The Commonwealth of the Northern Mariana Islands

Final Watershed Plan

APPENDIX D

Environmental Resources Analysis

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US Army Corps
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1 Land Use

Saipan is located about 120 miles (190 km) north of Guam and 5 nautical miles (9.3 km) northeast of Tinian, from which it's separated by the Saipan Channel. Saipan is about 12 miles long and 5.5 miles wide. Saipan is the capitol and the largest and most populated island in The Commonwealth. Tinian is about 5 nautical miles southwest of Saipan, separated by the Saipan Channel. It has a land area of 39 square miles, with its highest elevation at Mount Lasso (561 ft). Rota is the southernmost island of the United States Commonwealth of the Northern Mariana Islands (CNMI) and the second southernmost of The Marianas Archipelago. It lies approximately 40 nautical miles north-northeast of Guam. Sinapalo village is the largest and most populated followed by Songsong village. Figure 1 shows all the CNMI islands and coral reef topography. (DPL, 2019)

Well-planned and strategic land use is especially critical for islands with limited land mass and numerous and sometimes competing land use needs. It is also essential to ensure that supporting infrastructure – from power, water, and wastewater to roads, waste management, transportation services, and emergency response facilities are well distributed to meet community needs (CSDP, 2021).

The 2020 census reported the total population of CNMI as 53,883. Saipan has 48,220 residents, Tinian 3,136, and Rota 2,527 (https://www.census.gov/history/pdf/sis_2020map_cnmi.pdf). Total "developed" land area is 10.69%, 9.0%, and 8.29% on Saipan, Tinian, and Rota respectively including cropland. Land cover analysis for Saipan from 1978 to 2009 reveals that developed areas increased more than 10% from 1978 to 2009, and most of the changes came from forest and grassland. As the capital of CNMI, Saipan contains most of the residential, tourist, and commercial facilities and the least number of public lands available for development due to steep slopes. Out of the 7,000 acres of vacant public land only 54 acres are considered eligible for development. Casino's, hotels, and shopping, and cultural sites areas are the main attractions for tourists. Saipan has 22 Formerly Used Defense Sites (FUDS), unexploded ordinances (UXOs), and brownfields containing hazardous petroleum tanks. A Records search found UXOs present from the former Kagman Airfield with bomb bunkers, Aguijan Island (target for bombing and close proximity to Saipan/Tinian) during WWII, Tinian Harbor, Naftan Ordnance Disposal/Naftan Bomb Storage, Tanapag Fuel Farm, Angel Falig Property, CPA Buried Drum Site, Lau Lau Trail Tract 41-2, Masalog Ridge, Pina Plateau, and Masalog Site. Government offices, hospitals, port facilities, schools and fire stations comprise most of the public facilities. There are approximately 2,000 agricultural and village homesteads. Homesteads are for residents without village lots to farm or establish housing. The Department of Public Lands manages the homesteading program and provides eligible residents 800 to 1000 m^2 lots for residential use and agricultural lots of 10,000 m^2 for subsistence farming (DPL,2019). Figure 2 illustrates land uses on Saipan (DPL, 2019).

Tinian is 25,148 acres. Private lands are 10% (2,367 acres) of the area and public lands are 90% (22,681 acres). There are 2,874 acres of vacant public lands but only 1,549 acres available for development (slopes less than 10%, not leased by military, or held as homesteads). The northern portion of Tinian is largely occupied by U.S. Military. Public lands are limited to the southern area. Garment manufactures and casino and hotels once attracted workers and tourists to Tinian however these businesses closed in 2015. Tinian's contains protected areas along the coastline. These conservation areas along with cultural and historical sites attract visitors. The U.S. Military has inventoried areas of potential environmental concerns and military munition sites. Most of the areas are on military leased lands with no residential occupancy. Commercial development is small and consists of basic services such as restaurants and small shopping stores near schools, government, and other businesses. Agriculture and ranching

lands are an active component of Tinian. There are approximately 900 agricultural and village homesteads. Figure 3 illustrates land uses in Tinian (DPL, 2019).

