Environmental
Appendix D

Guam Watershed Plan

US Army Corps of Engineers ®
Honolulu District

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Contents

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1 Introduction

This Environmental Analysis is Appendix D to the Guam Watershed Plan. The purpose of this appendix is to give readers a baseline understanding of the water and resources in Guam, the land use distribution, and the present challenges to the environmental resources. No new models or research was performed in the creation of this appendix. Literature provided by other Federal agencies, the study partner, and existing published research papers were reviewed to create a holistic understanding of the unique environmental and challenges.

The goal of the Watershed Assessment was to provide recommendations for a strategic roadmap that can be used by various stakeholders, public and private, within Guam. Because the watershed study is purposefully broad, specific species are not named for study or action.

2 Water Supply System

The Northern Guam Lens Aquifer (NGLA) is the number one source of Guam's drinking water, Figure 1.

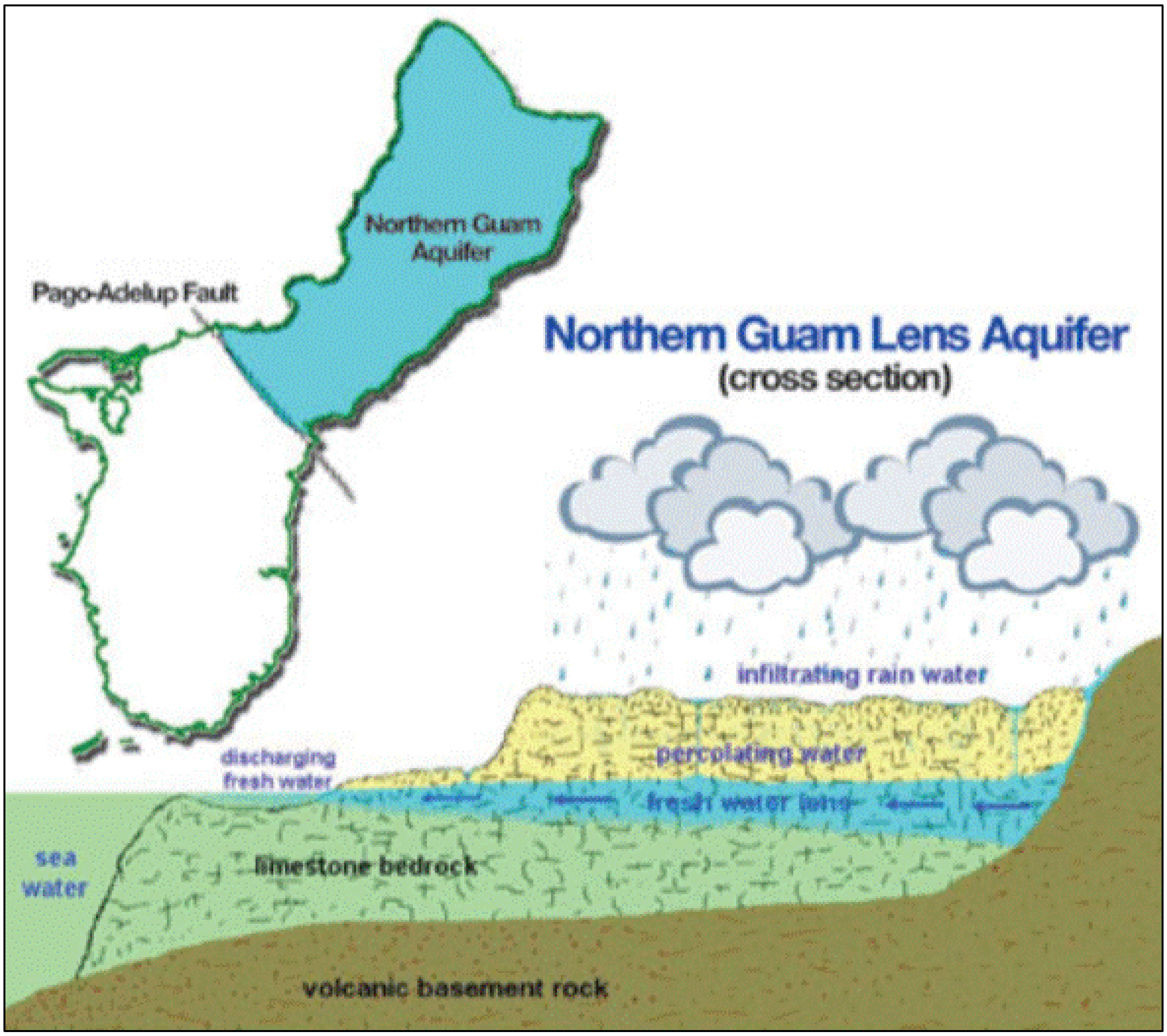


Figure 1. Cross Section of the Norther Guam Lens Aquifer (Newsletter of Guam and her Ocean Environment, Man, Land and Sea Volume 1 issue 2)

The NGLA encompasses all northern Guam. It consists of the limestone bedrock that is located north of the Pago-Adelup fault (geologic fault that separates the volcanic terrain of southern Guam from the limestone plateau in northern Guam), Figure 2. Limestone bedrock extends down until it reaches the volcanic units. The volcanic units are the base of the aquifer and are not a part of the aquifer itself. They are far less porous than the limestone and do not contain significant amounts of groundwater.

