power equipment, minimizing the extent of exposed soils at any given time, stabilizing soil as quickly as possible (e.g., soil binders, jute netting, and revegetation), use of water trucks or sprinkler systems to minimize dust, covering loose material hauled in trucks, and limiting number of vehicles and speed on unpaved surfaces. With implementation of these BMPs, construction-related impacts to air quality are expected to be less then significant; no mitigation would be required.

Over the long-term, the project would also result in air emissions from use of vehicles for O&M activities. In addition to the maintenance equipment and vehicle emissions, operation of the pump stations would result in indirect emissions because of fossil fuel energy use for electricity. However, these emission levels would be very low, and similar to those associated with construction, would be expected to have a negligible impact on air quality.

Specific to greenhouse gases, a limited amount of emissions would be associated with construction of the project resulting from the use of heavy equipment. Published USEPA data indicate that 22 pounds of carbon dioxide are produced for every gallon of diesel fuel burned, and 19.4 pounds are produced for every gallon of gasoline used (EPA 2008). Given the scale of the project, the total amount of emissions resulting from construction would be insignificant at a regional scale; further, the emission levels would be significantly under Federal reporting thresholds. As such, the project would be expected to have a negligible impact on greenhouse gas emissions and climate change.

With the implementation of BMPs described, Alternative B would result in no significant effects to air quality resource; no mitigation would be required.

3.6.10.4 Alternative B1: Channel Conveyance Improvements and Flood Barriers (Leaveave and Taumata Streams)

Air quality emissions that would occur with implementation of Alternative B1 are expected to be within the range of those described for Alternative B, and as such, impacts to air quality are expected to be less than significant; no mitigation would be required.

3.6.10.5 Alternative C: Taumata Flood Barrier and Nonstructural Improvements

Air quality emissions that would occur with implementation of Alternative C are expected to be even less than those described for Alternative B and B1, as work involves only one location (Taumata Stream) and only construction of one flood barrier on Taumata Stream. As such, impacts to air quality are expected to be less than significant; no mitigation would be required.

3.6.10.6 Alternative D: Nonstructural Improvements

Air quality emissions that would occur with implementation of Alternative D are expected to be even less than those described for Alternative B, B1, and C as Alternative D is a fully nonstructural solution. Implementation of the nonstructural measures would involve use of vehicles and perhaps other equipment to visit individual residences slated for dry flood proofing, etc. However, impacts to air quality are expected to be less than significant and no mitigation would be required.

3.6.10.7 Mitigation

Effects on air quality were considered significant if implementation of an alternative plan would result in any of the following:

- Exceedance of federal or Territorial air quality standards established for criteria pollutants
- Substantial contribution to an existing exceedance of a federal or Territory air quality standard (for pollutants in non-attainment)
- Generation of greenhouse gas emissions that would significantly contribute to climate change

Because the potential effects to air quality and climate change that could result from implementation of the alternatives was determined to be less than significant, no mitigation is required. Standard BMPs would be implemented to maintain any impacts to less than significant.

3.6.11 Public Health and Environmental Hazards

3.6.11.1 Affected Environment

The existing environment for public health and safety is defined by environmental hazards likely to be encountered during the deployment and O&M of the proposed project. The human population of interest within the existing environment of health and safety includes the general public near the proposed project study area. These populations could experience different degrees of exposure to hazards as a result of their relative access to these sites and their function throughout the deployment and operations of the proposed action.

In the event of catastrophic flooding, potential safety threats include loss of life, injury, and post-flood health hazards. Elevated and/or high-velocity floodwaters can threaten physical health and safety (e.g., risk of drowning and injury from movement of debris and other large objects), as well as mental health (e.g., stress and anxiety). Other health and safety hazards that could occur as a result of flooding include potential contamination of floodwaters (e.g., sewage, fuel oil, pesticides, and solvents); in addition, flood conditions can increase exposure to bacteria and/or mold (e.g., leptospirosis). Currently, the affected population within the 1 percent ACE floodplain includes approximately 2,500 residents, of which more than 20 percent are over the age of 65 or under the age of 5 (and are thus more vulnerable to flood-related safety hazards).

3.6.11.1.1 Critical Infrastructure

Critical infrastructure includes emergency facilities or other assets that are essential for functioning of a community and can directly affect public health and safety; these include fire and police stations, hospitals and medical clinics, and evacuation shelters. Access to these facilities can be limited during and after flood events; in some cases, critical infrastructure may need to be evacuated (e.g., temporary closure of medical facilities would) interrupt normal public health operations, as well as trauma care).

3.6.11.2 Alternative A: No Action Alternative

Under the No Action Alternative, the federally sponsored FRM measures would not be implemented and public health and safety would continue to be threatened by flood events. The currently affected population of approximately 2,500 residents, would remain in the 1 percent ACE floodplain, and could potentially grow as the population increases over time. Although, the potential flood characteristics are not projected to be of a depth and velocity that imminently threaten life safety. The more prominent health and safety threats are expected to be reduced mobility and timely access to medical facilities, reduced response times of police and medical personnel during flood events, injuries associated with movement of debris and/or health concerns related to contaminated flood waters.

Much of the watershed's critical infrastructure would remain within the floodplain, which elevates the risk associated with these health and safety threats. Critical infrastructure that is within the existing 10 percent ACE floodplain would remain subject to flooding.

Alternative A would result in significant effects to public health in the form reduced mobility and timely access to medical facilities, reduced response times of police and medical personnel during flood events.

3.6.11.3 Alternative B: Channel Conveyance Improvements (Taumata and Leaveave Streams)

Overall, the project would function to decrease health and safety risks associated with potential flooding in the watershed. Implementation of Alternative B would significantly reduce the potential extent of flooding in the watershed, thus reducing the number of people subject to flood-related health and safety risks, including the majority of the watershed's residents. It is not possible to eliminate the potential for flooding in the watershed and there would still be some degree of health and safety risks associated with movement of debris and health concerns from contaminated flood waters in areas still subject to flooding. However, the depth and velocities of flooding would be reduced and the overall risks to health and safety from flooding would be greatly improved, such that these residual impacts are expected to be minimal in comparison to the benefits provided across the watershed.

In addition to reducing health and safety risks to the affected population, critical infrastructure and other public facilities would be removed from the 1 percent ACE floodplain, thus contributing to health and safety through increased resiliency in response to flood events. Another beneficial impact associated with implementation of the project is heightened awareness of the flood-related risks, including an increased understanding of the overall potential for flooding based on dissemination of project-related information, thereby improving public health and safety.

Alternative B would not result in significant effects to public health, and could actually improve this resource by maintaining mobility, timely access to medical facilities, and reduced response times of police and medical personnel during flood events.

3.6.11.4 Alternative B1: Channel Conveyance Improvements and Flood Barriers (Leaveave and Taumata Streams)

Overall, implementation of Alternative B1 would provide similar benefits to public health and safety as described for Alternative B, but it would provide an even greater level FRM to residents and critical infrastructure through the construction of a flood barrier along both Leaveave and Taumata streams. Effects for Alternative B_1 would be as described for Alternative B.

3.6.11.5 Alternative C: Taumata Flood Barrier and Nonstructural Improvements

Implementation of Alternative C would still provide benefits to public health and safety as described for Alternative B and B1 but would achieve this through different means by incorporating both structural and non-structural solutions. A flood barrier would be constructed along Taumata Stream and provide protection to residents and critical infrastructure most affected by the greatest depth of flooding along Taumata Stream. In addition, non-structural measures will be used to protect structures that will not receive flood protection from the flood barrier alone. Effects for Alternative B1 would be generally as described for Alternative B.

3.6.11.6 Alternative D: Nonstructural Improvements

Implementation of Alternative C would still provide benefits to public health and safety as described for Alternative B and B1, but only incorporates nonstructural solutions to include dry flood proofing nonresidential buildings and elevating residential structures. Effects for Alternative D would be generally as described for Alternative B.

3.6.11.7 Mitigation

Effects on public health and safety were considered to be significant if implementation of an alternative plan would result in any of the following:

- Substantial interference with or increase to the response time of police, fire or emergency medical services
- Increased health and safety risks to residents and/and visitors
- Decreased access to or functionality of critical infrastructure, or other public facilities including schools, churches, and places of worship
- Conflict with or impaired implementation of an adopted plan or policy, including applicable hazard mitigation plans

Because there were no readily quantifiable metrics for public life-safety for this evaluation, assessments are qualitative, relying on quantitative data where possible. However, because all alternative proposed would function to decrease health and safety risks associated with potential flooding in the watershed, any negative effects on public health and safety are considered to be far outweighed by the benefits achieved through implementation of any of the alternative plans proposed. Therefore, any impacts would to be less than significant, and no mitigation is required.

3.6.12 Noise and Vibration

This section discusses noise and vibration conditions as they relate to humans and wildlife that would be potentially sensitive to impacts from deployment and operation of the proposed action.

3.6.12.1 Affected Environment

Noise is a form of sound caused by pressure variations that the ear can detect and is often defined as unwanted sound (*USEPA 2012*). Sound can be perceived as loudness or /intensity in terms of decibels (dB). Sound measurement is refined by using a dBA scale that emphasizes the range between 1,000 and 8,000 cycles per second, which are the sound frequencies most audible to the human ear. The perceived increase in loudness of a sound does not correspond directly to numerical increase in dBA values. Typically, an increase of less than 3 dBA is barely noticeable, an increase of 5 dBA is noticeable, an increase of 10 dBA is perceived as a doubling in apparent loudness, while an increase of 20 dBA is perceived as a four-fold increase.

Noise is one of the most common environmental issues that can interfere with normal human activities and otherwise diminish the quality of the human environment. Typical sources of noise that can result in this type of interference in both urban and suburban surroundings include interstate and local roadway traffic, rail traffic, industrial activities, aircraft, and neighborhood sources like lawn mowers, leaf blowers, etc. Table 25 shows typical noise levels generated by common indoor and outdoor activities and provides possible human effects. The effects of noise can be classified into three categories: 1) noise events that result in annoyance and nuisance; 2) interference with speech, sleep, and learning; and 3) physiological effects such as hearing loss and anxiety.

Table 25: Typical noise levels and possible human effects (Source: WSDOT 2015)

Common Noises[a]	Noise Level (dBA)	Effect
Rocket launching pad (no ear protection)	180	Irreversible hearing loss
Carrier deck jet operation	140	Painfully loud
Air raid siren		
Thunderclap	130	Painfully loud
Jet takeoff (200 feet)	120	Maximum vocal effort
Auto horn (3 feet)		
Pile driver	110	Extremely loud
Loud concert		
Garbage truck	100	Very loud
Firecrackers		
Heavy truck (50 feet)	90	Very Annoying
City traffic		Hearing damage (8 hours of exposure)
Alarm clock (2 feet)	80	Annoying
Hair dryer		
Noisy restaurant	70	Telephone use difficult
Freeway traffic		
Business office		
Air conditioning unit	60	Intrusive
Conversational speech		
Light auto traffic (100 feet)	50	Quiet
Living room	40	Quiet
Bedroom		
Quiet office		
Library/soft whisper (15 feet)	30	Very quiet
Broadcasting studio	20	Very quiet
Pin dropping	10	Just audible
Threshold of hearing	0	Hearing begins

Source: WSDOT 2015

dBA = A-weighted decibel
[a] No common 10 dBA source(s) was available, but expected noise effects for this decibel value were included.

Related to noise, vibration is a fluctuating motion described by displacement with respect to a reference point. Ground-borne vibrations, which in many instances can be caused by tools or equipment that generate noise, can also result from roadway traffic, rail traffic, and industrial activities as well as from some construction-related activities such as blasting, pile-driving, vibratory compaction, demolition, and drilling. Unlike noise, most ground-borne vibrations are not typically experienced every day by most people because the existing environment does not include a significant number of perceptible ground-borne vibration events. Depending on the intensity, vibrations may create perceptible ground shaking and the displacement of nearby objects as well as rumbling sounds. Table 26 lists vibration source levels produced by typical construction machinery and activities at a distance of 25 ft in units of vibration decibels (VdB). The vibration thresholds for human perceptibility and potential building damage are 65 and 100 VdB, respectively *(*FTA 2006).

Ambient noise levels vary with land use throughout the Nu'uuli Pala watershed. In the forested portions of the upper watershed, ambient noise levels are relatively low, with most sounds associated with environmental factors such as wind, rain, and wildlife (particularly birds). In American Samoa, evergreen forest accounts for 78 percent of land cover, and developed land covers less than four percent of the territory. Units of the National Park System (National Parks, Wilderness Areas, National Historic Sites, etc.) comprise approximately 48 percent of recreation land in the Territory (see Section 3.6.15.8 Recreation Affected Environment). Ambient day-night noise levels in the most sensitive areas in American Samoa, such as the National Park of American Samoa, are expected to be 35 dBA or less.