Rota is 21,037 acres and the southernmost of the islands, approximately 40 miles northeast of Guam. Private lands are 28% (5,960 acres) and public lands are 72% (22,682 acres). Rota has 6,469 acres of vacant public lands but only 956 acres available for development due to steep topography. Rota is the least populated area in this assessment and has many natural, historical, and cultural resources. The major population centers are Songsong and Sinapalo. Rota is known as the “Friendly Island”. Tourists are attracted to Rota for exceptional bird viewing and water sports. There is one golf course on the island but no major hotels or casinos. Three FUDS sites are present on Rota. Unlike the other islands Rota was never invaded during World War II and thus retains much of its original limestone forests. There are approximately 1,000 agricultural and village homesteads. Future land uses forecasted for Rota include eco-tourism, solar farms, and nature preserves. Figure 4 illustrates land uses on Rota (DPL, 2019).

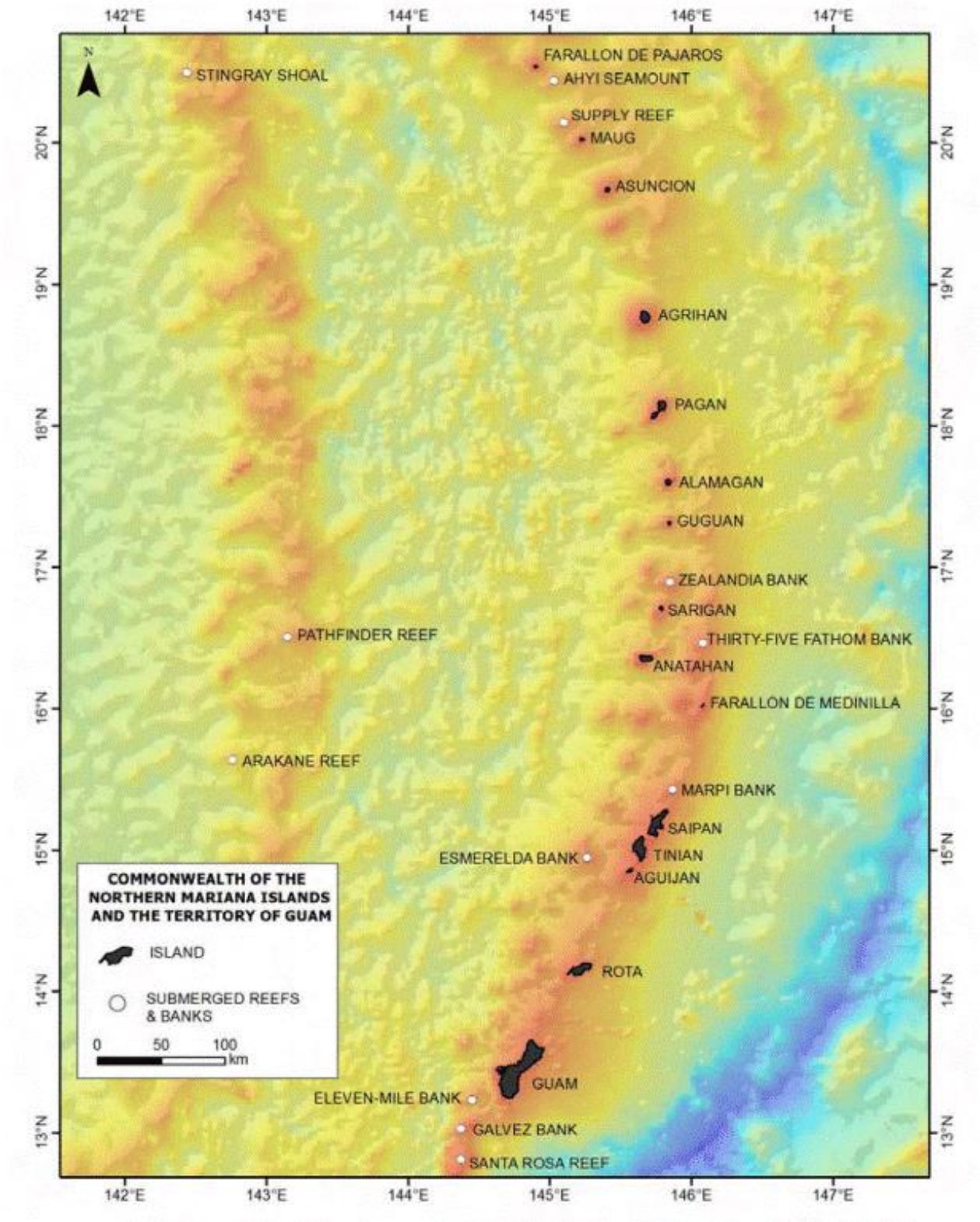


Figure 1. CNMI Map (DPL, 2019)