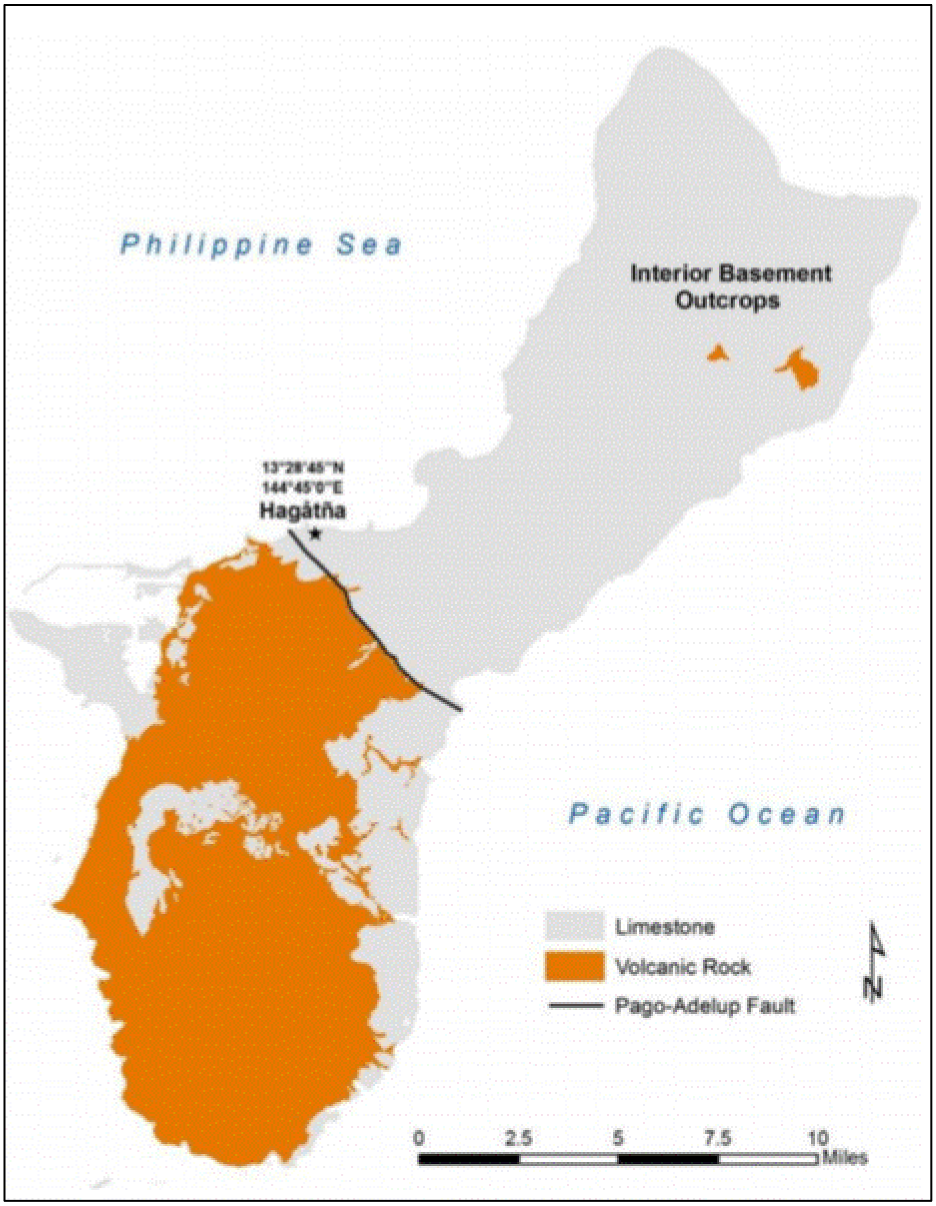


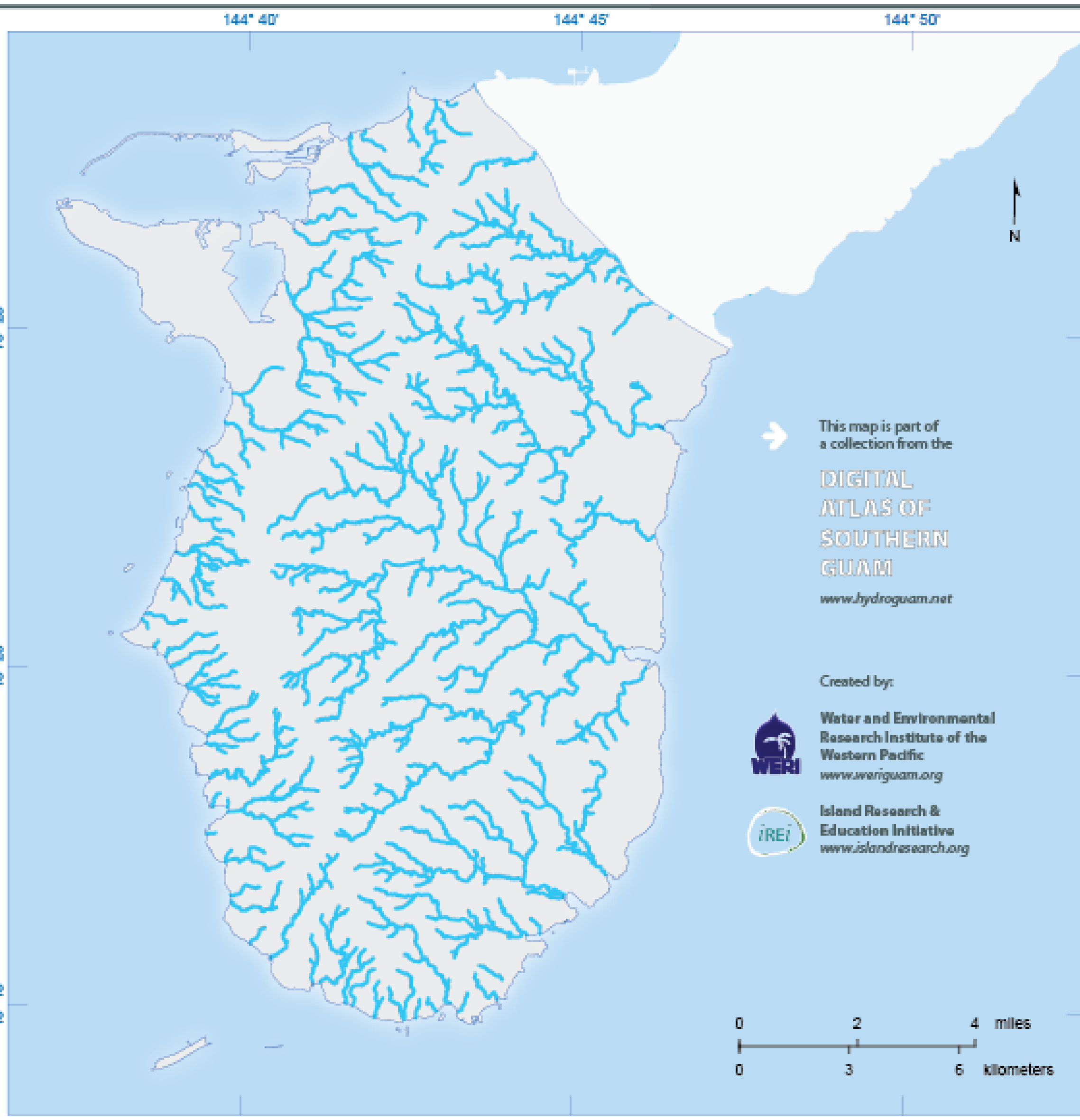
Figure 2. Location of Pago-Adelup Fault and Volcanic Rock (WERI Tech. Report 142)

Unlike other aquifers (for example, the Floridan Aquifer), the NGLA is not a subterranean lake in a giant underground room; but rather water is contained within the rocks. These rocks, though solid and dense, are full of holes and empty space, and this space can accommodate lots of water. The empty spaces include pores and gaps that were created by coral when the limestone was still a live reef. Cracks and fractures developed from earthquakes and tectonic movements, and karst voids were created by water as it moved through the rocks and removed some of the limestone bedrock in solution. These spaces make the NGLA particularly vulnerable to contamination.

Protecting the NGLA from contaminants is crucially important for public health and sustainable development. Drinking water is pumped from the underground aquifer into the water distribution system. Contaminants can affect the water supply from beneath the aquifer and from the land surface. For example, salty groundwater that normally underlies the aquifer is kept in its place by the weight of fresh groundwater sitting atop of it. If too much freshwater is removed by pumping, the saltwater then moves upward into the aquifer to achieve equilibrium. This contamination by seawater is a major risk in island aquifers. In addition to contamination from percolation and runoff of surface pollution (including trash and debris), saltwater intrusion occurs in the aquifer. This is due to well construction, rainfall, and over-pumping. Roughly 120 wells are used on Guam to withdraw water from the NGLA, and the halocline (transition zone) of brackish and fresh water will thicken as fresh water is reduced during over pumping and droughts. Saltwater intrusion depends on recharge rates, the hydraulic properties of the rocks, and well location and depth (2003, USGS-WERI).

Other sources of contaminants are at the land surface. Domestic wastewater and sewage, industrial spills, and agricultural and stormwater runoff can reach the aquifer and contaminate it. Several thousand septic tanks and pit toilets sit right above the NGLA and are major sources of contaminants. Septic tanks alone discharge roughly 5 million gallons of wastewater into the Guam environment each day. The extent to which contaminants have impacted the chemical and biological integrity of the NGLA is currently unknown and cannot be ignored due to the well-connected open spaces which facilitate rapid movement of water (and any contaminants therein) without being filtered. (Digital Atlas of Northern Guam)

Figure 3, 4 and 5 display the freshwater streams and rivers, groundwater sources and watersheds found in Southern Guam. All surface and groundwater in Guam discharges into the Pacific Ocean. Of Guam's 100 named streams and rivers, 46 drain directly into the ocean. This means that southern Guam has many small drainage basins, which can be grouped into fourteen large watersheds, Figure 5. A mountain ridge running along the western coast topographically defines many of the watersheds. It divides southern Guam watersheds into small and steep areas with short streams in the west, and broader floodplains and longer, larger rivers in the east. (Digital Atlas of Southern Guam)



Drainage network
(All streams and rivers)

Streams and rivers

This map shows the extent of streams and rivers in southern Guam. Southern Guam is characterized by a well developed drainage network, in contrast with the highly porous, karstified land surface in the northern half of the island. The geospatial data were derived from the recently updated National Hydrography Database (NHD) by the United States Geological Survey (USGS) in collaboration with Bureau of Statistics and Plans (BSP) and the Water and Environmental Research Institute of the Western Pacific (WERI). The dataset was extracted from the NHD Flowline dataset and slightly modified. The original NHD data can also be viewed and downloaded using the NHD Viewer (*http://viewer.nationalmap.gov/viewer/nhd.html?p=nhd*).