Table 26: Typical outdoor sound levels by land use category (Cavanaugh and Tocci 1998; Bies and Hansen 2009)

Land Use Category	L_d (dBA)[a]	L_n (dBA)[b]	L_{dn} (dBA)[c]
Wilderness areas	35	25	35
Rural and outer suburban areas with negligible traffic	40	30	40
General suburban areas with infrequent traffic	45	35	45
General suburban areas with medium density traffic or suburban areas with some commerce or industry	50	40	50
Urban areas with dense traffic or some commerce or industry	55	45	55
City or commercial areas or residences bordering industrial areas or very dense traffic	60	50	60
Predominantly industrial areas or extremely dense traffic	65	55	65

Sources: Cavanaugh and Tocci 1998; Bies and Hansen 2009

In locations that interface with low density development (i.e., dispersed residential areas) within the Tafuna Plain, sounds associated with human activity generally increase ambient noise levels. For example, ambient day-night noise levels in rural and suburban American Samoa towns (e.g., 'Ili'ili, Nu'uuli, etc.) with infrequent traffic are expected to range from 40 to 45 dBA. Within the more commercial districts, ambient noise levels range from relatively quiet residential neighborhoods to commercial and industrial areas, which typically generate higher levels of noise. For example, ambient day-night noise levels in major cities such as Pago Pago, Tafuna, Leone, and Faleniu, as well as areas with dense traffic or some commerce or industry, are expected to range from 55 to 65 dBA. Sources of noise include commercial and industrial operations, construction activities, intermittent aircraft flybys, and traffic, especially along the major arterial roads. Although these may all contribute to ambient noise levels, some of the uses within and surrounding the proposed project site are also considered to be sensitive to high levels of ambient noise; these include residences, schools, and churches.

There are no numerical noise or vibration limits in American Samoa. Per the Occupational Safety and Health Act of 1970, employees should not be exposed to more than 85 decibels (dB) for an 8-hour day, and if the noise level exceeds the 85 dB threshold, protective measures must be installed to reduce noise exposure (*29 CFR § 1910.95(c)(1)*).

3.6.12.2 Alternative A: No Action Alternative

Under the No Action Alternative, the FRM improvements would not be implemented, such that no increase in ambient noise levels would occur. Land uses under the future without-project condition are expected to be reasonably consistent with the existing land uses. Given that the types of noise and maximum permissible noise levels are linked to the various land uses types, the general range of ambient noise levels across the watershed are not expected to measurably change over the period of analysis. Alternative A would therefore not result in any significant effects to sensitive noise receptors.

3.6.12.3 Alternative B: Channel Conveyance Improvements (Taumata and Leaveave Streams)

Construction of Alternative B would require operation of heavy equipment for various activities, including clearing, site preparation, excavation, grading, and installation of the structures. Construction activity would generally occur between the hours of 7:00 a.m. and 5:00 p.m. Monday through Friday, though some work outside those times may be necessary. Typical sound levels produced by this type of construction equipment are listed in Table 27; these sound levels are based on an inventory of equipment noise emissions that were compiled by the Federal Highways Administration as part of their Construction Noise Handbook (USDOT 2006).

Table 27: Example of typical sound levels emitted from construction equipment

Type of Equipment [a]	Lmax at 50 feet (dBA, slow) [b]	Type of Equipment [a]	Lmax at 50 feet (dBA, slow) [b]
Backhoe	80	Excavator	85
Compactor (ground)	80	Flatbed truck	84
Concrete saw	90	Front end loader	80
Drill rig truck	84	Grader	85
Dozer	85	Pick-up truck	55
Dump Truck	84	Tractor	84

SOURCE: USDOT, 2006 (http://www.fhwa.dot.gov/environment/noise/construction_noise/handbook/handbook09.cfm)
Notes:
[a] This is an abbreviated list for example purposes; a more complete list of construction-related equipment is available at the above-referenced source.
[b] The sound levels shown are specification limits for each piece of equipment expressed as a maximum sound level (L_{max}) in dBA "slow" at a reference distance of 50 foot from the loudest side of the equipment.
dBA = A-weighted decibels

Based on the typical noise levels emitted by construction equipment (Table 27), construction noise would be expected at each of the measure locations that would significantly exceed normal ambient levels. Therefore, incorporation of noise reduction BMPs into the construction plan and/or holding community meetings to discuss construction noise with the respective village matai (chief), neighboring residents, and business owners should be implemented. BMPs to be implemented to reduce noise levels, particularly for noise-sensitive receptors including nearby residents, are expected to include:

- Proper tuning and balancing of construction equipment, and maintenance in accordance with the manufacturer's specifications
- Use of noise barriers and/or mufflers on diesel and gasoline engines
- Restriction of construction activities to typical working days/hours
- Keeping unnecessary noise to a minimum

During active construction, it is expected that construction noise levels would be significantly higher than ambient noise levels for sensitive noise receptors. However, given the short duration and temporary nature of the construction activities, advance notice and coordination with residents, and implementation of noise-reduction measures, construction-related noise impacts would be reduced to a less-than-significant level.

Over the long-term, the FRM measures are not expected to substantially affect ambient noise levels. There would be some noise generated during O&M activities (e.g., maintenance vehicles and debris removal equipment), but these would be very short-term increases that occur on a periodic basis (e.g., once per year), such that the impact on noise levels is expected to be insignificant.

With the incorporation of appropriate noise reduction BMPs, Alternative B is not expected to result in any significant effects to sensitive noise receptors.

3.6.12.4 Alternative B1: Channel Conveyance Improvements and Flood Barriers (Leaveave and Taumata Streams)

Noise levels that would occur as a result of construction and O&M-related activities for Alternative B1 would be within the range of those described for Alternative B. With the incorporation of appropriate noise reduction BMPs, Alternative B1 is not expected to result in any significant effects to sensitive noise receptors.

3.6.12.5 Alternative C: Taumata Flood Barrier and Nonstructural Improvements

Noise levels that would occur as a result of construction and O&M activities for Alternative C would be within the range of those described for Alternative B. However, as construction would occur at only one location (Taumata Stream) it would be more localized and reduced in scale. Some level of noise would also be produced as non-structural measures are implemented (e.g., flood proofing and elevating structures), but these would be even more highly localized and at a much smaller scale than any structural solutions such that these activities are not expected to substantially affect ambient noise levels or any sensitive receptors. With the incorporation of appropriate noise reduction BMPs, Alternative C is not expected to result in any significant effects to sensitive noise receptors

3.6.12.6 Alternative D: Nonstructural Improvements

Noise levels would occur as a result of construction and O&M activities for Alternative D, but this noise would be produced through implementation of non-structural measures only (e.g., flood proofing and elevating structures), and would be even less than Alternative C. However, as for Alternative C, any noise produced would be highly localized and at a much smaller scale than any structural solutions such that these activities are not expected to substantially affect ambient noise levels or any sensitive receptors. Alternative D is not expected to result in any significant effects to sensitive noise receptors.

3.6.12.7 Mitigation

Effects related to noise were considered to be significant if implementation of an alternative plan would result in any of the following:

- Exceedance of maximum permissible levels established by local noise ordinances
- Long-term exposure of noise-sensitive receptor(s) to a substantial increase in noise levels over the ambient condition

With the incorporation of appropriate noise reduction BMPs, the potential effects to sensitive noise receptors that could result from implementation of the alternatives would result in less than significant impacts. Noise reduction BMPs would need to be incorporated into the construction plans and community meetings held with the respective village matai (chief), neighboring residents, and business owners to discuss potential construction noise. BMPs to reduce construction noise levels, particularly for noise-sensitive receptors including nearby residents, should also be implemented to include:

- All noise-producing project equipment and vehicles using internal combustion engines (including haul trucks) would be fitted with mufflers; air-inlet silencers, where appropriate; and any other appropriate shrouds, shields, or other noise-reducing features. These devices would be maintained in good operating condition to meet or exceed original factory specifications. Mobile or fixed “package” equipment (e.g., arc welders or air compressors) would be equipped with the shrouds and noise control features that are readily available for that type of equipment.

- All mobile or fixed noise-producing equipment used on the project site that is regulated for noise output by a local, territorial, or federal agency would comply with such regulation while used in the course of project activity.
- The use of noise-producing signals, including horns, whistles, alarms, and bells, would be for safety warning purposes only.
- In addition to these contractor-implemented measures, written notification to property owners and residents near the project sites and staging areas, as determined in consultation with the matai of the affected villages, should be provided. The notice would provide a construction schedule, the required noise reduction measures for the project, and the name and telephone number of the project manager who can address questions and problems that may arise during construction. Any deviation from the proposed construction schedule would require the contractor to contact the respective village matai and nearby residents surrounding the active work site within 24 hours of construction activities to notify them of the anticipated construction schedule.

3.6.13 Socioeconomics and Environmental Justice

This section presents select demographic data relevant to the assessment of environmental justice in American Samoa. Demographic and economic variables can be used to define the socioeconomic conditions within a study area, thus providing a baseline that can be used to evaluate whether a proposed project would have a large or disproportionate impact on any one social or economic class of the population. These data were obtained from various sources including past U.S. Census datasets (primarily the most recent available data based on the 2012 American Community Survey [ACS]).

Executive Order (E.O.) 12898 addresses the effect of Federal actions on the environmental and human health effects of federal actions on minority and low-income populations with the goal of achieving environmental protection for all communities environmental justice issues arise when minority or low-income groups experience disproportionately adverse health or environmental effects, including ecological, cultural, human health, economic, and social impacts (*CEQ 1997*). There are no known American Samoa-specific Territorial, local, or Tribal laws or regulations specific to environmental justice.

3.6.13.1 Affected Environment

Environmental justice impacts of the proposed project would most likely occur at a local level and are most likely to occur within the confines of a particular place and at a local level. For example, if adverse impacts from dust and noise exposure from construction, changes in property values, or effects from operations or maintenance occur disproportionately in a specific environmental justice community (or communities), then these could constitute an environmental justice impact.

Historic and current population estimates for the study area are summarized in Table 17. From 2010 to 2020, the overall population of American Samoa declined by 10.5 percent. During the same time period, the population of the Tafuna village remained very stable, rising by only 43. Tualauta County, where Tafuna village is located, was the only division of American Samoa to experience positive growth, with a total population increase of 9.4 percent. Table 28 shows the total population counts. Table 29 shows the racial and ethnic breakdown of the population in the study area, as well as that of the American Samoa to provide context. Approximately 93 percent of American Samoa's population identifies itself as Samoan or Other Pacific Islander.

Table 28: Historic and current population estimates

Area	Population		Total Change	Annualized Change over Decade
	2010	2020	2020-2010	
Tafuna	7,945	7,988	43	+0.05%
American Samoa	55,519	47,710	-5,809	-1.1%

Source: 2018 American Samoa Statistical Yearbook and 2020 US Census

Table 29: Race and ethnicity in the study area by percentage of population (2018)

Race or Ethnicity	Tafuna Study Area		American Samoa	
	Population	% of Population	Population	% of Population
Samoan	6,743	84.9%	49,333	88.9%
Tongan	228	2.9%	1,614	2.9%
Other Pacific Islander	179	2.3%	456	0.8%
Asian	356	4.5%	1,994	3.6%
White	152	1.9%	493	0.9%
All Other Single Ethnicities	31	0.4%	150	0.2%
Two or more ethnic origins	256	3.2%	1,479	2.7%
Total	7,945	100%	55,519	100%

Source: 2018 American Samoa Statistical Yearbook

Low-income populations in the study area were identified by several socioeconomic characteristics, including per capita income, median household income, and poverty status. Table 30 displays these economic characteristics for the study area based on 2018 U.S. Census Bureau data.

Table 30: Income and poverty in American Samoa

Area	Individuals in Poverty[1]	Families in Poverty	% Living in Poverty		2010 Median Household Income[1]
			Individual[1]	Family	
Tafuna	-	615	-	12.8%	-
Tualauta County	11,840	1,718	57.6%	37.0%	$25,062
Amer. Samoa	31,809	4,810	57.8%	54.4%	$23,892

3.6.13.2 Alternative A: No Action Alternative

The demographics of the study area generally reflect that of the island-wide population. Without implementation of the proposed FRM project, a large portion of the Nu'uuli Watershed would continue to be within at risk of catastrophic flooding. These conditions are not expected to significantly change over the period of analysis. Given this, no effect to socioeconomics or environmental justice is anticipated.

3.6.13.3 Alternative B: Channel Conveyance Improvements (Taumata and Leaveave Streams)

In general, it is expected that the area directly affected by the project would be those areas within the immediate vicinity of the proposed measures, with benefits extending throughout the existing floodplain and watershed. Given the effects of local flooding on the mobility on the entire population of the island (due to impacts on the transportation network), the benefits of the project are expected to extend to the entire island. Given the current extent of urbanization within the study area, the proposed project is not expected to induce population growth or otherwise affect the overall population within the watershed, nor is the project expected to displace any portion of the population/housing, reduce employment opportunities or income levels, or otherwise adversely affect socioeconomic conditions in the watershed. Rather, the project is expected to increase the level of FRM within the watershed, thereby reducing the potential for displacement of people/housing and impacts to employment/income as a result of flooding. As part of the increased level of protection, Alternative B would reduce the risk of flooding of community facilities, including schools, various churches, religious establishments, recreational facilities, and other areas that serve as community gathering areas. As such, the project is expected to have a positive influence on social connectedness.

3.6.13.4 Alternative B1: Channel Conveyance Improvements and Flood Barriers (Leaveave and Taumata Streams)

Similar to Alternative B, Alternative B1 would increase the level of FRM within the watershed, thus providing socioeconomic benefits through reduced displacement of people/housing and impacts to employment/income due to flooding. Consistent with the analysis provided for the Tentatively Selected Plan, implementation of Alternative B1 would not disproportionately affect any low-income or minority group within or near the project site and may provide long-term benefits associated with reduced flood hazards. As such, the proposed project is not expected to result in an impact to environmental justice.

3.6.13.5 Alternative C: Taumata Flood Barrier and Nonstructural Improvements

Similar to Alternative B, Alternative C would increase the level of FRM within the watershed, thus providing socioeconomic benefits through reduced displacement of people/housing and impacts to employment/income due to flooding. As such, the proposed project is not expected to result in an impact to environmental justice.

3.6.13.6 Alternative D: Nonstructural Improvements

Similar to Alternative B, Alternative D (albeit through nonstructural solutions) would increase the level of FRM within the watershed, thus providing socioeconomic benefits through reduced displacement of people/housing and impacts to employment/income due to flooding. As such, the proposed project is not expected to result in an impact to environmental justice.

3.6.13.7 Mitigation

Effects related to socioeconomics and environmental justice were considered to be significant if implementation of an alternative plan would result in any of the following:

- Inducement of substantial population growth (either directly or indirectly)
- Displacement of substantial numbers of existing people or housing
- Substantial reduction of employment opportunities or income levels in the area
- Significantly affect the social connectedness of the community

- Disproportionately affect any particular low-income or minority group
- Disproportionately endanger children in areas within or near the project site

Because the potential effects related to socioeconomics and environmental justice that could result from implementation of the alternatives are considered less than significant, no mitigation would be required.

3.6.14 Land Use, Utilities and Public Services

This section describes potential impacts to land use, utilities and public services from the proposed project. Public services and utilities that are available within the Nu'uuli Pala Watershed include police, fire, and emergency medical services and infrastructure for electricity, telecommunications, solid waste, and water and wastewater.

3.6.14.1 Affected Environment

Land uses within the affected environmental include agricultural, residential, commercial uses. On Tutuila, concentrations of community assets are within the developed and populated lowland areas like the Tafuna Plain (Figure 7). Community assets are critical infrastructure and facilities important to the character and function of a community immediately following a major flood event, including locations with dense populations and high social vulnerability (Dobson et al. 2021).

The village of Tafuna within the affected environment is the largest village in population and also has the largest concentration of businesses in American Samoa. It is also one of the few places in American Samoa that allows for the private purchase of land, which has encouraged residential and commercial development within the local area. Nu'uuli village is the fifth-largest village in land area in American Samoa and the second largest on Tutuila Island. Nu'uuli village is a shopping district that is home to South Pacific Traders, Nu'uuli Shopping Center, Aiga Supermarket and many more shops.

3.6.14.1.1 Police Services

The American Samoa Department of Public Safety (DPS), formerly known as the American Samoa Territorial Police, is made up of the police, correction, and fire divisions. The DPS has jurisdiction everywhere within the territory. There is one central police station in American Samoa and four sub-stations (one of which is in Tafuna).

3.6.14.1.2 Fire Services

The American Samoa DPS Fire Division provides fire services for the Territory. One fire substation is co-located with the police substations in the village of Tafuna.

3.6.14.1.3 Emergency Medical and Hospital Services

Emergency medical services in the Territory are provided by the Lyndon B. Johnson (LBJ) Tropical Medical Center in Pago Pago. This is the only hospital in American Samoa (see Figure 29 in subsequent section). This facility is not located within the study area.

3.6.14.1.4 Utilities

3.6.14.1.4.1 Energy

American Samoa depends almost entirely on imported fossil fuels and diesel fuel for electricity power generation. Electricity is primarily supplied by generators that consume No. 2 diesel fuel.

The American Samoa Power Authority (ASPA) owns and operates two generating plants and one electric grid on Tutuila. These plants and electric grids have the capacity to generate 40 megawatts of electricity. Much of the electricity generated in the territory is used for pumping, treating, and distributing water for the public. Approximately one-third of the power generated on American Samoa is used for residential purposes (*EIA 2015*).
The largest solar facility in American Samoa is a 1.75-megawatt array near Pago Pago International Airport located on the Tafuna Plain but not within the project area. This facility is owned and operated by ASPA and is expected to offset their diesel consumption by more than 175,000 gallons annually (EIA 2015).

3.6.14.1.4.2 Wastewater

The ASPA Wastewater Division is responsible for the O&M of the wastewater system in American Samoa. Wastewater is treated either by ASPA's community wastewater collection, treatment, and disposal system, or by individual systems owned and operated by private businesses and individuals. This system serves 3,500 households and businesses and is made up of gravity sewer mains and lift stations. ASPA operates the Fogagogo Wastewater Treatment Plant, located in west Tutuila, with the capacity to treat 2 million gallons of water per day of wastewater. This treatment plant serves the communities of Nu'uuli, Pala Lagoon, Tafunafou, Malaeimi, Faleniu, lower Pava'ia'i, Ottoville, and Fogagogo. Treated sewage from both treatment facilities are discharged into the Pago Pago Harbor through a 24-inch high-density polyethylene pipe sewer outfall. Homes not served by American Samoa Power Authority Wastewater Division typically utilize a drainfield system, cesspools, and septic tanks (GEF IW:LEARN 2010).

The U.S. Department of the Interior has plans in place to assist American Samoa in developing a Hazard Mitigation Project in order to address issues at the sewage ocean outfalls on Tutuila (DOI 2015).

3.6.14.1.4.3 Water Supply

The primary water supply system in American Samoa is located on the island of Tutuila and is provided by ASPA. There are 7,300 residential, government, and commercial metered water connections throughout the islands. The system runs along the southern coast of Tutuila from Onenoa Village, continues along the downtown Pago Pago Harbor area, and terminates in Poloa Village in northwest Tutuila. The system is able to serve north shore communities via overland transmission mains and numerous booster stations located (GEF IW:LEARN 2010).

3.6.14.1.4.4 Storm Water

American Samoa has a tropical climate with an average rainfall of approximately 200 inches in a year. Streams are often one of the primary means for storm water drainage in the territory, and during heavy rains it is common for streams to overflow. The USEPA regulates all storm water from American Samoa that is discharged into the waters of the U.S. (FEMA 2008).

3.6.14.2 Alternative A: No Action Alternative

Under the No Action Alternative, the FRM measures would not be constructed, and as a result, there would be no construction-related impacts to public services and utilities. However, large portions of the watershed (and the associated public services and utilities) within the project area would remain vulnerable to increased levels of flooding. Flood-related impacts include increased emergency response requirements by police, fire and medical teams during flood events; many of the emergency response facilities in the watershed are located within the ten percent ACE floodplain. In addition, portions of the utility infrastructure may be subject to flooding (including the groundwater wells, sewer and stormwater drainage systems, and electrical substations), which could cause widespread service disruptions. Given the current extent of development and the extensive network of utilities within the watershed, it is assumed that the distribution and scope of public utilities and services would remain relatively constant over the duration of the period of analysis.

3.6.14.3 Alternative B: Channel Conveyance Improvements (Taumata and Leaveave Streams)

Construction of the project is not expected to affect police, fire protection or emergency medical services. Planning and coordination would be conducted with these service providers relative to construction-related road closures, detours, and other potential traffic delays, as needed to maintain adequate response times and levels of service. Over the long-term, reduction of flood risk resulting from project implementation would be expected to provide some degree of benefit by decreasing the flood response burden on these service providers. In addition, some of the infrastructure for these emergency services would benefit from the increased flood protection afforded by the proposed project, thus improving flood response capabilities.

3.6.14.3.1 Electricity and Telecommunications

Construction of Alternative B would require removal/relocation of onsite utilities, where they occur within the construction limits. The specific locations of existing utility lines and detailed relocation plans would be identified as part of the design phase. There may be some temporary interruptions in service, as needed to accommodate utility removal/relocation, but the interruptions would be minimized to the extent practicable and adequate notification would be provided, such that these impacts are expected to be insignificant. The existing utilities would be replaced/relocated such that following construction, there is not expected to be any reduction in the extent or level of service provided. Planned utility relocations would be coordinated and accommodated through the final design phase, to the extent practicable. Given this, the proposed project is not expected to significantly impact public utilities.

3.6.14.3.2 Solid Waste

Construction and operation of the proposed project is not anticipated to generate a significant amount of solid waste. During construction, all waste would be stored and periodically carried out and properly disposed of in a permitted landfill. Some solid waste may be recycled; these materials would be stored and hauled separately to the appropriate recycling company. O&M would involve periodic removal of sediment and debris; other maintenance activities (e.g., pump maintenance) would generate minimal amounts of solid waste. All materials generated during O&M would be properly disposed of in an approved landfill. No hazardous solid waste is expected to be generated as a result of construction or O&M of the proposed project. Because only a small amount of solid waste is expected to be generated during construction and O&M, and appropriate BMPs would be implemented, impacts to solid waste disposal or processing are expected to be minor.

3.6.14.3.3 Water and Wastewater

Some water would be needed to support construction activities (e.g., mixing concrete, providing dust control, etc.). This water would be obtained from the municipal water supply; the required quantities are expected to be well within the current water supply. The proposed project would not involve discharge to the wastewater treatment facilities. Given this, no impacts to water or wastewater are anticipated.

3.6.14.3.4 Storm Water Drainage

The project is not expected to affect the quantity of storm water runoff, nor would it otherwise burden the stormwater drainage system. Overall, the project would reduce the extent of the stormwater drainage system that is subject to flooding. In addition, the design includes features to maintain the functionality of the storm water drainage system during flood conditions.

3.6.14.3.5 Stream Channel Maintenance

The proposed FRM structures would require ongoing maintenance, beyond the existing maintenance that is conducted for the stream channels; specific O&M activities will need to be identified. As previously described, the non-federal sponsor is responsible for fulfilling all O&M requirements for the project. A detailed O&M manual would be developed as part of the final design phase, and O&M costs would be specified as part of the Project Partnership Agreement (PPA), which must be executed before construction. Although the O&M requirements would require expenditure of non-federal sponsor resources, the development and implementation of detailed O&M practices is considered to be beneficial to the overall maintenance of the stream channel infrastructure in the watershed.

3.6.14.4 Alternative B1: Channel Conveyance Improvements and Flood Barriers (Leaveave and Taumata Streams)

Changes relative to public services and utilities that would occur with implementation of Alternative B1 are expected to be within the range of those described for Alternative B, and as such, impacts are expected to be less than significant and/or beneficial; no mitigation would be required.

3.6.14.4.1 Stream Channel and Flood Barrier Maintenance

The proposed FRM structures would require ongoing maintenance, beyond the existing maintenance that is conducted for the stream channels; specific O&M activities will need to be identified. As previously described, the non-federal sponsor is responsible for fulfilling all O&M requirements for the project. A detailed O&M manual would be developed as part of the final design phase, and O&M costs would be specified as part of the Project Partnership Agreement (PPA), which must be executed before construction. Although the O&M requirements would require expenditure of non-federal sponsor resources, the development and implementation of detailed O&M practices is considered to be beneficial to the overall maintenance of the stream channel infrastructure in the watershed.

3.6.14.5 Alternative C: Taumata Flood Barrier and Nonstructural Improvements

Changes relative to public services and utilities that would occur with implementation of Alternative C are expected to be similar, but of a much smaller scale, those described for the Alternative B, and as such, impacts are expected to be less than significant and/or beneficial; no mitigation would be required.

3.6.14.6 Alternative D: Nonstructural Improvements

No effects to land use, utilities, or public services are expected under Alternative D.

3.6.14.7 Mitigation

Effects on land use, utilities and public services were considered to be significant if implementation of an alternative plan would result in any of the following:

- Substantial interference with, or increase in the response time of police, fire or emergency medical services
- Permanently disruption or decrease in the level of service for any public utility
- Significant burden to any public service or utility, including the water, wastewater, or storm water drainage system

The potential effects to land use, public services and utilities that could result from implementation of the alternatives are considered less than significant so no mitigation is required.

3.6.15 Traffic Circulation

This section focuses on the temporary effects of the alternatives on traffic circulation during construction. American Samoa has a defined road system (Figure 29). Transportation occurs mainly by personal vehicles, but a local bus service is available and highly utilized. Due to the condition of many roads and topography, larger heavy-duty trucks and Sports Utility Vehicle (SUVs) are common on roadways.

3.6.15.1 Affected Environment

There are approximately 150 miles of highways in American Samoa (CIA 2015). On Tutuila, there are three main, numbered transportation routes designated as a “Territorial highways” by the Federal Highway Administration (AS 001, 005, and 006). American Samoa Highway 001, which travels from Poloa to Onenoa; American Samoa Highway 005, which travels from Pago Pago to Fagasa; and American Samoa Highway 006, which extends from Aua to Vatia. AS 0001) is the main east-west transportation corridor for Tutuila Island that runs for 35.8 miles from the village of Poloa at its eastern terminus, through the capital of Pago Pago at Pago Pago Harbor, to the village to Onenoa at its western terminus.