Figure 3. Streams and Rivers in Southern Guam

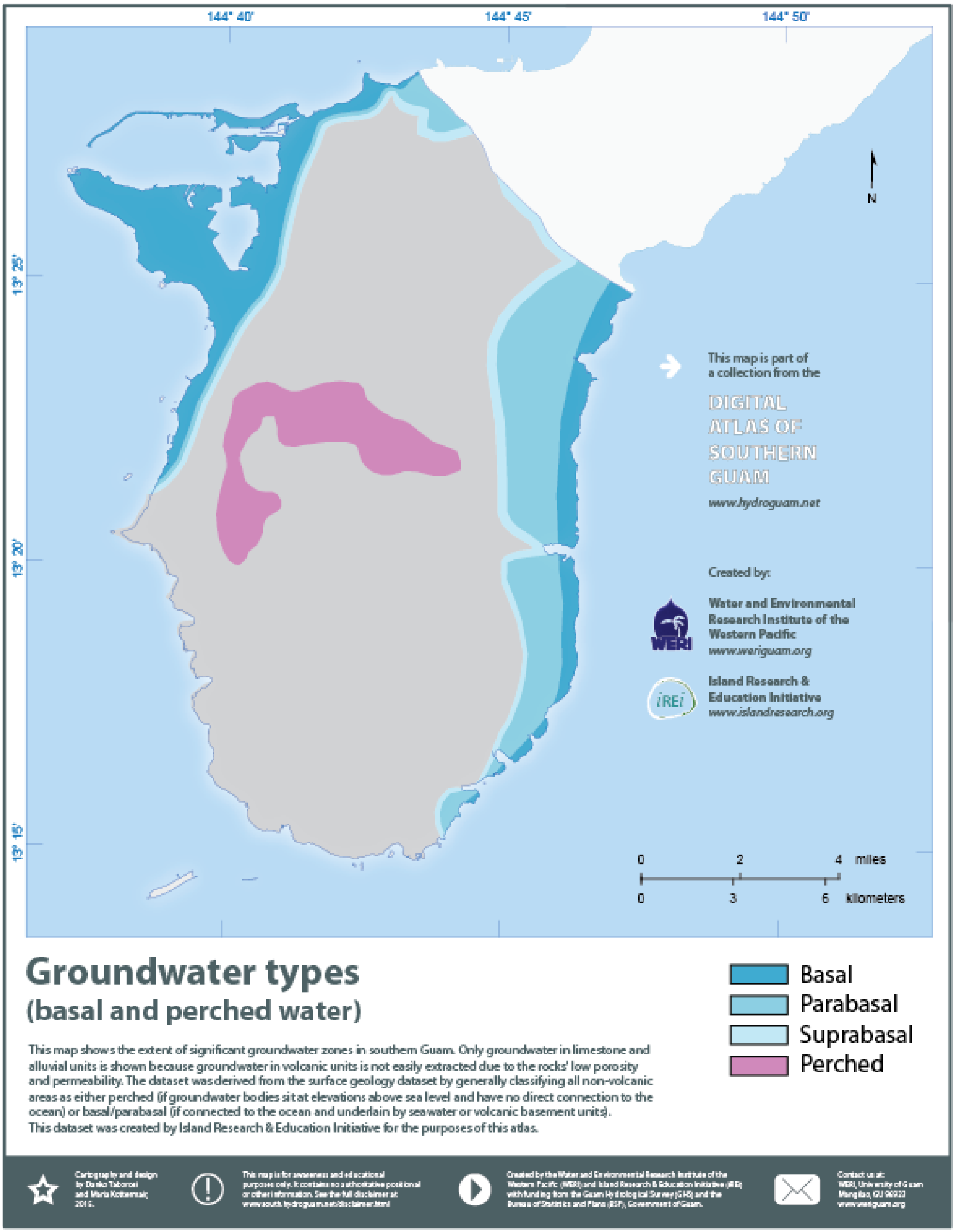


Figure 4. Southern Guam Springs

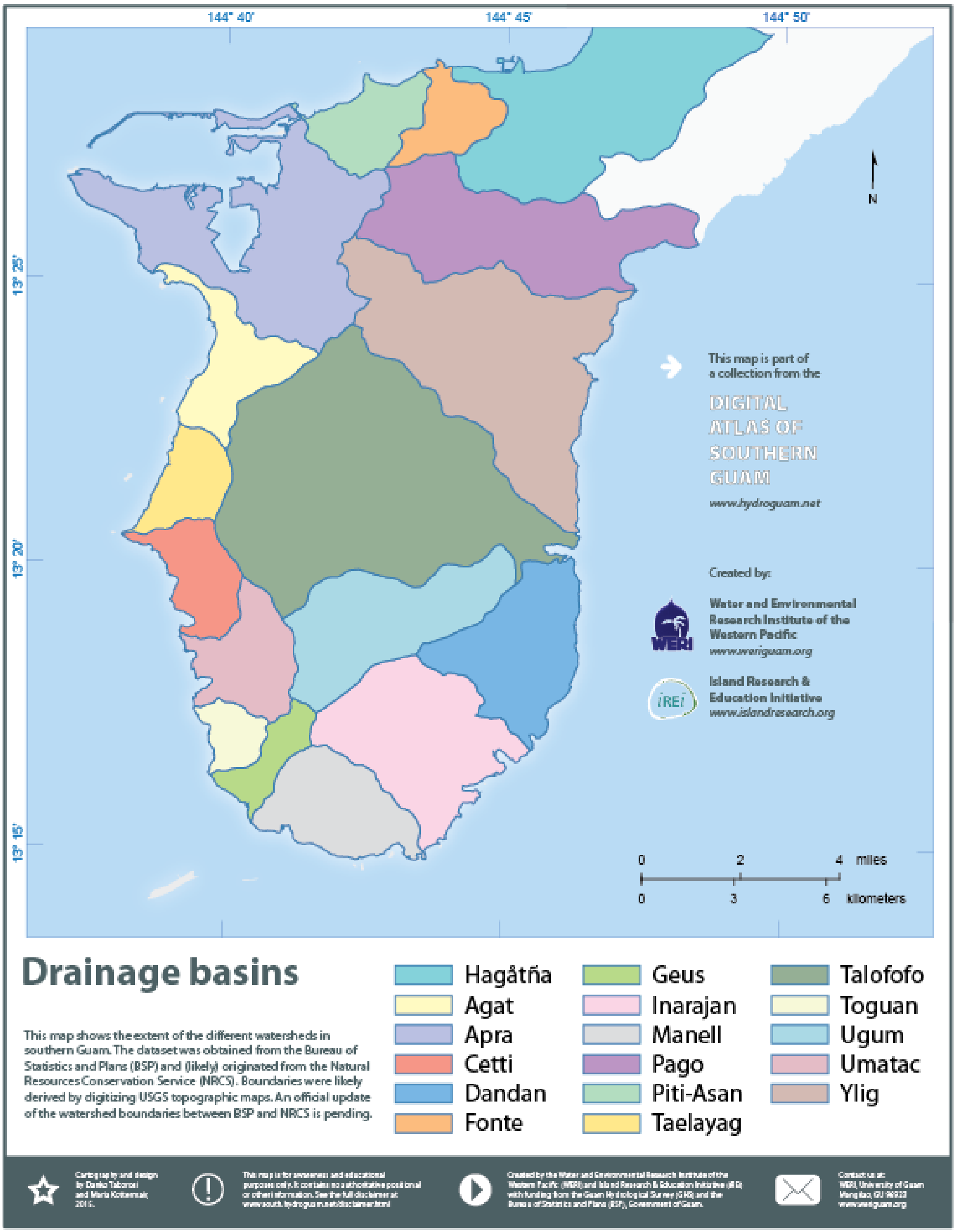


Figure 5. Southern Guam Watersheds

The Consolidated Commission on Utilities (Guam CCU) comprises the Guam Waterworks Authority (GWA) and the Guam Power Authority (GPA). The CCU supplies power, drinking and wastewater services for all of Guam. Sources of water supply other than the NGLA include freshwater springs and rivers. Surface sources used by GWA include an intake from the Ugum River plus water purchased from the US Navy Water System (FENA). Spring water from Santa Rita is used to supplement the water supply from FENA for the villages of Asan, Piti, Anigua, Agat, Santa Rita and some areas of Barrigada and Mongmong-Toto-Maite, Figure 6.

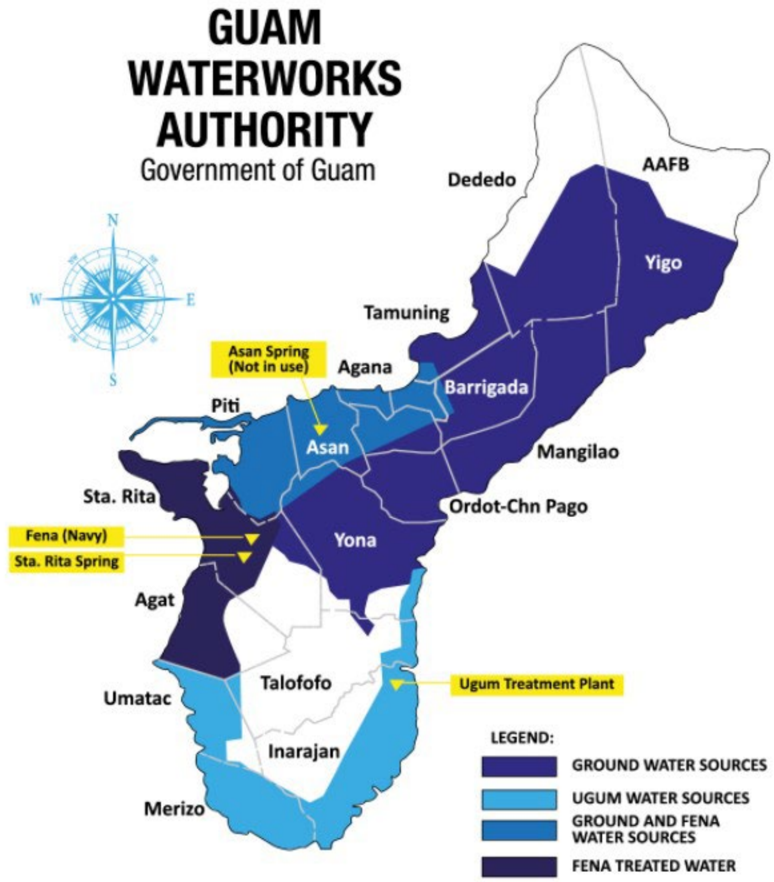


Figure 6. Guam Water Sources

3 Water Supply

According to the 2020 GWA Water Quality Report, all of Guam's water supply met or surpassed EPA standards to protect public health. However, a primary water quality concern on Guam remains the persistence of Per- and Polyfluorooctane sulfates (PFAS/PFOS) in the water, and subsequent bioaccumulation in humans. PFAS/PFOS is a fully fluorinated anion whose long-term health effects include cancer, high cholesterol, decreased antibodies, liver damage, pregnancy complications and thyroid diseases. PFAS/PFOS was once widely used in industries for fire repression, emulsifiers, and other purposes and it is very persistent in local water sources. It also has substantial bioaccumulation and biomagnification properties, particularly in humans. PFOS is moderately water soluble (~600 mg/L).

In 2009, the USEPA issued a provisional drinking water health advisory for PFOS of 200 ng/L. A final health advisory of 70 ng/L was promulgated on May 25, 2016 (Federal Register 2016). The GWA began monitoring PFOS in Guam's groundwater in March 2015, in response to USEPA's third Unregulated Contaminant Monitoring Rule, (UCMR3). Overall, five production wells were identified as PFOS contaminated and levels in two of them were consistently above the USEPA's 70 ng/L benchmark. The highest PFOS levels ranged from 220-410 ng/L in March and September of 2015 respectively (BSP-GCMP, 2020).

Although GWA has not detected PFAS or PFOS in Guam's water distribution systems, two of the five wells with the highest levels of PFOS are currently offline because of this contamination and may be retrofitted with granular activated carbon (GAC) filters in the future. GWA and Water and Environmental Research Institute (WERI) continue to monitor PFAS/PFOS in drinking water sources. If levels are above advisory limits, the sources are disconnected or treated. Results acquired to date show a strong positive correlation between PFOS concentrations in wells and monthly rainfall (Jensen et al. 2019).

There are 25 listed water bodies in Guam and six permitted NPDES dischargers. Waters are listed due to exceedance of WQS applicable to swimming, recreation, fish consumption, and drinking water. Sources of impairments include runoff (non-point and point source) of nutrients, pesticides, other chemicals and soils, wastewater plant discharges, agricultural practices, and naturally occurring bacteria.