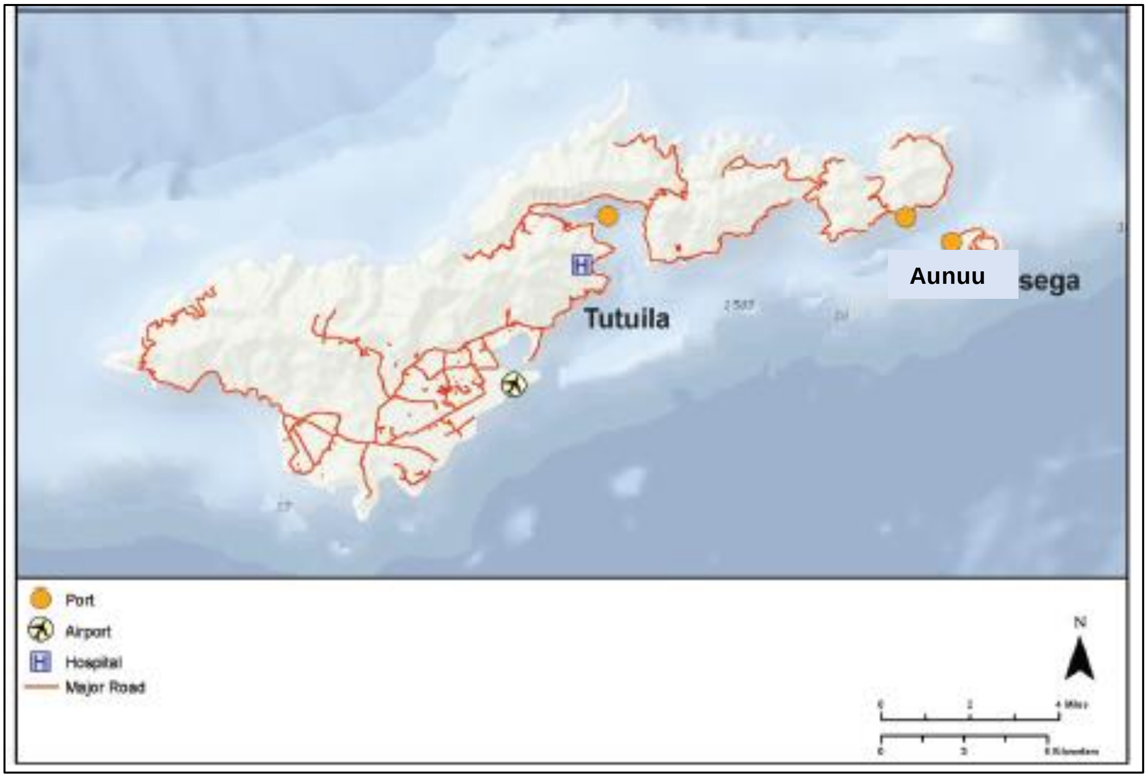

Figure 29: American Samoa transportation and hospital locations (National Atlas 2014; NGA 2015; Oak Ridge National Laboratory 2014; USDA 2010)

In addition to the three numbered routes, there are un-numbered highways. All are maintained by the American Samoa Department of Public Works (DPW). The highway system in American Samoa is managed by the American Samoa DPW. The Territory has no railways (*Taxi2Airport 2015*). The remainder of the transportation network within the Nu'uuli Pala Watershed is comprised of smaller, local roads, such as those providing access into the residential neighborhoods.

On Tutuila, work hubs draw workers from villages all over the island (Xu et al. 2018), with a small number of employer locations attracting the majority of commuters. Major commercial commuting hubs include the town of Pago Pago, Fagotogo, and Atu'u (location of the tuna cannery) at Pago Pago Harbor and Tafuna (commercial hub, airport, and many government and business offices). Tafuna is considered the largest commuting hub on Tutuila (Xu et al. 2018). Fundamental changes in land uses and employment opportunities occurred within Pago Pago Harbor, altering the role of the downtown area of the island of Tutuila. Retail trade has not grown within the harbor area, and major growth has occurred outside of the Pago Pago Harbor area, with the movement of population towards Tafuna and Western Tutuila. Because there is only one major east-west highway corridor to serve the island, traffic congestion is common, due in part to traffic loading along the highway during peak commuting hours, generally narrow roadways, multiple pedestrian crossings through villages, slow posted traffic speeds, and lack of traffic separation.

3.6.15.2 Alternative A: No Action Alternative

Under the No Action Alternative, none of the proposed FRM measures would be implemented and the anticipated reductions in potential flooding within the watershed would not be realized.

Over the period of analysis, it is anticipated that traffic levels could increase, but the transportation resources within the watershed are not expected to substantially change. Although none of the construction-related impacts to traffic and transportation resources would occur, the benefits associated with protecting important roadways during flooding would also not occur.

3.6.15.3 Alternative B: Channel Conveyance Improvements (Taumata and Leaveave Streams)

Alternative B would impact AS 001 and Faga'ima Road and would result in wide-spread (albeit temporary) traffic disruption during construction. Construction of Alternative B would require the delivery of construction equipment and materials, as well as the transportation of construction workers to each of the measure locations, which is expected to impact traffic and transportation resources. Specific impacts that are anticipated include the following:

- Increased traffic congestion and/or reduced circulation when trucks are hauling material to/from the site(s)
- Reduced roadway capacity (e.g., lane closures) when construction vehicles or equipment are required within the public right-of-way
- Temporary closure of sidewalks, walkways, crosswalks and/or bicycle lanes
- Degradation to existing pavement/condition of roadways, curbs, or intersections from large, heavy construction vehicles and equipment
- Decreased driver safety because of reduced sight-distances or increased visual hazards associated within construction vehicles
- Temporary changes in access to businesses, residences or public facilities (e.g., churches) in areas adjacent to construction zones
- Temporary reduction in availability of public, on-street parking because of construction activities.

Alternative B would entail construction along both Leaveave and Taumata streams, which would result in widespread disruption of traffic at two stream locations. Traffic disruption at the Leaveave site would likely be a major disruption to traffic and possibly resident access along minor Routes 14, 18,19, and especially along Faga'ima Road, due to material and equipment delivery to the site during construction. Traffic at the Taumata Stream site is near AS 001 can could cause delays along this major transportation corridor with increased truck traffic and ingress/egress of vehicles and construction equipment to the construction site.

These impacts could significantly increase travel times and/or affect other transportation resources. However, these impacts would be limited to construction, such that they would be temporary in nature. In addition, the contractor would be required to prepare and implement a Transportation Management Plan. Preparation and implementation of the plan would be coordinated with the relevant transportation agencies, including the American Samoa DPW. With implementation of the plan, it is anticipated that impacts to traffic and transportation resources would be reduced to a less-than-significant level. Once constructed, the FRM measures would not permanently displace any transportation facilities, including roadways, bicycle lanes, pedestrian pathways and/or parking. The project would function to substantially reduce the extent of flooding within the watershed and would effectively protect many major thoroughfares and collector roads (as well as smaller access roads) from the floodplain, including Fagaima Road and minor Routes 14, 18, and 19). By decreasing the potential for flooding within these roadways, the project would provide important benefits, including improved access within and out of the watershed during flood conditions.

During non-flood conditions, O&M of the proposed measures would require the use of trucks and other vehicles (e.g., to remove and dispose of debris, etc.). It is expected to be similar to traffic levels associated with similar types of maintenance operations for other projects. Accessibility of all sites are along existing major roadways, so long-term effects would be minimal. In addition, only a minimal number of vehicles would be required, and activities would occur on a periodic basis, such that traffic and transportation resources are not expected to be significantly affected on a long-term basis. With appropriate BMPs and minimization measures, effects to traffic and circulation expected under Alternative B would be less than significant.

3.6.15.4 Alternative B1: Channel Conveyance Improvements and Flood Barriers (Leaveave and Taumata Streams)

Alternative B1 would likely result in similar overall impacts to traffic and access as described for Alternative B. Because construction of flood barriers at both locations would entail the delivery of more material and presumably more construction trips, impacts to traffic and access could be expected to be greater than for Alternative B. Construction of Alternative B1 could also take longer to complete, lengthening the period of traffic disruption from a temporal perspective.

Impacts to traffic and transportation that would occur because of implementation of Alternative B1 would be similar in nature to those described for Alternative B, but could be even more impactful to roadways and transportation resources with the construction of a flood barrier along both streams. As described for Alternative B, construction-related impacts could include increased congestion; delays in traffic movement and circulation; reduced capacity/availability of roadways and other transportation resources (including sidewalks or walking paths); decreased access to adjacent businesses, residences, and public facilities; and displacement of parking. These impacts could significantly increase travel times and/or affect other transportation resources but would be minimized to the extent possible as described for Alternative B, such that construction-related impacts are expected to be less than significant. Similar flood reduction benefits as described for Alternative B would be realized. Significant negative effects to traffic and circulation are expected under Alternative B1 without appropriate minimization measures. With appropriate minimization measures, effects to traffic and circulation are expected under Alternative B would be less than significant.

3.6.15.5 Alternative C: Taumata Flood Barrier and Nonstructural Improvements

Alternative C would result in less overall impacts to traffic as described for Alternative B and B1 because construction of a flood barrier at only one location along Taumata Stream would occur. However, because the Taumata Stream site is near AS 001 and could cause delays as described for Alternative B and B1, significant negative effects to traffic and circulation are still expected under Alternative C without appropriate minimization measures. With appropriate minimization measures, effects to traffic and circulation expected under Alternative C would be less than significant.

3.6.15.6 Alternative D: Nonstructural Improvements

No significant negative effects to traffic and circulation are expected under Alternative D. An increased number of individual vehicle trips could be expected as individual structures are visited and flood proofing activities commence at individual sites, but significant, negative effects to traffic and circulation at this localized scale are not expected under Alternative D.

3.6.15.7 Mitigation

Effects on transportation and traffic were considered to be significant if implementation of an alternative plan would result in any of the following:

- Substantial increase in vehicle travel times due to increased congestion, delays in traffic movement and circulation, and/or reduced roadway capacity
- Substantial reduction in availability, quality and/or safety of roadways or other transportation resources (e.g., sidewalks, bicycle lanes, etc.)
- Substantial decrease in access to businesses, residences or public facilities
- Substantial displacement of parking and/or other significant changes in parking supply

With the implementation of a Traffic Control Plan, the potential effects to transportation and traffic that could result from implementation of the alternatives B, B1, and C would be reduced to less than significant. To minimize potential adverse impacts to traffic and circulation during construction, it is recommended to implement the following measures to ensure these alternatives would not result in adverse effects with respect to traffic (especially along Fagaima Road and AS Highway 001):

- Stage construction equipment, materials, and vehicles to minimize hindrances to traffic flow
- Provide advance written notice of the construction schedule to all residents and business owners who would have limited access to their homes or driveways during construction
- Review traffic patterns to determine if and when traffic restrictions would be required during construction
- Develop a Transportation Management Plan that includes identifying safe and reasonable detours, including those needed for pedestrians, and provide adequate advance notification
- Provide temporary parking in nearby locations to the extent possible
- Repair surface damage to local roads used for construction haul routes to pre-construction conditions

3.6.15.8 Recreation Affected Environment

Recreation is American Samoa includes various forms of active and passive, mainly outdoor, activities. Active recreation includes group sporting competitions (e.g., rugby, American football, wrestling), jogging, and hunting (mainly for feral pigs), while passive family-oriented activities, like picnicking at public parks, are common. Recreation tends to be pursued mostly at specific facilities and sites and to be focused on group sporting events. Structured recreational programs (mainly sports) in American Samoa are geared and managed mainly for school students and youth through the involvement of the public school system under the Department of Education.

Marine and beach-based based water activities that involve boating and fishing, whether traditional subsistence fishing in the historical past of today's more modern boat-based fishing, have always been an important component of Pacific island economies (Doulman and Kearney 1991), with American Samoa no exception. Recreational fishing, including recreational fishing tournaments for pelagic fishes, is very popular in the Territory (Craig et al 1993).

The American Samoa Government Parks and Recreation Department oversees the maintenance of all public parks, including the Lions Park situated along the Nu'uuli Pala Lagoon in the village of Tafuna. Recreational outlets and activities geared exclusively to tourists, although available, are not common in American Samoa.

Although not a recreational activity per se, church attendance in American Samoa is high and most villages contain at least one church (see https://culturalatlas.sbs.com.au/samoan-culture/samoan-culture-religion). This reflects the central role of Christianity in the lives and communities of most Samoans. Christianity of various denominations (the Congregational Christian Church of American Samoa ministers to half of the population) continues to be devoutly followed and daily life and the working week is structured around the Christian worship calendar. It is often expected that everyone will attend church on Sundays and will adhere to its expectations. The church is a major point of social cohesion in Samoan society and many recreational/social events and activities are planned through or by local churches

3.6.15.9 Alternative A: No Action Alternative

Over the period of analysis, the type and extent of recreational opportunities are expected to be consistent with the existing condition. Under the No Action Alternative, recreational facilities and activities within the watershed would not be affected by construction of flood-risk management measures, including the golf course, Veteran's Memorial stadium. However, in the absence of these FRM measures, significant portions of the watershed would remain within the 10 percent ACE floodplain and some sites be subject to flood conditions. Under this alternative, no impact to the recreational uses is expected to occur and would not result in any effects to recreation.

3.6.15.10 Alternative B: Channel Conveyance Improvements (Taumata and Leaveave Streams)

This alternative is not expected to interfere measurably with public recreational uses. Under this alternative, the public could have limited access to some areas until construction is complete. For example, walking and jogging along portions of Fagaima Road could be restricted during construction. Access to some churches (e.g., EFKAS/CCCAS Ierusalema Fou Church located off Fagaima Road) could experience some access issues during active construction. Shoreline accessibility at Lions Park along the Nu'uuli Pala Lagoon in the village of Tafuna would not be restricted from construction traffic and staging activities. Overall, recreation is not expected to be significantly affected from this alternative.

Some of the FRM measures could be located adjacent to churches or church facilities (e.g., parking lots, banquet halls for church social events), and result in a temporary restriction of access and/or use within the construction area for the duration of construction, thus temporarily limiting the range and/or accessibility of facility use. On occasion, these same facilities would not be available for recreational purposes during or immediately following a flood, during which time post-flood maintenance would be conducted to remove accumulated debris/sediment. However, construction-related impacts would be temporary and adequate notice would be provided to inform users of the construction and alternative locations for proposed activities would be provided. As such, Alternative B would not result in any significant effects to recreation.

3.6.15.11 Alternative B1: Channel Conveyance Improvements and Flood Barriers (Leaveave and Taumata Streams)

Impacts to recreational use and access from this alternative are expected to be similar to those described for Alternative B and less than significant. Alternative B1 would not result in any significant effects to recreation.

3.6.15.12 Alternative C: Taumata Flood Barrier and Nonstructural Improvements

Impacts to recreational use and access from this alternative are expected to be similar to those described for Alternative B1. However, given the one location along Taumata Stream and reduced scale of construction, potential impacts would be less than for Alternatives B and B1.

Alternative C would not result in any significant effects to recreation.

3.6.15.13 Alternative D: Nonstructural Improvements

Under Alternative D, no impact to the recreational uses or access is expected to occur unless a church facility is slated to be the subject of a non-structural measure (i.e., dry flood proofing). If this is the case, then access to the structure may be temporarily restricted as flood-proofing commences. As above, construction-related impacts would be temporary and adequate notice would be provided to inform users of the construction and alternative locations for proposed activities would be provided. As such, Alternative D would not result in any significant effects to recreation.

3.6.15.14 Mitigation

Effects on recreation were considered significant if implementation of an alternative plan would result in any of the following:

- Substantial disruption of activities that occur at an institutionally recognized recreational facility
- Substantial reduction in availability of and access to designated recreational or open space areas

Because there were no potential effects to recreation and open space identified that could result from implementation of any of the alternatives, no mitigation is required.

3.6.16 Aesthetics and Visual Resources

Aesthetics refer to the natural and constructed features a particular environment that provide its visual appeal. In undeveloped areas, landforms, water bodies, and vegetation are the primary aesthetic elements that characterize the landscape. These components are characterized in terms of form, color, texture, and scale. They also may be described in terms of the extent to which they are visible to surrounding viewers (i.e., whether they are considered foreground or background). In developed areas, the natural landscape often provides a background for constructed features, which are often characterized in terms of the size, form, materials, and function of buildings, structures, roadways, and associated infrastructure. The combination of these characteristics defines the overall landscape, thus determining the visual quality of an area. Attributes used to describe visual quality include significant views or vistas, landscape character, perceived aesthetic value, and uniqueness. Visual quality is also described in terms of sensitive receptors, which include areas with high scenic quality (such as designated scenic corridors or locations), areas where concentrations of people may be present (such as residential or recreation areas), and important historic or archaeological locations.

3.6.16.1 Affected Environment

In general, the visual landscape within the Nu'uuli Pala Watershed is characterized by sweeping views of the mountains, Pacific Ocean, and the broad distribution of developed features on the Tafuna Plain. The airport and its runways are a prominent anthropogenic feature of the landscape. Tuasivitasi Ridge and Matafao Peak (highest point on Tutuila) effectively serve as a visual backdrop for the watershed (Figure 30), with prominent views of its steep ridges and slopes from locations throughout the watershed and nearshore waters. In addition to the mountains, other natural features that contribute to the overall visual character of the Nu'uuli Watershed include Pala Lagoon (Figure 30) and the broader Pacific Ocean. Although the ocean is the most prominent feature of views from the shoreline, it is less visible than the mountains from central portions of the watershed, as the low-lying views are more readily obscured by urban development.

Figure 30: Viewshed within the Nu'uuli watershed on Tutuila, Pala Lagoon in foreground (C. Solek)

Urban development (including residential buildings, commercial structures, and roadways) covers much of the Tafuna plain, but are of natural vegetation and agriculture remain and the adjacent valleys are relatively undeveloped. Although commercial structures often block views of the ocean, they are a significant component of the visual landscape of this region. From within the urban corridor, views of the mountains and ocean are often most prominent along established corridors that are perpendicular from the mountain to the ocean, particularly those along major roadways.

The visual landscape of the study area along Leaveave and Taumata streams are proximate to adjacent residential properties and roads intermixed with secondary forest vegetation and fallow agriculture plots that are reverting back to forest scrub.

3.6.16.2 Alternative A: No Action Alternative

Under the No Action Alternative, the FRM measures would not be constructed and therefore would not affect visual resources. Over the period of analysis, the natural features within the watershed (including Tuasivitasi Ridge and Matafao Peak) are not expected to significantly change in form, color, texture, or scale. As such, the visual characteristics of these features are expected to remain consistent over time. As previously noted, the urbanized portions of the watershed may be subject to redevelopment, which could affect the overall visual landscape. However, it is assumed that the existing development guidelines and standards would continue to be implemented and maintain significant views and other important visual qualities. As such, Alternative A would not result in any significant effects to aesthetics and no mitigation would be required.

3.6.16.3 Alternative B: Channel Conveyance Improvements (Taumata and Leaveave Streams)

Once constructed, Alternative B would introduce built elements to the natural environment that could alter the visual landscape to some degree. The in-stream channel conveyance improvements are expected to be more low-profile features and are not expected to substantially affect visual resources. Construction of Alternative B would involve the use of large construction equipment, exposed soils, and staged materials, which could temporarily reduce the overall aesthetic quality at each of the proposed project locations. However, these activities would be temporary; in addition, the construction sites would be kept free of litter and excess equipment and materials, and generally maintained in a clean and organized condition, such that impacts are expected to be less than significant.

In the case of both the Leaveave and Taumata Streams, these streams are not readily accessible by the public and the vegetation surrounding each site can be expected to screen views from adjacent areas. As such, Alternative B would not result in any significant effects to aesthetics and no mitigation would be required.

3.6.16.4 Alternative B1: Channel Conveyance Improvements and Flood Barriers (Leaveave and Taumata Streams)

Construction of Alternative B1 would be as for Alternative B but include flood barriers. Once constructed, the flood barriers would alter the visual landscape. However, neither of the constructed the flood walls are expected to substantially obstruct broad landscape views (including those of Tuasivitasi Ridge) but could diminish localized views for residents. Recognizing the effect that the flood barriers could have on the visual landscape; project siting and design would be conducted in a manner so as to best integrate each flood barrier with the natural characteristics of the site and minimize visual impacts to the extent possible. In particular, the use of any natural topography to minimize the overall size and obtrusiveness of the proposed structures will be investigated. Efforts throughout the planning process would also look for opportunities to minimize the impacts to the extent possible, particularly as related to the overall floodwall heights. Further refinements would be made during the pre-engineering design phases and would further evaluate opportunities to reduce the dimensions of the floodwalls, as well as incorporate design details that may otherwise minimize potential visual impacts, such as use of construction materials and/or landscaping to blend the structures into the surrounding environment. Implementation of these minimization measures is expected to reduce potential visual impacts to a less-than-significant level. As such, Alternative B1 would result in less than significant effects to aesthetics and no mitigation would be required.

3.6.16.5 Alternative C: Taumata Flood Barrier and Nonstructural Improvements

Alternative C includes construction of a 2,400 lf of flood barrier with an average height of seven ft (from ground elevation) on the Taumata Stream only. However, as described for Alternative B1, project siting and design would be conducted in a manner so as to best integrate this flood barrier with the natural characteristics of the site and minimize visual impacts to the extent possible to reduce potential visual impacts to a less-than-significant level. As such, Alternative C would result in less than significant effects to aesthetics and no mitigation would be required.

3.6.16.6 Alternative D: Nonstructural Improvements

No significant negative effects to aesthetics are expected under Alternative D. Nonstructural measures of dry flood proofing and elevating structures would be done in such a way as to preserve the aesthetic qualities of any structures targeted for these measures. As such, Alternative D would result in less than significant effects to aesthetics and no mitigation would be required.

3.6.16.7 Mitigation

Effects on aesthetics and visual resources were considered significant if implementation of an alternative plan would result in any of the following:

- Development that substantially conflicts with the surrounding landscape (i.e., a form, line, color, or texture that contrasts with the visual setting)
- Obstruction of established viewshed, significant view corridor, or other public views of important environmental resources and/or landscapes
- Substantial reduction of the views or aesthetic values associated with a historic property, scenic byway, or other important landmark

No mitigation would be required as the potential effects to visual resources that could result from implementation of the alternatives could be reduced to a less than significant level using the techniques described above to minimize effects to aesthetics.

3.7 Mitigation, Monitoring, and Adaptive Management

Table 31 contains the mitigation requirements for the TSP by resource type. Criteria were identified for each resource to assist with evaluation of the potential for significant adverse effects; the criteria are based on the definitions of significance and the specific considerations identified for NEPA as well as other standards of professional practice. Based on the significance criteria, the analysis presented for each resource concludes the following mitigation requirements as shown in Table 31 to avoid and minimize environmental effects for the TSP. No compensatory mitigation is required for the proposed TSP as appropriate avoidance and minimization measures can reduce the environmental consequences to less than significant levels.

Table 31: Summary of environmental consequences and proposed mitigation measures for the TSP

Impact	Tentatively Selected Plan
Hydrology, Hydraulics, Geomorphology	
Reduced extent of potential flooding	Implementation of Tentatively Selected Plan would substantially reduce the ten percent ACE floodplain, with decreased water surface elevations. **Beneficial.**
Erosion resulting from construction-related ground disturbance	Approximately 2.3 acres of ground disturbance; BMPs would be implemented as part of Stormwater Pollution Prevention Plan (SWPPP). **Less than significant; no mitigation required.**
Erosion resulting from O&M activities	BMPs would be implemented as part of SWPPP. **Less than significant; no mitigation required.**
Reduced functionality and/or unintended hydraulic consequences due to landslide, subsidence, liquefaction or collapse	No impact
Terrestrial Habitats and Species	
Disturbance and decreased habitat availability for native (non-listed) terrestrial wildlife species	Affected habitat mostly non-native, disturbed, and used by non-native terrestrial wildlife; Non-listed native terrestrial species are generally common and widespread; affected habitat represents very small part of range available to species. **Less than significant; no mitigation required.**
Direct impacts (e.g., injury, death) to native terrestrial species as a result of construction and O&M activities	Affected habitat mostly non-native and used by non-native terrestrial wildlife; biological monitor to be present during construction; environmental awareness training of construction crews to avoid and minimize direct impacts; **Less than significant with mitigation.**
Ongoing vegetation management, including trimming and clearing, as part of O&M	Approximately 2.3 acres subject to vegetation management; predominantly non-native and/or landscaped species. **Less than significant; no mitigation required.**
Introduction of new invasive terrestrial plant species	Implementation of BMPs, including washing/inspection of construction equipment, certification/inspection of any revegetation materials, and monitoring of revegetated areas through O&M. **Less than significant with mitigation.**
Potential impacts to endangered *Eua zebrina* landsnail from construction activities (e.g., use of heavy equipment, vegetation removal	Habitat to be impacted does not support species; **Less than significant; no mitigation required.**
Potential impacts to endangered *Ostodes strigatus* landsnail from construction activities (e.g., use of heavy equipment, vegetation removal	Species may be extinct; Habitat to be impacted does not support species; **Less than significant; no mitigation required.**
Aquatic Habitats and Species	
Impacts to in-stream aquatic habitat	Approximately 2,400 lf flood barrier within the permanent construction footprint; avoidance, minimization measures, and BMPs to prevent impacts; **Less than significant with mitigation.**
Disturbance and decreased habitat availability for native (non-listed) aquatic wildlife species	Habitat to be impacted (riparian) mostly non-native and disturbed; Non-listed native aquatic species are generally common and widespread; affected habitat represents very small part of