Bacteria total maximum daily loads (TMDLs) for Guam Beaches were approved by the EPA in 2015. These TMDLs address the bacteria listings for 25 beaches in southern Guam and represent a significant accomplishment in addressing Guam's 303(d)-listed waters. The Integrated Report (IR) from Guam's Environmental Protection Agency (GEPA) provides updates every two years regarding Clean Water Act (CWA) sections 303(d) and 305(b) to track overall surface water and ground water quality, causes and sources of impairments, and efforts to correct impairments of designated water quality and uses.

GWA is improving water quality and water supply through several activities. The GWA Masterplan (2018) identifies the following key actions to address these issues i) replacement of filtration media to treat and remove PFOS contaminants; ii) sewer line rehabilitation; iii) installation of new water storage tanks; iv) improvements to lift stations; v) water line replacements; vi) refurbishing interceptor sewer systems; and, vii) monitoring system leaks and training personnel on risks and quality management. (GWA Master Plan 2018).

Other sources of contamination include land-based pollutants, bacterial contamination from septic and animal waste systems, leftover unexploded ordinances and other ammunition from WWII, leachates, illegal dumping, sedimentation, and saltwater intrusion.

3.1 Erosion

Erosion and associated sedimentation are the primary threats to Guam's terrestrial and aquatic environments, and to human land uses. Human activities that reduce vegetation cover increase erosion. Natural processes and geography can also contribute to erosion through intense rain, steep terrain, narrow river cross sections, changes in river direction, areas of existing bank erosion, and mass wasting. All increase the potential for sediment to be introduced to and carried by rivers. Soil characteristics including type, permeability, and moisture, greatly affect the land use vegetation, and habitat types. Land use and soil subsequently influence overland runoff that can lead to erosion and landslides.

The entire coastline of Guam is vulnerable to coastal erosion hazards. The western coast of Guam has experienced the most coastal erosion to date due to tropical cyclones and monsoon surges that have produced high waves. Coastal erosion can be caused by wind, ocean current, storm surge, high surf, seismic activity, and by changes in the geometry of tidal inlets, river outlets, and bay entrances. La Niña and El Niño events also contribute to erosion. El Niño causes intermittent lower water levels and increases tropical cyclone activity. La Niña causes less tropical cyclone activity, but higher background sea levels. Heavy rainfall increases erosion, during the rainy season (July – October) Guam averages 85 – 115 inches annually.

The effects of climate change and relative sea level change are expected to affect coastal erosion and shoreline recession. Sea levels around Guam have risen about 8 inches over the last century, with the largest increase occurring over the last two decades. An increase in base water level, which is estimated to be 3 feet in Guam by 2100, combined with the expected intensification of storms will likely magnify erosion and shoreline recession. Present erosion rates can be as high as 23 inches per year and 50 inches per year at Sagna Bay and Apaca Point respectively (2019, Guam Homeland Security).

Human-made structures and human activities, shoreline protection structures and dredging, can exacerbate erosion or local scour around the structures. Armored shorelines (seawalls, armor stone, rip-rap) can increase the coastal erosion in adjacent unarmored properties. Shoreline armoring also prevents natural deposition of suspended sediments to replenish lost beach material.

Areas cleared for development for residential, municipal, agriculture, industrial or military uses are exposed to prevalent winds or open ocean waves and are more likely to experience heavy coastal erosion than highly vegetated areas with buildings set farther inland. The erosion of coastal cliffs can threaten the safety of humans and cause environmental degradation. The impacts from coastal erosion can damage roadways and critical infrastructure. It can also stress ecosystems and increase land recession. For example, coastal erosion sometimes leads to sediment transport onto nearby reefs. Sediment deposition on reefs can reduce sunlight necessary for growth, and, if contaminated, the sediment can harm the health of the reefs.

4 Coral Reefs and Marine Ecosystems

Hard corals, also known as scleractinian and stony coral, produce a rigid skeleton made of calcium carbonate ($CaCO_3$) in crystal form called aragonite. Hard corals are the primary reef-building corals. Colonial hard corals, consisting of hundreds to thousands of individual polyps, are cemented together by the calcium carbonate skeleton they secrete. Hard corals that form reefs are called hermatypic corals, Figure 7.

Figure 7. Reef building Corals (iNaturalist.org)

Soft coral, also known as Alcyonacea and ahermatypic coral, do not produce a rigid calcium carbonate skeleton and do not form reefs, though they are present in reef ecosystems. Soft corals are mostly colonial; what appears to be a single large organism is a colony of individual polyps combined to form a larger structure. Visually, soft coral colonies tend to resemble trees, bushes, fans, whips, and grasses, Figure 8.
(https://coralreef.noaa.gov/education/coralfacts.html)

Figure 8. Soft Corals (Guamcoralreefs.com)

There are four ESA-listed corals in Guam, *Acropora globiceps, Acropora retusa, Acropora speciosa*, and *Seriatopora aculeata*. *Acropora* is a branching coral and common species include table, elkhorn and staghorn coral (NOAA Fisheries, 2016). All three ESA-listed *Acropora* species are susceptible to major threats identified for corals - ocean warming, disease, and ocean acidification. Despite their wide range of distribution, these species occur primarily in a limited depth range of 0 to 8 meters for *A. golobiceps* and 0 to 5 meters for *A. retusa*. Shallow reef areas can be physically diverse and complex but are often subjected to frequent and extreme changes in environmental conditions, tides, temperatures, water chemistry, human interaction, and simultaneous effects from multiple stressors, both local and global in nature. Future projections of climate change impacts to coral reef environments indicate that a shallow depth range, in combination with its other biological, demographic, and spatial characteristics, contributes to a risk of extinction within the foreseeable future for these four species.

A. speciosa has a broad geographic range, and an effective small population size of 1,204,000 colonies. Because of the widespread nature of the global threats to corals, a threat event has the potential to impact many colonies at once so a species with a relatively small effective population size may have a high proportion of genetically unique individuals affected by threats at any given time within the foreseeable future.

Seriatopora aculeata is also susceptible to major threats identified for corals - ocean warming, disease, and ocean acidification. A significant proportion of its current known geographic range is within the Coral Triangle area. This area is projected to have the most rapid and severe impacts from climate change and localized human impacts for coral reefs over the 21st century. Multiple ocean warming events have already occurred within the western equatorial Pacific (which includes the Coral Triangle area) that suggest future ocean warming events may be more severe than average in this part of the world. A range constrained mostly to this geographic area that is likely to experience severe and increasing threats indicates that a high proportion of the population of this species is likely to be exposed to those threats over the foreseeable future. (http://www.fpir.noaa.gov)

For more information and pictures of these corals see Attachment 1 – Listed Coral Species Fact Sheets.

Figure 9 displays the geomorphology around Guam in 2008 by the Pacific Islands Benthic Habitat Mapping Center. Using backscatter and bathymetric data the mapping shows hard bottom concentrated largely in the North. This is consistent with the optical validation of percent cover of Scleractinia coral (hard bottom)

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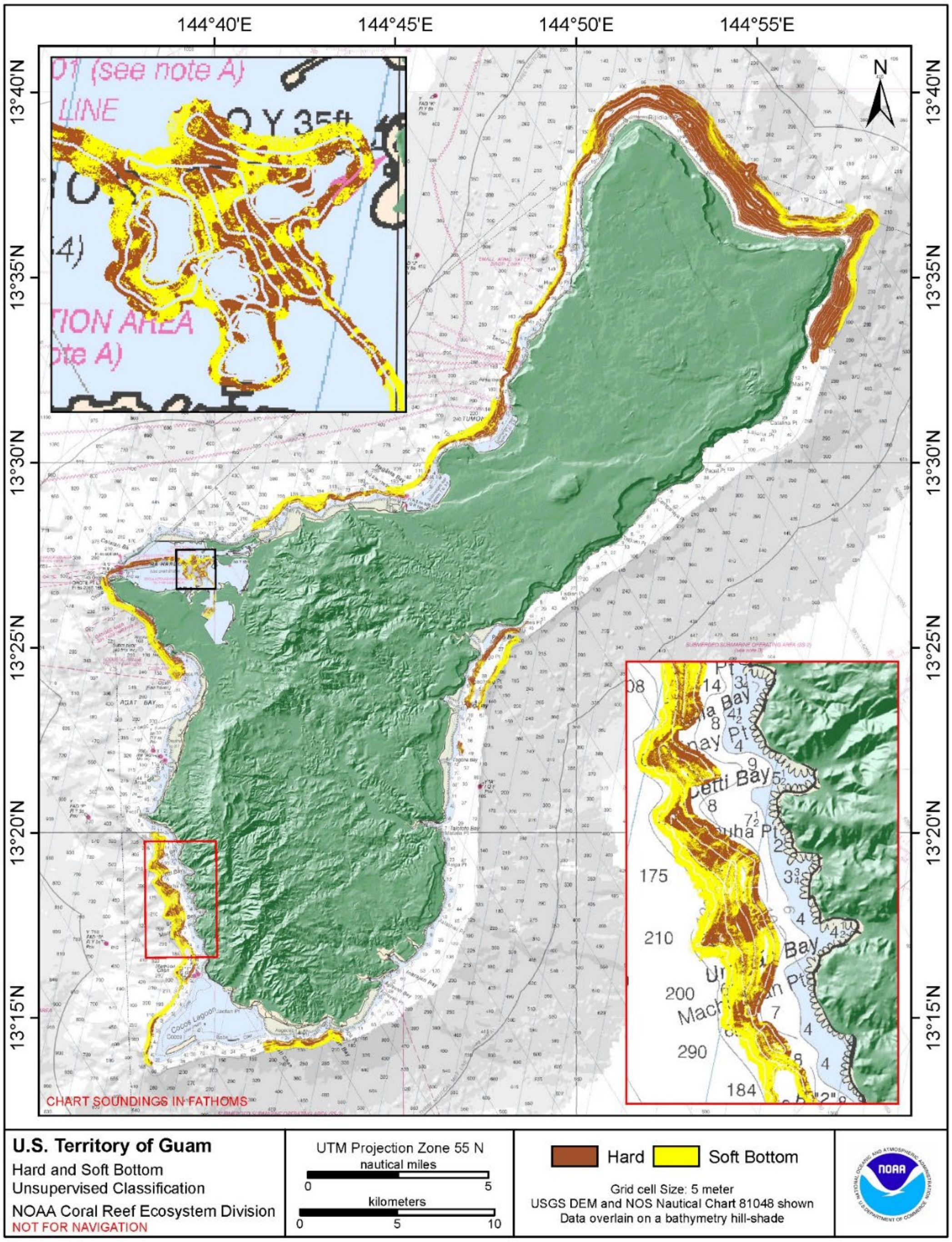