Impact	Tentatively Selected Plan
	range available to species. **Less than significant; no mitigation required.**
Introduction of new invasive aquatic plant species	Implementation of BMPs, including washing/inspection of construction equipment, certification/inspection of revegetation materials, and monitoring of revegetated areas. **Less than significant with mitigation.**
Direct impacts (e.g., injury, death) to native aquatic species as a result of construction and O&M activities	In-stream work would be limited to low-flow conditions; biological monitor to be present during construction; environmental awareness training of construction crews to avoid and minimize direct impacts; **Less than significant with mitigation.**
Potential impacts to endangered hawksbill and green sea turtle from construction activities (e.g., use of heavy equipment, vegetation removal	No directs impacts, but BMPs would be implemented at construction site as part of SWPPP to mitigate any indirect downstream effects on Pala Lagoon; **Less than significant with mitigation.**
Cultural, Historic, and Archaeological Resources	
Construction and operations related impacts to archaeological and historic resources within the APE	Treatment recommendations to mitigate potential impacts include avoidance, historic documentation, data recovery, and community assistance. A draft Programmatic Agreement has been developed to establish a process for further resource identification and effects determinations and resolving adverse effects. **Less than significant with mitigation.**
Inadvertent discovery of human remains or other cultural materials	Construction contractor would immediately cease all work in the area, and appropriate agencies would be notified according to applicable laws, including NHPA and HRS Section 6E. **Less than significant with mitigation.**
Temporary impacts to cultural practices associated with access limitations within measure locations during construction	Measure locations are dominated by non-native species, and there would still be abundant opportunities to gather resources along streams in the upper watershed. Following construction, none of the measures are expected to limit access to cultural resources or practices. **Less than significant; no mitigation required.**
Water Resources and Quality	
Placement of dredged or fill material within Waters of the U.S. (including areas considered to be riffle and pool complexes)	Floodwall would be sited so as to minimize impacts Waters of the U.S., but construction would involve placement of up to approximately 2.3 acres of fill in waters of the U.S.; avoidance, minimization measures, and BMPs would be implemented during construction; **Less than significant with mitigation.**
Increased sediment and associated pollutants in stormwater runoff during construction	BMPs would be implemented as part of SWPPP; excessive levels of sediment-bound pollutants not anticipated. **Less than significant; no mitigation required.**
Accidental release of hazardous materials during construction	BMPs would be implemented as part of SWPPP. **Less than significant; no mitigation required.**
Increased channel/bank erosion due to disturbance during construction of floodwall	Floodwall sited and designed to minimize the need for excavation and grading; BMPs would be

Impact	Tentatively Selected Plan
	implemented as part of SWPPP. **Less than significant; no mitigation required.**
Air Quality	
Construction-related impacts to air quality due to fugitive dust and internal combustion engine emissions	BMPs would be implemented to avoid and minimize potential impacts. **Less than significant; no mitigation required.**
Air emissions from vehicles used for O&M	Emission levels would be very low and would be expected to have negligible impact. **Less than significant; no mitigation required.**
Public Health and Environmental Hazards	
Accidental release of hazardous materials (e.g., gasoline, diesel fuel) during construction or O&M	BMPs would be implemented as part of SWPPP. **Less than significant; no mitigation required.**
Decreased number of residents and visitors subject to flood-related health and safety risks	Increased protection for the watershed's residents most impacted by flooding; **beneficial.**
Removal of critical infrastructure and other public facilities including schools from the ten percent ACE floodplain, thus increasing resiliency in response to flood events	Critical infrastructure would be removed from the ten percent ACE floodplain; **beneficial.**
Heightened awareness of flood-related risks, which is expected to translate to increased levels of preparedness	Increased understanding of potential for flooding through awareness of the project; **beneficial.**
Noise and Vibration	
Temporary construction-related noise that exceeds the Territory's maximum permissible noise levels	BMPs would be implemented. **Less than significant with mitigation.**
Temporary increase in noise levels as sociated with O&M activities	Noise levels during O&M would be short-term and would only occur on a periodic basis. **Less than significant; no mitigation required.**
Socioeconomics and Environmental Justice	
Reduced potential for displaced people/housing, impacts to employment/income, and improved social connectedness in response to floods	**Beneficial**
Land Use, Utilities and Public Services	
Decreased flood response burden on police, fire and medical emergency services	**Beneficial**
Temporary construction-related disruption of existing land uses	Construction phasing, easements, and restoration of temporarily disturbed areas to pre-project conditions. **Less than significant with mitigation.**
Temporary interruption in utility services during construction	**Less than significant; no mitigation required**
Temporary interruption in public services during construction	**Less than significant; no mitigation required**
Development and implementation of detailed O&M plan	**Beneficial**
Traffic and Circulation	
Reduced potential for flooding within important thoroughfares and collector roads (as well as smaller access roads)	Reduced potential for flooding would provide improved access within and out of the watershed during flood conditions, including routes used for evacuation and flood response activities. **Beneficial.**
Construction-related impacts to traffic and transportation resources (e.g., increased	Preparation and implementation of Transportation

Impact	Tentatively Selected Plan
congestion; reduced capacity; reduced access and parking, etc.)	Management Plan. **Less than significant with mitigation.**
Recreation	
Temporary loss of access and use of recreational facilities during construction	Provide adequate notification to inform users of construction and alternative recreation locations/access. **Less than significant with mitigation.**
Displacement of recreational area by permanent footprint of Taumata floodwall	Measures designed to have the smallest footprint possible, and to minimize impacts to recreational activities during non-flood conditions. **Less than significant; no mitigation required.**
Limited access and/or use of recreational facilities during and immediately following flood conditions (to allow for post-flood clean-up and recovery)	O&M activities would be programmed as part of the standard flood responses activities to minimize post-flood maintenance response time. **Less than significant; no mitigation required.**
Aesthetics	
Construction of floodwalls that diminish views toward Tuasivitasi Ridge	Design refinements will consider opportunities to reduce the structure dimensions and incorporate design details to reduce visual impacts (e.g., use of construction materials and/or landscaping to blend structures into surrounding environment); this effort will incorporate design input solicited as part of the NHPA Section 106 consultation process. **Less than significant with mitigation.**
Temporary visual impacts associated with construction (e.g., equipment, stagged materials, etc.)	Construction area to be kept free of litter and excess equipment/materials and maintained in a clean and organized condition. **Less than significant; no mitigation required.**

For archaeological and cultural resources, the USACE developed a draft Programmatic Agreement (PA) that includes proposed mitigation measures for all historic properties that may be adversely affected by undertaking activities. Treatment strategies include design-based avoidance, design-based minimization, and data recovery. For locations or actions that the USACE and the American Samoa State Historic Preservation Office (ASSHPO) agree may be inappropriate for archaeological data recovery, but for which there are still impact concerns, archaeological monitoring shall be considered as a mitigation option. If implemented, archaeological monitoring would be included in the construction specifications and drawings demarcating where archaeological monitors (hired under contract) are to be used. Adaptive Management is a systematic approach for improving resource management by learning from post-project monitoring outcomes (40 CFR 1508.1(s)). Adaptive Management focuses on learning and adapting in order to create and maintain sustainable resource systems. The purpose of the proposed Adaptive Management Program is to the provide flexibility over the 50-year life of the project to modify/adjust future renourishment events in terms of timing, location, volume, construction methods and other elements of the project if post-construction monitoring data indicates that project-related impacts are substantially different (e.g., greater or lesser) that those predicted by the *Integrated Feasibility Report*.

The key steps in the Adaptive Management process are the following: 1) Design; 2) Implement; 3) Monitor; 4) Evaluate; 5) Assess; and 6) Adjust. For the TSP , potential scenarios that could trigger an Adaptive Management action include no impacts, impacts are larger than expected, impacts are smaller than expected, higher erosion in the project area, slower erosion in the project area, climate change and sea level rise beyond maximum predicted levels. Should the need for an Adaptive Management action be determined based on subsequent information, it would be implemented accordingly so that any adjustment could be made.

3.8 Identification of the National Economic Development Plan

Alternative C: Taumata Flood Barrier and Nonstructural Improvements, is the NED Plan that maximizes net NED benefits.

3.9 Tentatively Selected Plan

Alternative C: Taumata Flood Barrier and Nonstructural Improvements is both the NED plan and the TSP. While maximizing net benefits (affirming federal interest), it also provides relatively higher amounts FRM benefits compared to the other alternatives, has anticipated positive impacts on water quality (e.g., avoids impacts to mangrove habitat), has a manageable amount of real estate requirements, and is supported by the American Samoa government.

4 The Tentatively Selected Plan

4.1 Plan Components

The TSP (Alternative C) includes two components: 1) the construction of approximately 2,400 lf of flood barrier with an average height of seven ft (from ground), along Taumata Stream, and 2) the nonstructural component of this alternative will include dry flood proofing 38 nonresidential buildings and elevating 242 residential structures (assumes 100 percent participation rate) as these structures will not receive FRM benefits from the Taumata Stream flood barrier (Figure 31).

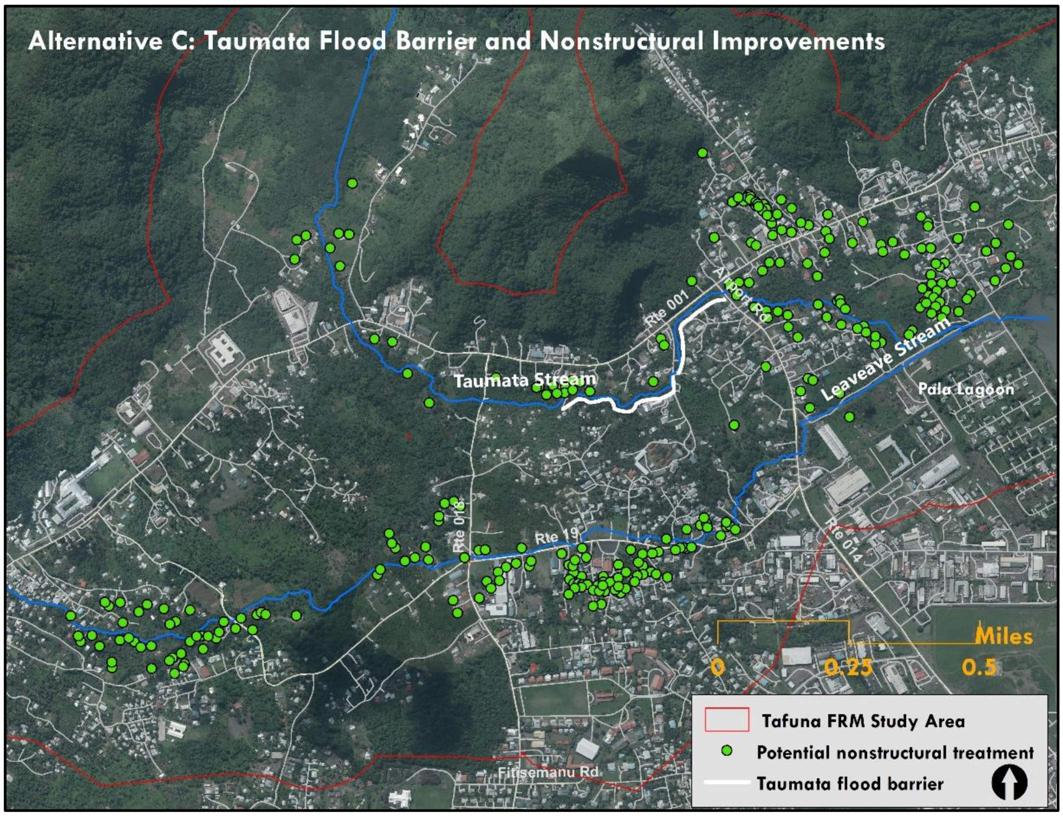

Figure 31: Alternative C components

4.2 Plan Accomplishments

The construction of Taumata flood barrier will provide FRM benefits for roughly 45 structures. Alternative C, the TSP, will also provide FRM benefits to roughly 310 structures (assuming 100 percent participation). Alternative C is expected to reduce the duration and depth of flooding within the study area, thereby reducing negative impacts on health and safety, as well as the environment.

Alternative C is expected to reduce flooding on the roads, with the construction of Taumata flood barrier, improving physical safety. In addition, the construction of flood barrier along the edge of the Taumata Stream, allows the stream to flow naturally without disrupting the ecosystem and habitat within the stream. Alternative C is also expected to positively impact cultural identity because the flood barrier is expected to reduce flooding to grave sites which have cultural value to residents. Moreover, the reduced flooding to roads and areas like malae (community gathering areas) would reduce disruption to cultural events and, therefore, support cultural identity. Finally, the Taumata flood barrier will limit the amount of overbank flows through the community, limiting the amount of debris and rubbish collected before it finally discharges into Pala Lagoon. At the FY 2022 discount rate of 2.5 percent, the total project first cost of the TSP is approximately $138 million with a benefit-to-cost ratio of 1.6. The TSP reduces damages by approximately 81% with fewer residual damages compared to other structural alternatives and has higher NED benefits compared to other structural alternatives.

4.3 Cost Estimate

The total project first cost (Constant Dollar Cost at FY2022 price levels) of the TSP (Alternative C) is $136,628,000. In accordance with the cost share provisions of Section 104 of the Water Resources Development Act (WRDA) of 1986, as amended (33 U.S.C. 2213), the federal share (65 percent) of the project first cost is estimated to be $88.8 million and the non-federal share (35 percent) is estimated to be $47.8 million, including $1.8 million in LERRDs.

Table 32 and Table 33 provide the cost breakdown for total project first cost, equivalent annual benefits and costs, and cost-share information. Detailed information on Project costs can be found in Appendix F Cost Engineering.

Table 32: Total project cost summary

Construction Item Cost	Project First Cost (FY22 Price Level; $1000s)
Construction	$134,916
LERRDs	$1,758
Relocations	36
Cultural Mitigation	$429
Preconstruction Engineering & Design	$853
Construction Management	$394
Total First Cost ($1000s)	$138,386

Table 33: Equivalent annual benefits and costs

Investment Costs	**(FY22 Price Level; $1000s)**
Total Project Construction Costs	$138,386
Interest During Construction	$1,551
Total Investment Cost	$139,937
Interest and Amortization of Initial Investment	$4,690
OMRR&R	$46,000
Total Average Annual Costs	$4,736,000
Average Annual Benefits	$7,461,020
Net Annual Benefits	$2,724,000
Benefit to Cost Ratio	1.6

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

The TSP involves land owned by the Government of American Samoa as well as private persons and entities. The minimum estates required are 2.3 acres of flood protection levee easements for flood barriers and 1.8 acres of temporary work area easements for staging, access, and construction. Staging, access, and construction are planned for two years. Additionally, non-structural measures of flood proofing are planned for up to 38 structures, and elevating is planned for up to 242 residences. Flood proofing and elevating structures would be offered to property owners on a voluntary basis. Along with a right of entry agreement, a flood proofing agreement would be executed between the property owner and the American Samoa government (non-federal sponsor).

The estimated real estate cost associated with the TSP is approximately $1,758,100, including all recommended LERRDs, administrative costs to be carried out by the American Samoa government, and government costs for LERRDs monitoring and certification. The estimated real estate cost estimate includes planned temporary relocations for floodproofing structures and elevating residences in accordance with Public Law 91-646. A limited exception exists to voluntary relocation payments when an eligible tenant is displaced to accomplish the voluntary elevation measure benefiting a property owner. The estimated real estate cost represents approximately 1 percent of total project costs. For projects in which the value of LERRDs is not expected to exceed 15 percent of total project costs, a real estate cost estimate performed by a licensed USACE appraiser is appropriate.

Of the total LERRDs cost estimate, structural measures account for 6 percent while non-structural measures, temporary relocations, and administrative costs account for 94 percent. The structural risk contingency is estimated at 30 percent. Since structural measures account for a small portion of overall LERRDs cost and nonstructural measures assume 100 percent participation, risk is appropriately captured in the LERRDs cost estimate.

The American Samoa government will be assessed on its capability to acquire and provide the LERRDs necessary for the proposed project.

4.5 Operations, Maintenance, Repair, Replacement and Rehabilitation

Once construction of the project is complete, the project would be turned over to the non-Federal sponsors. Operations, maintenance, repair, replacement, and rehabilitation (OMRR&R) would be the responsibility of the non-Federal sponsors for FRM features and would be accomplished in accordance with the OMRR&R manual.

Periodic maintenance of the new FRM flood wall would be required to maintain the flood wall to design elevation. Erosion and excessive vegetative growth on levee side slopes could require maintenance. Maintenance requirements will be discussed in detail in the OMRR&R manual. In general, the project would be inspected and maintained periodically, as well as during and after floods by the non-federal sponsor. The USACE would also inspect the project features and recommend corrective action to ensure that the project functions as designed.

Vegetated areas on transition zones, established either through natural processes after pond breaching or through restoration plantings as an adaptive management activity, are expected to be self-sufficient, requiring little to no maintenance. A minimal amount of routine maintenance of such items as gates, locks, signs, fencing, and other items that protect the restoration areas would be required. In addition, periodic checklist type inspections on an annual or biannual basis would be required to monitor the site for severe adverse effects. Additional activities covered by OMRR&R could include graffiti removal, levee inspection and repairs, trash and debris removal, and sign installations or repairs.

After the completion of the design of the project features and prior to construction, a draft OMRR&R manual would be prepared in coordination with the non-federal sponsor and affected agencies. A final OMRR&R manual would be prepared after the completion of construction.

4.6 Risk and Uncertainty

The TSP, Alternative C, reduces damages by approximately 81 percent compared to the without-project conditions; equivalent annual damages that remain with the construction of Alternative C are approximately $ 1.7 million. Alternative C will reduce the duration and depth of flooding in areas that benefit from the Taumata flood barrier (e.g., along Airport Rd. and nonresidential and residential structures south of Rte. 1). Flooding will continue to be an issue along Leaveave Rd/Rte. 19, which is a main road and key transportation corridor in the study area. In addition, the following high-risk items were identified during the plan formulation process:

Hydrologic and Hydraulic modeling likely underestimates channel capacities due to uncertainty in cross-section geometry. Due to the COVID pandemic, it was not possible to complete additional ground surveys. Cross section spacing were minimized to the extent practical based on engineering judgement to ensure most accurate topography was reflected.

The inability to access the study area (i.e. travel to American Samoa and complete a detailed site visit) means higher risks with data critical to plan selection (e.g. channel capacities, first floor elevations of structures, conduct necessary outreach and coordination with affected landowners, village chiefs, and stakeholders). The study team will reduce the associated risk by conducting a site visit in early 2022. Future COVID-19 related travel restrictions could prevent the study team from completing the site visit, and this scenario would likely delay the final report.

Historical land ownership records and uniform zoning maps are not available for American Samoa. As an unincorporated territory of the United States, American Samoa supports a mixture of communal, freehold, and individual land ownership. Under the communal land system rights to land use come with membership in the descent group. Second, no real property tax is levied in American Samoa; therefore, no assessed value information is available. For purposes of plan evaluation, land value data was obtained through commercial brokerage firms, including Samoa Properties Realtors and Samoa Realty, Ltd.

4.7 Cost Sharing

Table 34: Estimated project first cost and cost share (FY22 price level)

Item	Federal Cost	Non-Federal Cost	Project First Cost
Construction	$87,695,272	$47,220,531	$134,915,803
Preconstruction Engineering and Design	$554,631	$298,648	$853,279
Construction Management	$255,984	$137,837	$393,821

LERRDs (non-cash contribution)	$0	$1,758,100	$1,758,100
Relocations	$23,238	$12,512	$35,750
Cultural Mitigation	$278,850	$150,150	$429,000
TOTAL	**$88,807,975**	**$49,577,5778**	**$138,385,753**
Cost Share Percentage	**65%**	**35%**	**100%**

4.8 Design and Construction

Expected estimated quantities are shown in Table 35 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 35. Estimated quantities of the TSP

Measures:	Quantity	Unit
Flood Barrier, 7 feet high (average) - Taumata	2,400	lf
Channel Improvements, conveyance • Total Channel Excavation: 12,578 CY • Riprap: 35,000 CY	19,460	lf

Required equipment to construct the TSP could include, but is not limited to, the use of a dozer(s), a pile driver and end loader. Storage of material and equipment will be required and a staging area for the alternative has been identified. The staging area is proposed on an existing site owned by the DPW, which is about 0.5 mile south of Route 1 and just east of Route 14. The staging area is less than one mile from the proposed project site area. The staging area is generally flat and will be restored upon construction completion. Any material stored in the staging area should be covered to reduce loss of material due to erosion and avoid impacts to the adjacent environment.

After site preparation and vegetation removal activities, it is anticipated that the construction of the flood barrier would occur. Once site conditions can be assessed, the project team will determine whether a levee, floodwall or combination should be proposed. Currently within the TSP footprint, there is limited information available for potential utility impacts. Based on Google Earth we know that the flood barrier alignment is near the Route 1 corridor in a generally residential area; therefore, some utility impacts can be anticipated. The documentation of utility impacts will be refined after the 2022 site visit. If relocation of any utilities is required, it will be determined post TSP in coordination with the non-federal sponsor. Finally, construction (structural and nonstructural) is anticipated to require approximately 48 months.

4.9 Environmental Commitments

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 minimized and/or reduced 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.

4.9.1 Hydrology, Hydraulics, and Geomorphology

- **EC-H-1** The contractor shall design the flood barrier in compliance with ER 1110-2-1806 (Earthquake Design and Evaluation for Civil Works Projects)

4.9.2 Biological Resources (Aquatic, Terrestrial, and T&E Species)

EC-H-2 The contractor shall construct the flood barrier with materials that would maintain strength and stability during seismic activities.

- **EC-BR-1** Upon development of final construction plans and prior to site disturbance, the Corps shall clearly delineate the limits of construction on project plans. All construction, site disturbance, and vegetation removal shall be located within the delineated construction boundaries. The storage of equipment and materials, and temporary stockpiling of soil shall be located within designated areas only, and outside of natural habitat areas/channel. The limits of construction shall be delineated in the field with temporary construction fencing, staking, or flagging.
- **EC-BR-2** A Corps approved environmental monitor will monitor construction activities to ensure compliance with environmental commitments.
- **EC-BR-3** Construction activities shall be monitored by a Corps approved environmental monitor to assure that vegetation is removed only in the designated areas. Riparian and instream areas not to be disturbed shall be flagged *(staked, or otherwise demarcated)*.
- **EC-BR-4** Prior to construction activities and throughout the construction period, a Corps approved environmental monitor shall continue to inspect the construction site and adjacent areas to determine if any birds are nesting within 200 feet of the construction site. If active nests are found, the Corps biologist will coordinate with Department of Marine and Wildlife Resources (DMWR) to determine appropriate avoidance or minimization measures.
- **EC-BR-5** Prior to any ground-disturbing activities (e.g., mechanized clearing or rough grading) for all project related construction activities, a Corps approved environmental monitor shall conduct a pre-construction surveys of the project site for the presence any terrestrial or aquatic special-status or sensitive species. During these surveys the biologist will:

    - Inspect the project area for any sensitive species
    - Ensure that potential habitats within the construction zone are not occupied by sensitive species
    - In the event of the discovery of a non-listed, special-status species, and in coordination with the DMWR, recover and relocate the animal to adjacent suitable habitat within the project site at least 200 ft from the limits of construction activities.
- **EC BR-6** Prior to construction activities, a USACE approved environmental monitor shall conduct pre-construction environmental training for all construction crew members. The training shall focus on required mitigation measures and conditions of any regulatory agency permits and approvals (if required). The training shall also include a summary of sensitive species and habitats potentially present within and adjacent to the project site.
- **EC-BR-7** When construction is completed in a given area, the construction contractor shall hydroseed all temporarily disturbed areas, including borrow sites, with local native shrubs or an appropriate groundcover. The mix of native species in the hydroseed shall be approved in advance by the USACE.

4.9.3 Cultural, Historic, and Archaeological Resources

- **EC-CR-1** If previously unknown cultural resources are found during construction of any feature of the Project, construction in the area of the find shall cease until the requirements in 36 CFR 800, are met. This would include coordination with the ASSHPO, the Advisory Council on Historic Preservation, and appropriate other interested parties. It may require additional measures such as test and data recovery excavations, archival research, avoidance measures, etc.

4.9.4 Water Resources and Quality

- **EC-WR-1 Construction SWPPP**. A SWPPP shall be developed for the project by the construction contractor and filed with ASEPA and Department of Commerce 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 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. 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 American Samoa Erosion and Sediment Control (ESC) Field Guide ver. 2.0. These shall be incorporated into a SWPPP.
    - The contractor shall produce and submit a project-specific Stormwater Pollution Prevention Plan (SWPPP) to the Contracting Officer for approval, prior to the commencement of work. The SWPPP must meet the requirements of 40 CFR 122.26 for stormwater discharges from construction sites.
    - Maintain an approved copy of the SWPPP at the onsite construction office, and continually update as regulations require, reflecting current site conditions.
    - 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 NPDES permit conditions.
    - The contractor shall ensure that the USACE reviews compliance reports prior to submittal
    - The contractor shall prepare a Notice of Intent (NOI) for NPDES coverage under the general permit for construction activities. Submit to the Contracting Officer for review and approval.
- **EC-WR-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-WR-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-WR-4 Conditional Notifications and Reports:**
    - **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 ASEPA staff.
- **EC-WR-5 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 ASEPA staff member overseeing the Project. The ASEPA 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.

4.9.5 Air Quality

- **EC-AQ-1** The project construction contractor shall electrify equipment, where feasible.
- **EC-AQ-5** The project construction contractor shall restrict the idling of construction equipment to ten minutes.
- **EC AQ-6** The project construction contractor shall ensure that equipment will be maintained in proper tune and working order.
- **EC-AQ-7** The project construction contractor shall use catalytic converters on all gasoline equipment (except for small [2-cylinder] generator engines).
- **EC-AQ-10** The project construction contractor shall use only solar powered traffic signs (no gasoline-powered generators shall be used).
- **EC-AQ-11** The project construction contractor shall apply non-toxic soil stabilizers according to manufacturers' specification to all inactive construction areas
- **EC-AQ-12** 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 five percent or greater silt content.
- **EC-AQ-13** The project construction contractor shall water active grading/excavation sites at least twice daily.
- **EC-AQ-14** 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-15** The project construction contractor shall suspend all excavating and grading operations when wind speeds (as instantaneous gusts) exceed 25 mph (40 kph).
- **EC-AQ-16** 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-17** 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-18** 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-19** 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-20** 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-21** 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-22** 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.

4.9.6 Public Health and Environmental Hazards

No environmental commitments are required for this resource. These are addressed per other environmental commitments for other resource categories (e.g., Traffic and Circulation, Noise, etc.).