Figure 9. Geomorphology of Guam (PIBHMC 2008)

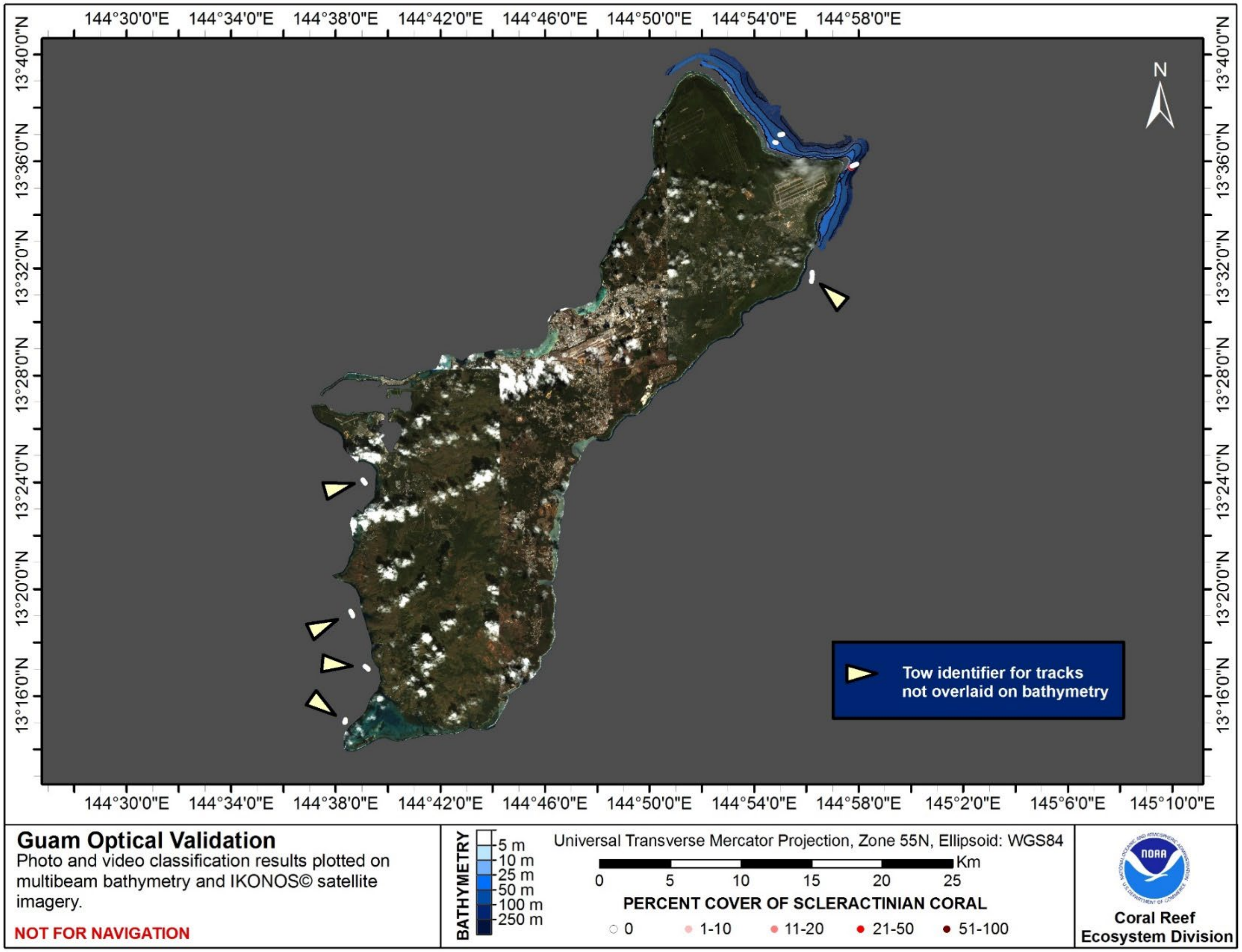

Figure 10. Percent Cover of Scleractinian Coral (NOAA 2008)

Reefs in the northern part of the island and between river outflows are unaffected by sediment, nutrient loading, and freshwater runoff, and these conditions encourage relatively healthy coral communities. These reefs have not suffered the large-scale bleaching events and coral diseases seen in other parts of Guam. Unfortunately, some reefs have been damaged by land-based sources of pollution and heavy fishing pressure.

Guam's coral reefs are an important component of its tourism industry. The reefs and the protection that they provide make Guam a popular tourist destination for Asian travelers (70 to 80% from Japan). According to the Guam Economic Development Authority, the tourism industry accounts for up to 60% of the government's annual revenues and provides more than 20,000 direct and indirect jobs. An economic valuation in 2007 (Van Buekering, 2007) estimated Guam's coral reef resources at $127 million per year.

Traditionally, coral reef fishery resources formed a substantial part of the local Chamorro community's diet and included finfish, invertebrates, and sea turtles (Amesbury and Hunter-Anderson 2003). Today, coral reef resources are both economically and culturally important. Reef fish, although somewhat displaced from the diet by westernization and declining stocks, are still found at the fiesta table and at meals during the Catholic Lenten season. Many of the residents from other islands in Micronesia continue to include reef fish as a staple part of their diet (Amesbury and Hunter-Anderson 2003). Sea cucumbers, sea urchins, mollusks, marine algae, and a variety of crustaceans are also eaten locally. In addition to the cash and subsistence value of edible fish and invertebrates, reef-related fisheries are culturally important as family and group fishing is a common activity in Guam's coastal waters.

The Department of Agriculture's Fisheries section has been collecting data from shore-based rod and reel fishers and boat-based bottom fishers since the 1970s. This allows various fishing sectors to be analyzed for trends in catch, participation, and effort. At the Agat marina, commercial bottom fishers have been surveyed since the opening of the marina in the 1990s. During the early 1990's, as many as four commercial operators began operating out of the Agat marina with as many as 30 guest bottom fishing along the same two mile stretch of reef at Agat. This provided a unique opportunity to analyze the effect of high fishing effort over a relatively long period on a small reef area. Initial analysis showed rapid depletion of important fish species, followed with a decrease in the size of fish harvested, and finally catches which comprised of juveniles and smaller fish species.

Public Law 24-21 was passed in 1997 that established five permanent marine preserves, Tumon Bay, Piti Bomb Holes, Sasa Bay, Achang Reef Flat, and Pati Point (Figure 11). Two of the preserves, the Tumon Bay and Pati Point Marine Preserves, allow limited rod and reef fishing year-round. The Pati Point Marine Preserve allows shoreline rod and reel fishing for all species, while the Tumon Bay Marine Preserve allows shoreline rod and reel fishing for only rabbitfish, convict tang, and juvenile jacks. Boat-based bottom fishing is allowed to begin at the 100-foot contour at the Tumon Bay marine preserve. Boat-based bottom fishing is allowed only beyond the 600-foot contour at the Pati Point Marine Preserve, the Achang Bay Marine Preserve, and the Piti Bomb Holes Marine Preserve. The Tumon bay 100-foot contour, however, is regularly fished by commercial bottom fishing charter boats from the Agana boat basin, proving an opportunity to observe simultaneously the effect of having high fishing effort and spillover effect. Fishing activity is restricted in the preserves with limited cultural take permitted in three of the five areas. The preserves are complemented by the War in the Pacific National Historical Park; Ritidian NWR; the two Naval Ecological Reserve Areas, Orote and Haputo; and the Guam Territorial Seashore Park. While the five marine preserves are enforced, the other areas currently have limited management and enforcement. (DOA GMC 2020, NOAA CORIS, 2018)

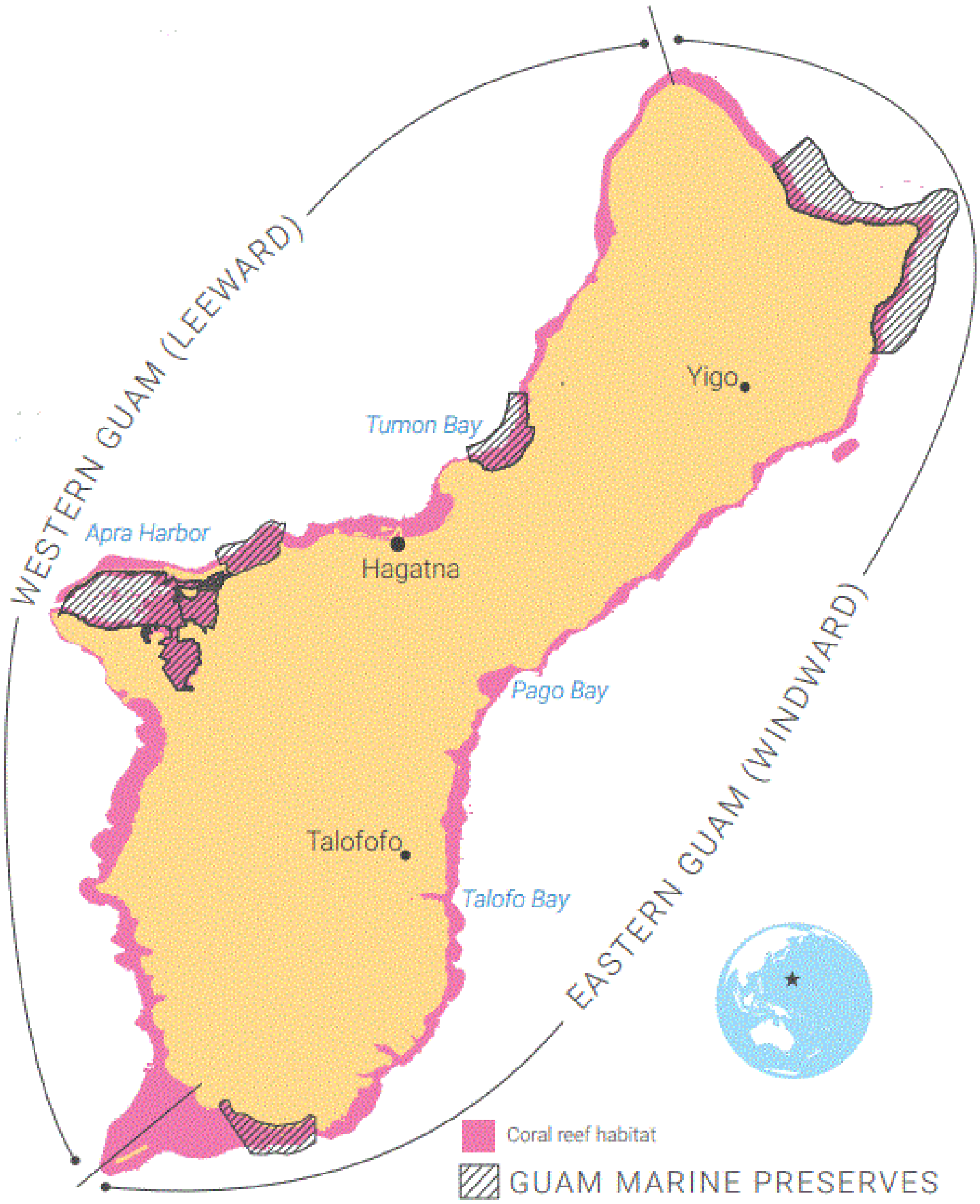

Figure 11. Marine Protected Areas (MPAs)

5 Land Use Plans and Maps

5.1 Land Use Plan

The Land Use Plan assigns land in Guam to one of four districts: Urban, Rural, Agricultural, and Conservation.

5.1.1 Urban District

This district is characterized by high-intensity development, including high-density residential, commercial, and industrial uses. Urban district lands also include areas where the government anticipates future growth and where expansion of existing infrastructure has been planned. Growth within these urban areas is encouraged to develop in a clustered manner, rather than in a sprawling suburban pattern, but no specific regulations to implement this philosophy are offered.

5.1.2 Rural District

Rural district lands are areas of probable future development and are characterized by a mixture of low-density residential lots and agricultural uses. In areas where urban levels of services are absent, residential density should not exceed 1 dwelling unit per half-acre. These rural areas are also often where residents pursue traditional lifestyles, including backyard farming and households containing extended families. The Land Use Plan states that, in these areas, the government is not committed to providing urban services, such as sewer, roads, and water and power, beyond essential needs.

5.1.3 Agricultural District

Agricultural lands are defined as those areas whose physical characteristics make them well suited for agricultural uses. They are relatively level and are located on suitable agricultural soils. Primary uses on agricultural land include field farming, livestock production, aquaculture, or forestry. Other compatible uses include farm residences, storage facilities, animal shelters, roadside agricultural product markets, open space, and small-scale recreation areas. While some infrastructure improvements are necessary in these areas to support agricultural activities, intensive development is discouraged.

5.1.4 Conservation District

Conservation district lands are intended for the preservation of unique natural and cultural features, protection of watersheds and water resources, and conservation of indigenous wildlife and their habitat. While often adjacent to areas of existing development, preferred uses in Conservation districts include low-intensity residential development, agriculture, parks, and other uses determined not to be environmentally damaging.