4.9.7 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 American Samoa. 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.

4.9.8 Socioeconomics and Environmental Justice

No environmental commitments are required for this resource.

4.9.9 Land Use, Utilities, and Public Services

See Traffic Circulation.

4.9.10 Traffic Circulation

- **EC-T-1** The Contractor shall develop a Traffic Management Plan and ensure that designated roads are used during construction, in particular at the ingress/egress to the project site. The Contractor shall coordinate in advance with municipal emergency services to avoid roads restricting movements of emergency vehicles. At locations where access to nearby property is blocked, provision shall be ready at all times to accommodate emergency vehicles, such as plating over excavations, short detours, and alternate routes in conjunction with local agencies. The Traffic Management Plan shall include details regarding emergency services coordination and procedures. Additionally, the Traffic Management Plan shall clearly identify all affected roadways, bike paths, and pedestrian paths within the affected area. The plan shall identify measures to notify the public and divert automobile and pedestrian traffic safely around the construction area, including but not limited to a notice posted in the local publication, posted signage, and written notification to the American Samoa DPW.

- **EC-T-2** The project construction contractor shall schedule all material deliveries to the construction spread outside of peak traffic hours, and minimize other truck trips during peak traffic hours, or as approved by local jurisdictions.

4.9.11 Recreation

No environmental commitments are required for this resource.

4.9.12 Aesthetics

- **EC-A-1 -** If artificial lighting is required during construction, a Lighting Plan will be developed by the contractor to outline and determine locations of light sources. All work occurring after dark will be coordinated with local municipalities to avoid disturbance to residents and wildlife.
- **EC-A-2 -**The contractor shall use construction materials and/or landscaping to blend structures into surrounding environment to the greatest extent possible.
- **EC-A-3-** The contractor shall maintain the construction area maintained a clean and organized condition, free of litter and excess equipment/materials.

4.10 Environmental Operating Principles

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 early. An interagency meeting was held very early in the project's development process.

- The TSP incorporates lessons learned from similar actions (e.g., other FRM 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 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 C) considered areas of relevant risk and the intent is to consider adaptive management through the project life cycle process.
- The TSP includes the construction of flood barriers along the edge of the Taumata Stream, allowing the stream to flow naturally without disrupting the ecosystem and habitat within the Stream. Additionally, the barrier limits the amount of overbank flows through the community, limiting the amount of debris and rubbish collected before it finally discharges into Pala Lagoon. The TSP's nonstructural measures along both Taumata and Leaveave streams, also reduce the amount of impact to natural streams.

4.11 Views of the Non-Federal Sponsor

The American Samoa government supports Alternative C as the TSP. Alignment for the support was coordinated with the Governor of American Samoa. Concurrent with the draft decision document release, the study team will coordinate a site visit to American Samoa to complete necessary outreach with the public, local agencies and specific stakeholders (e.g., relevant village chiefs).

5 Environmental Compliance *

NEPA documentation includes a draft EA integrated with a feasibility report. The EA addresses: 1) the no action alternative, 2) Alternative B: Taumata and Leaveave Stream Conveyance improvements, 3) Alternative B1: Taumata and Leaveave Stream Conveyance improvements with Flood Barriers, 4) Alternative C: Taumata Flood Barrier (i.e., the preferred alternative) and 5) Non-structural Improvements only (i.e., floodproofing and elevating structures). The Corps' evaluation of environmental effects of the proposed action, including coordination with Federal, Territorial, local agencies, and the public, in accordance with the NEPA, is documented in the attached draft integrated report/EA and Appendix C for Environmental Resources for a detailed description of how the TSP complies with all applicable federal environmental laws, statutes, and executive orders. This section also discusses any related regulation specific to American Samoa (Territory). The status of the project's compliance with applicable federal, state, and local environmental requirements is also summarized and includes an administrative record of environmental coordination and compliance conducted to date as part of the proposed Project

Additional environmental compliance activities are summarized below:

ENDANGERED SPECIES ACT. Pursuant to Section 7 of the Endangered Species Act (ESA) of 1973, as amended, the Corps determined that the recommended plan (Alternative C) would have no adverse effect on Federally listed species. There is no federally designated critical habitat within the immediate vicinity of the proposed project. The Corps has satisfied statutory requirements for the proposed federal action under Section 7 of the ESA.

FISH AND WILDLIFE COORDINATION ACT. Pursuant to the Fish and Wildlife Coordination Act (FWCA) of 1934, as amended (16 U.S.C. §§ 661–667e), the Corps consulted USFWS and NMFS on the effect of the recommended alternative (Alternative C) on fish and wildlife resources as documented in the 2022 Draft EA and a draft Planning Aid Report dated January 11, 2022, from the USFWS. The construction of the flood barrier along Taumata Streams does not require formal FWCA consultation. The Corps will continue to coordinate with the USFWS and NMFS through the remainder to the feasibility phase.

NATIONAL HISTORIC PRESERVATION ACT. Pursuant to Section 106 of the National Historic Preservation Act (NHPA) of 1966 (54 U.S.C. § 306108), as amended, the Corps has determined that the recommend plan (Alternative C) would adversely affect one major historic property within the Area of Potential Effect (APE) which is eligible for listing on the National Register of Historic Places (NRHP) and initiated consultation on November 22, 2021 with the American Samoa Historic Preservation Office (ASHPO). The ASHPO concurred with Corps determination on 11/23/2021 and agreed that Corps cannot complete the cultural resources investigations, evaluations, and coordination necessary to satisfy Section 106 prior to the design phase of the proposed Action. The Corps and the ASHP agreed that execution of this Programmatic Agreement (PA) will establish alternative procedures to streamline coordination in order to satisfy the statutory requirements for the proposed federal action under Section 106 of the NHPA.

CLEAN WATER ACT, SECTION 404. Pursuant to Section 404 of the Clean Water Act (CWA), the Corps evaluated the recommended plan (Alternative C) and determined that the action proposes discharges regulated under Section 404. The Corps adopts and incorporates by reference the draft 404(b)(1) analysis completed by Corps (see Appendix C).

CLEAN WATER ACT, SECTION 401. Pursuant to Section 401 of the CWA, the Corps must obtain a water quality certification (WQC) from the American Samoa Environmental protection Agency (ASEPA) for any discharge into state waters. On April 7, 2020, the Corps reached out the ASEPA to brief the ASEPA on the study and determine 401 obligations and processes. The ASEPA has been made aware of Corps' plans to obtain a WQC in the design phase, prior to implementation of the project.

COASTAL ZONE MANAGEMENT ACT. The Corps reached out to the American Samoa Department of Commerce (DOC) via electronic mail on November 3, 2021, and by telephone on November 18, 2021, to request initiation of federal consistency review. In a letter dated December 6, 2021, the Corps received acknowledgement of its request and conditional concurrence with the Corps' federal consistency determination pending review of the draft feasibility report. USACE will continue to coordinate with the DOC during the remainder of the feasibility phase and work within it process in order to obtain final concurrence for the proposed action to satisfy the statutory requirements under Section 307 of the CZMA. USACE will continue to coordinate with the DOC in the design phase and prior to construction.

5.1 Public Involvement

Stakeholder and public engagement activities for the proposed project include communication and outreach to resource agencies, regulatory stakeholders, businesses, tenants, issue and geographic area stakeholders, and public to provide opportunities for engagement at every project milestone to ensure that proposed project alternatives address concerns and priorities of the diverse stakeholder community. Outreach methods may include a community meeting series, targeted stakeholder engagement, attendance at community events and standing groups and webinars that allow for online engagement.

The American Samoa government supports the scope of the feasibility study and supports a range of efforts to manage flood damage risk in the study area. During scoping meetings, local partners from American Samoa Environmental Protection Agency and American Samoa Coastal Management Program encouraged the study team to maximize nature-based features and manage storm waters "on-site" through detention as much as possible and protect the critically important groundwater wells within the study area.

The USACE is also conducting NEPA scoping and has initiated Agency coordination under the FWCA, ESA, Magnuson-Stevens Fishery Conservation and Management Act, Clean Water Act, and Coastal Zone Management Act. The USACE invited Federal agencies with relevant expertise or jurisdiction by law to be Cooperating Agencies under NEPA. The Environmental Lead has coordinated with the national and local NMFS office, as appropriate. Most of the habitat that might be affected by the study alternatives is expected to fall under ESA, CWA, or CZMA requirements. However, the study team is coordinating with the agencies to identify appropriate ways to quantify impacts to environmental resources in the study area.

Consistent with the requirements of NEPA and HRS Chapter 343, the draft IFR/EA will be circulated for a 30-day public review. Copies of the draft document will be distributed to a variety of individuals and organizations, requesting their comments on the project. The distribution list for the Draft Feasibility Report/EA includes all project stakeholders identified to date. This list includes federal, state and local agencies; elected officials; community groups and organizations; adjacent landowners; libraries; and the news media. The complete distribution list is provided in Appendix C Environmental Resources.

The stakeholder involvement approach for this project incorporated a variety of different techniques, including phone interviews, small-group virtual meetings and informational presentations, agency working meetings, and e-mail updates. Through implementation of these techniques, the stakeholder involvement efforts have been designed to develop awareness of specific watershed conditions and project objectives, gain stakeholder input on issues and specific project measures, and generate dialogue on project alternatives to build support for project implementation. Due to unique challenges related to COVID-19 and restrictions to travel to American Samoa throughout the feasibility process, meetings with village matais (chiefs) and village councils, in-person open house meetings, and public events in the Territory were not possible. This level of in-person engagement in American Samoa is recognized as being very important for engendering community support. Future opportunities for the study team to travel to the Territory will be continually explored after the draft report is released to the public.

5.1.1 Scoping

An initial two-day Public/Agency Scoping meeting for the study was held from July 21 to 22, 2020. A follow up Scoping Meeting with the resource agencies was held on November 18, 2021. Email communications with individual resource agency staff were conducted throughout the feasibility process to keep them informed as the study developed.

5.1.2 Agency Coordination

Coordination with the resource agencies was conducted to comprehensively address USACE policies, as well as specific regulatory requirements for consultation. In particular, NEPA and HRS Chapter 343 require agency involvement as part of the environmental review process. In addition, NHPA Section 106 requires consultation with the ASSHPO as part of a federal agency's consideration of the effects of their proposed undertaking on historic properties.

5.1.3 List of Statement Recipients

See Appendix C Environmental Resources for a list of the agencies, organizations, and persons to whom USACE sent copies of the draft IFR/EA for review.

6 District Engineer Recommendation

I have considered all significant aspects of this project, including environmental, social, and economic effects and engineering feasibility. I support Alternative C, the Tentatively Selected Plan (TSP), for the Tafuna FRM 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 first cost of the TSP is approximately $136,628,000. OMRR&R expenses are estimated to be approximately $46,000 per year. The federal portion of the estimated total project first cost is approximately $88,800,000. The non-federal sponsors' portion of the estimated total project first costs is approximately $47,700,000. All amounts are in FY22 price levels.

Federal implementation of the project for structural flood risk management 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 percent, up to a maximum of 50 percent, of construction costs, as further specified below:
  1. Provide, during design, 35 percent of design costs in accordance with the terms of a design agreement entered into prior to commencement of design work for the project;
  2. Pay, during construction, a contribution of funds equal to 5 percent of construction costs;
  3. Provide all real property interests, including placement area improvements, and perform all relocations determined by the Federal government to be required for the project;
  4. Provide, during construction, any additional contribution necessary to make its total contribution equal to at least 35 percent of construction costs;
- Prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) that might reduce the level of flood risk reduction the project affords, hinder operation and maintenance of the project, or interfere with the project's proper function;
- Inform affected interests, at least yearly, of the extent of risk reduction afforded by the flood risk management features; participate in and comply with applicable Federal floodplain management and flood insurance programs; prepare a floodplain management plan for the project to be implemented not later than one year after completion of construction of the project; and publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in adopting regulations, or taking other actions, to prevent unwise future development and to ensure compatibility with the project;
- 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, Public Law 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 draft TSP 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 transmitted to Congress for authorization and/or implementation funding. However, prior to transmittal to Congress, the American Samoa Government, 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.

ERIC S. MARSHALL
Lieutenant Colonel, Corps of Engineers
District Commander

7 List of Preparers

The team members listed below provided substantial text to the Tafuna FRM Study IFR/EA.

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Kevin Foster	District Quality Control – Environmental	USACE New England District
Brett Hanson	District Quality Control – Hydrology & Hydraulics	USACE Chicago District
Eric Li	District Quality Control – Cost Engineering	USACE Honolulu District
Dean McLeod	Economics	USACE Sacramento District
Kristine Meyer	Hydrologic and Hydraulic Engineering	USACE Chicago District
Tiffany Murray	Real Estate	USACE Honolulu District
Benjamin Reder	Plan Formulation/Study Manager	USACE Honolulu District
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Timi Shimabukuro	District Quality Control – Economics	USACE Sacramento District
Christopher Solek	Environmental	USACE Los Angeles District
Laura Vanden Berg	District Quality Control - Design	USACE Chicago District
Nathan Vomocil	Economics	USACE Honolulu District
Rachel Wooten	District Quality Control – Plan Formulation	USACE St. Louis District

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