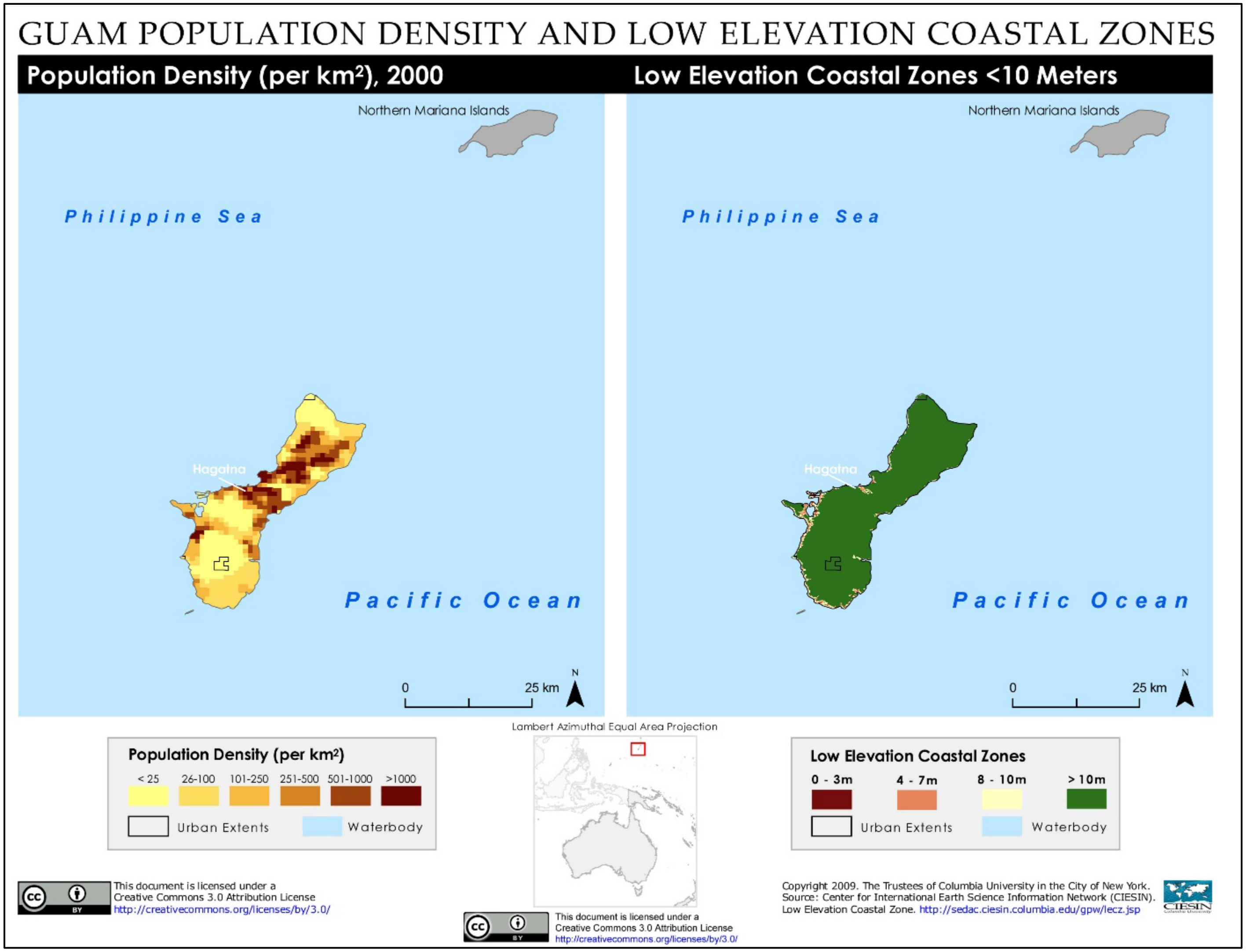

Figure 12. Guam Population Density and Low Elevation Coastal Zones

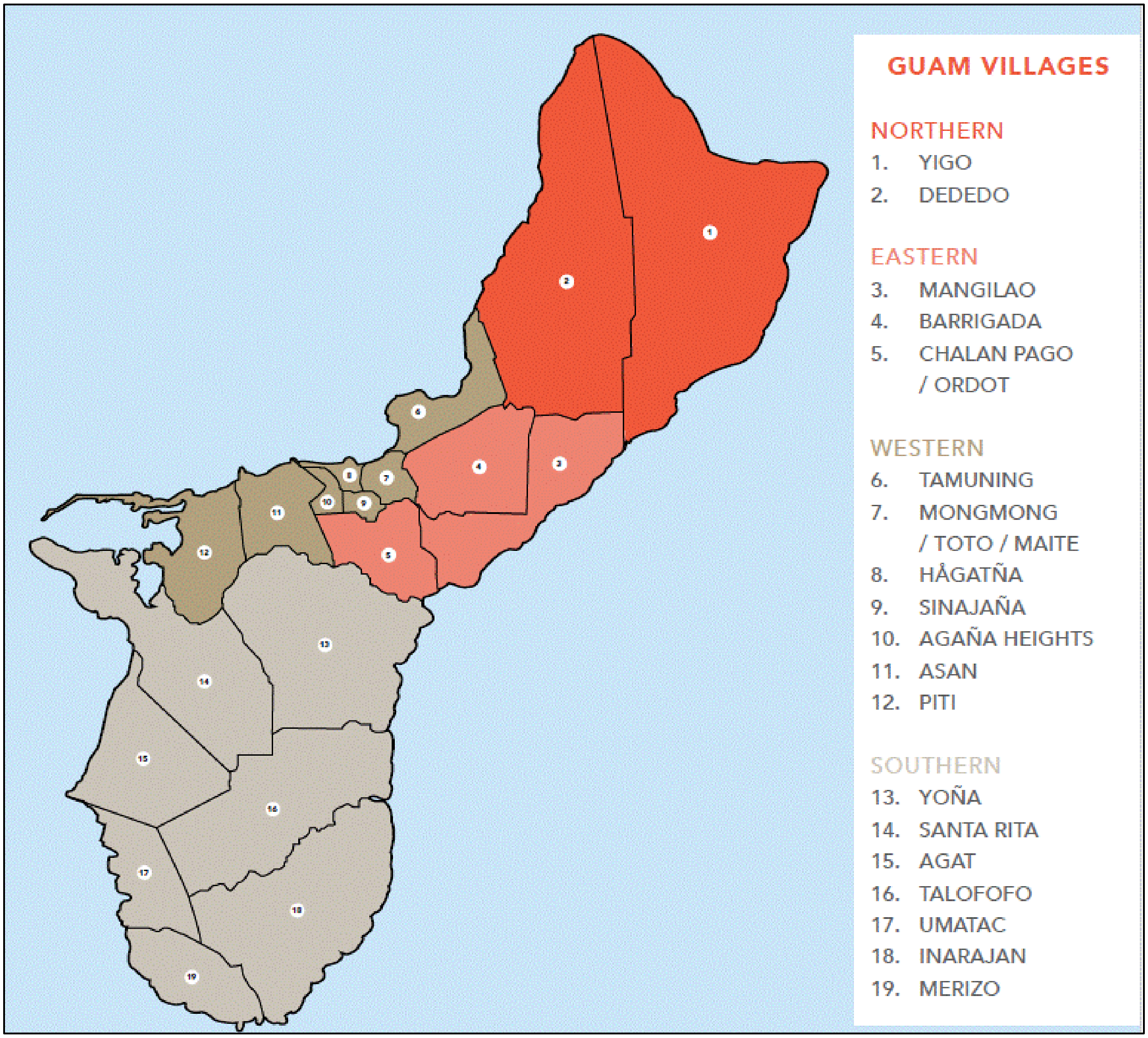

Figure 13. Villages of Guam (CESDS 2020-2025)

The southern portion of the island contains large expanses of undeveloped land. Development is limited due to steep slopes and unstable soils. Most villages are along the coast where the topography is flatter, with little development in the interior (ICF International. 2009).

5.2 Land Ownership

The federal government owns approximately 32% of the land on Guam, primarily for military uses, Figure 14. It is estimated that the Government of Guam owns an additional 20%, though data on the exact location and extent of Government lands are incomplete. Less than half of the island is currently available for private development. The largest concentrations of federal land ownership are at the northern tip of the island (Anderson Airforce Base) and on the southwest coast (U.S. Naval Base Guam and Ordinance Annex).

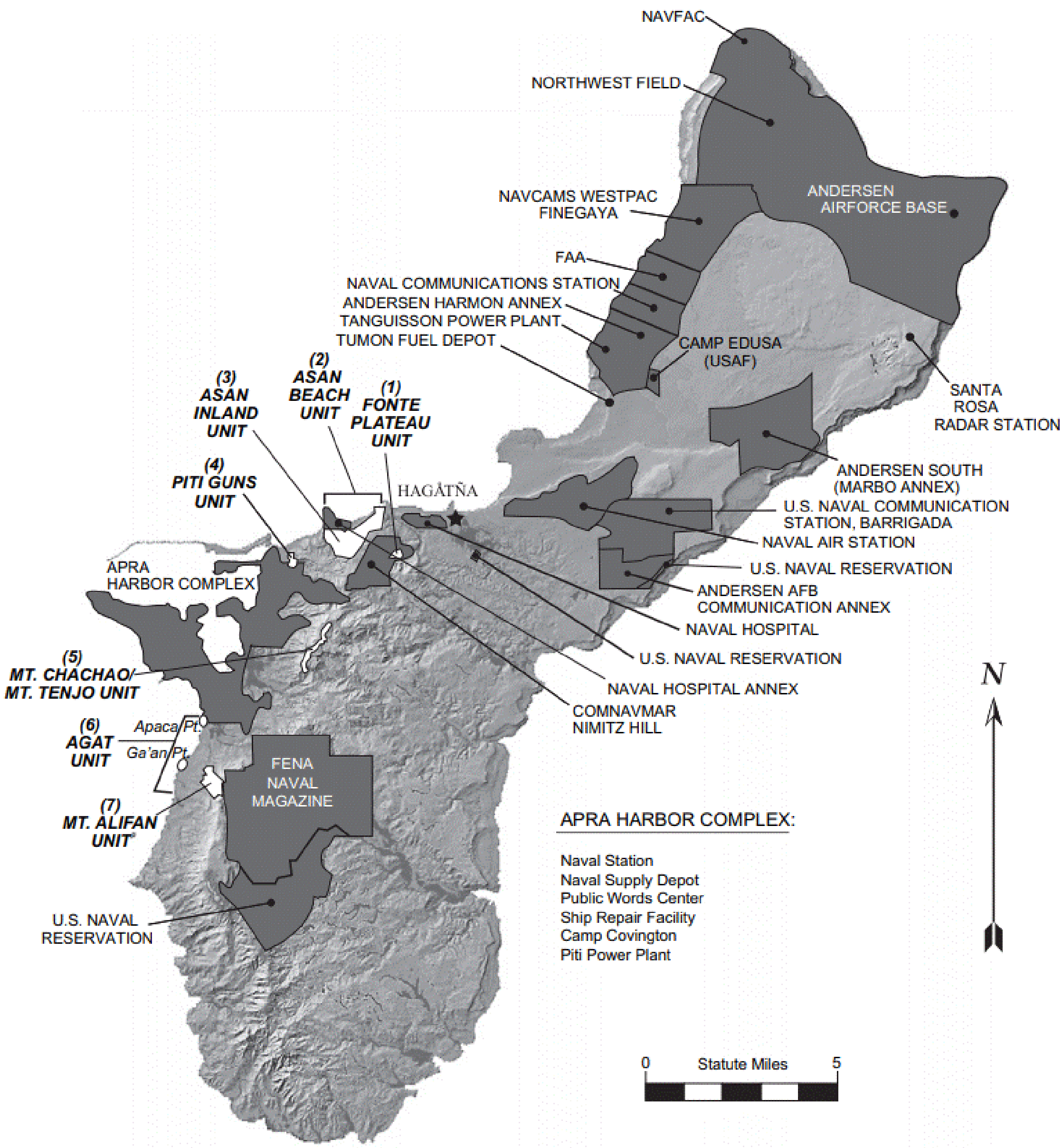

Figure 14. Lands held by US Military (Rogers 1995)

6 Wildfires

Wildfires are more common in the less-developed southern part of the island. Guam averages nearly 4% of its total land area burned each year (equivalent to California's worst year on record in 2020) and during its worst fire year, the El Niño-fueled drought of 1997 and 1998, 10 percent of the island burned (https://thehill.com/opinion/energy-environment/568793-pacific-islands-wildfires-highlight-vulnerability-to-climate). Wildland fires are more likely to occur during the 6-month dry season from December to May. The number and size of fires are likely to increase during droughts that follow El Niño seasons. (Guam HMP 2019) Figure 15 shows percent of land burned on Guam in 2019.

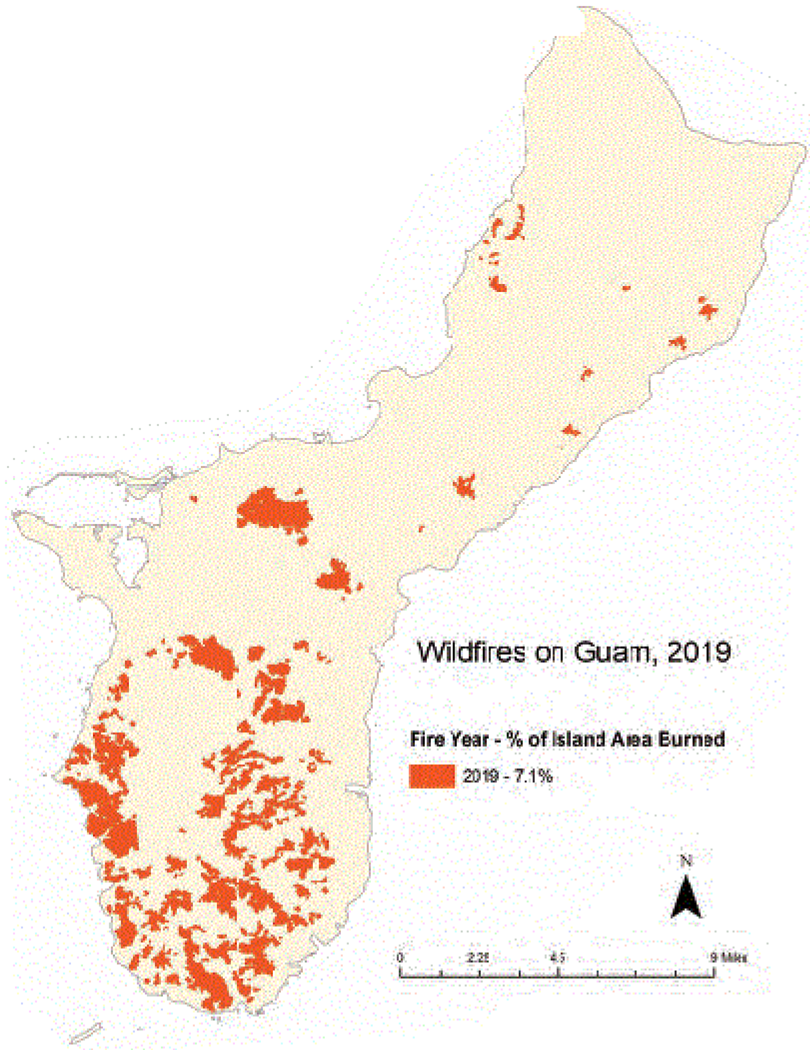

Figure 15. Percent of Wildfires on Guam, 2019 (USDA)

Wildland fires often occur in forests or other areas with dense vegetation. In addition to wildland fires, wildfires can be classified as urban fires, interface or intermix fires, and prescribed fires. The following three factors contribute significantly to wildland fire behavior and can be used to identify wildland fire hazard areas.

Topography: As the slope increases, the rate of wildland fire spread increases. South-facing slopes are also subject to more solar radiation, making them drier which can intensify wildland fire behavior. However, ridgetops may mark the end of wildland fire spread since fire spreads more slowly or may even be unable to spread downhill.

Fuel: The type and condition of vegetation plays a significant role in the occurrence and spread of wildland fires. Certain types of plants are more susceptible to burning or will burn with greater intensity. Dense or overgrown vegetation increases the amount of combustible material available to fuel the fire (referred to as the “fuel load”). The ratio of living to dead plant matter is also important. The risk of fire is increased significantly during periods of prolonged drought as the moisture content of both living, and dead plant matter decreases. The fuel’s continuity, both horizontally and vertically, is also an important factor.

Weather: The most variable factor affecting wildland fire behavior is the weather. Temperature, humidity, wind, and lightning can affect chances for ignition and spread of fire. Extreme weather, such as high temperatures and low humidity, can lead to extreme wildland fire activity. By contrast, cooling and higher humidity often signal reduced wildland fire occurrence and easier containment. Strong winds can also carry burning embers farther downwind, igniting new fires.

In addition to stripping the land of vegetation and destroying forest resources, large, intense fires can harm the soil, waterways, and the land itself. Soil exposed to intense heat may lose its capability to absorb moisture and support life. Exposed soils erode quickly and enhance siltation of rivers and streams, thereby enhancing flood potential, harming aquatic life, and degrading water quality. Lands stripped of vegetation are also subject to increased debris flow hazards.

The indirect effects of wildland fires in Guam can be catastrophic. As stated above, fires are not a natural occurrence on the island, which means that the native ecosystem is poorly adapted to burning. Thus, the native forests can be devastated by a wildland fire because the native forests plants are not adapted to revegetate after a fire. Native forestlands that have been heavily burned in Guam are often revegetated by grassland savanna. Many of these grassland plant species are nonnative species that are well adapted to repeated burning. The introduction of fire-adapted grass species to Guam has resulted in the promotion of fire on the island. When the grasses become dry during the dry season, they develop into an effective fuel source. In addition, when grasslands that are adjacent to forests burn, the forest edge is typically burned back, promoting revegetation by the non-native fire-adapted grasses. This event results in an expansion of the spatial extent of the grassland and a reduction in the size of the native forest.

Wildland fires have also contributed to a chronic erosion problem in Guam, especially in the southern half of the island. Lands stripped of vegetation are also subject to increased landslide hazards and can become incapable of revegetating. The accumulation of upland sediment onto the coral reefs of Guam is believed to be a large threat to the viability of these reefs. The die-off on the reefs off southwestern Guam has been attributed to the covering of the reef by eroded topsoil.

Erosion and sedimentation are part of the same watershed process and must be understood in its entirety to be effectively managed. The only way to successfully prevent nearshore sedimentation is to arrive at a long-term solution to upland erosion. (D. Minton 2005)

6.1 Past Wildland Fires

The National Climatic Data Center (NCDC's) Storm Event Database documents significant wildland fire events occurring in January, February, March, and April of 1998. The high number of fires incidents during this time frame was attributed to a very wet El Niño season in 1997 that was followed by a meteorological drought and heavy fuel loads from trees damaged by Super Typhoon Paka. During this period, approximately 1,400 fires burned 13,000 acres. One thousand residents were evacuated, one home was reported destroyed, and $250,000 in damage was reported. On March 23, 1998, approximately 1,000 acres were burned. On March 23, 1998, the fire suppression efforts to fight the Tiyan and Toto Complex fires were authorized by FEMA to receive fire suppression funding, under the declaration, FEMA-2197-DR-GU. In May 2001 a wildfire occurred in Barrigada that led to one injury. To date 250 wildfires burned approximately 6,448-acres of land comprising private, Government of Guam and Federal lands (4.75% total area burned island-wide) (State and Private Forestry Fact Sheet https://apps.fs.usda.gov/nicportal/temppdf/sfs/naweb/GU_std.pdf, accessed 9/5/2021).

Climate change has been increasing the length of the fire season, the size of the area burned each year and the number of wildfires on Guam. Drier conditions and higher temperatures in Guam increase not only the likelihood of a wildfire to occur but also the duration and the severity of the wildfire. Inversely large storm events contribute to erosion and sedimentation. Fires can be beneficial for the ecosystems, but changes in climatic conditions have led to uncontrolled burning. (Grenci, Z., W. Miles, R. King, A. Frazier, and V. Keener, 2020: Climate Change in Guam: Indicators and Considerations for Key Sectors. Report for the Pacific Islands Regional Climate Assessment. Honolulu, HI: East-West Center, https://www.eastwestcenter.org/PIRCA-Guam.)

7 Community Outreach

Guam is participating in the United Nations Sustainable Development Goals, founded in 2015. The Sustainable Development Goals are a universal call to action to end poverty, protect the planet and improve the lives and prospects of everyone, everywhere. The Goals were adopted by all UN Member States as part of the 2030 Agenda for Sustainable Development which set out a 15-year plan to achieve the Goals. These goals recognize that ending poverty and other deprivations must go together with strategies that improve health and education, reduce inequality, and spur economic growth – all while tackling climate change and working to preserve our oceans and forests. In September 2019, Governor Lourdes A. Leon Guerrero, and Lt. Governor Joshua F. Tenorio promulgated Executive Order 2019-23, creating an 80-member (now 99-member) Guam Green Growth Working Group (G3WG) of government, academia, private sector, non-profit, and youth partners to transition Guam toward a sustainable future. The executive order assigned the facilitation of the G3 Working Group to the University of Guam Center for Island Sustainability. The Guam Green Growth (G3) Initiative develops tangible solutions to sustainability challenges and contributes to a green economy for the island region. While G3 drives local action, it also places Guam at the global forefront of leadership in island sustainability. The network is co-chaired by the Hawaii Green Growth Hub and the Global Island Partnership. On September 23, 2020, the G3 Action Framework was signed into effect by Gov. Leon Guerrero and Lt. Gov. Tenorio. The G3 Action Framework is focused on five categories of action; 1) Healthy and Prosperous Communities; 2) Educated, Capable, and Compassionate Island; 3) Sustainable Homes, Utilities, and Transportation; 4) Thriving Natural Resources; and 5) Sustainable Alliances. There are 17 goals associated with the five categories of action, Figure 16.

Figure 16. United Nations 17 Sustainable Development Goals

While all 17 goals may be linked to the six problems identified in this Watershed Assessment the goals for Clean Water and Sanitation (6), Industry, Innovation, and Infrastructure (9), Sustainable Cities and Communities (11), Climate Action (13), Life Below Water (14), Life on Land (15), and Partnerships for the Goals (17) are especially relevant.

High priority outreach programs identified in the 2021 G3 Action include:

- Plastic Bag Ban (Mungnga Ma Ayek Act)
- Public outreach on the importance of stormwater drains and anti-litter campaigns
- Promote community walking, wheeling, and biking programs
- Promote opportunities for employment of residents in Guam
- Education on new construction permitting with best practices to ensure energy efficiency
- Re-evaluation and education of hotels waste management practices
- Conduct outreach to local business to ensure seamless transition from Styrofoam to eco-friendly options
- Education on minimization of fats, oils, and grease into the sewer system
- Increased conservation outreach to increase awareness amongst the Guam population on forest, soil, water quality, invasive species etc.
- Promote watershed concepts in public school teaching programs
- Outreach program for fisheries stock status, enforcement, and laws and regulations

- Increase climate literacy (education of all about climate change, its' impacts, and solutions)
- Better management, elimination, and control of invasive species
- Improve compliance and enforcement of all regulations

The University of Guam (UOG) Center for Island Sustainability (CIS) works with the community, non-profits, and government to conduct sustainability-related research. The CIS oversees the Guam Green Growth Conservation Corps to educate members on green economy and offers workforce training in sustainability areas such as island beautification, agriculture and aquaculture, circular economy (an economic system that tackles global challenges like climate change, biodiversity loss, waste, and pollution), reusing and recycling, invasive species removal, reforestation, and energy efficiency. The CIS conducts outreach to all ages to raise awareness on common environmental issues and promote sustainable practices. Other partners include UOG Sea Grant and Guam Ecosystems Collaboratorium for Corals and Oceans.

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