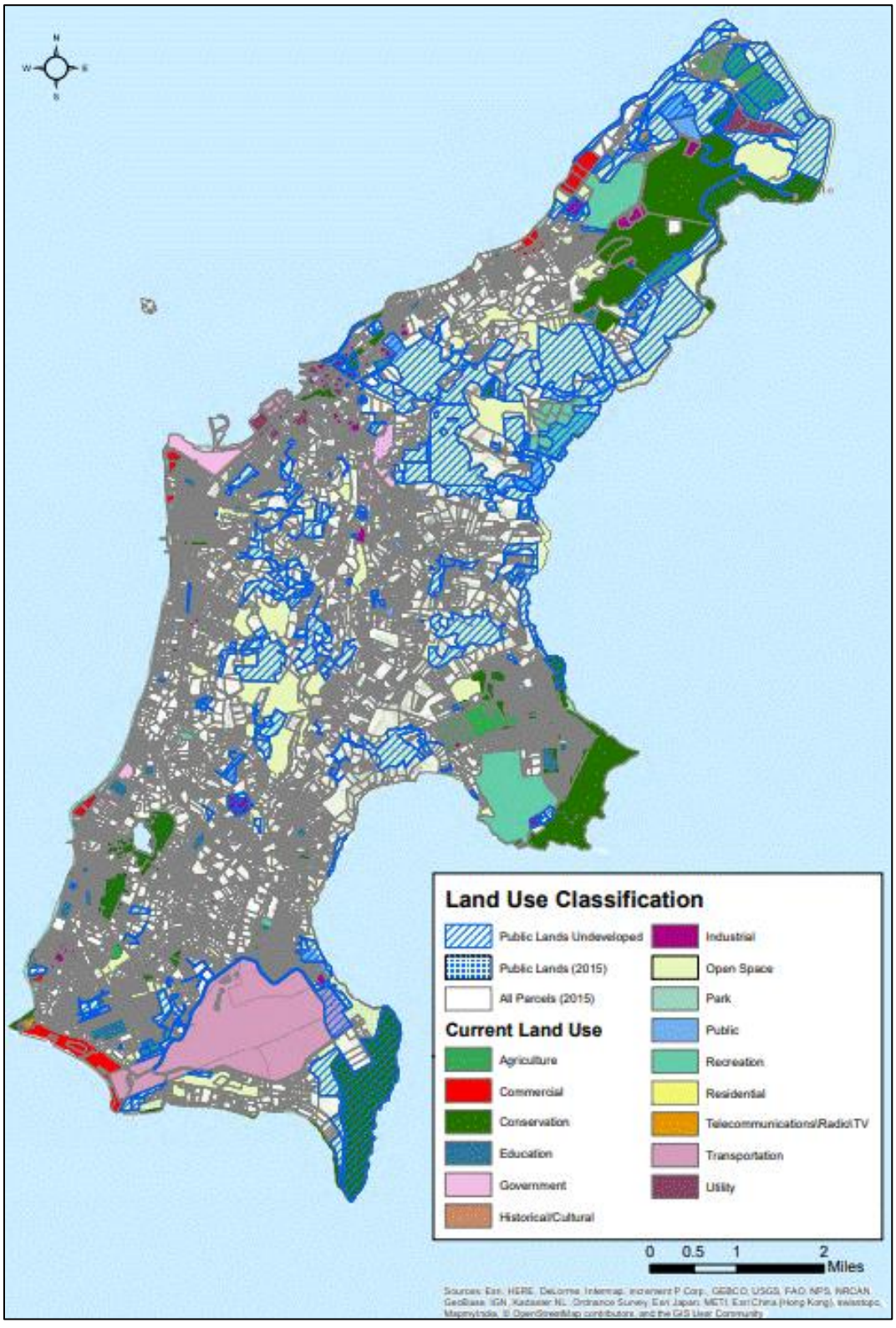


Figure 2. Saipan Land Use Classification (DPL, 2019)

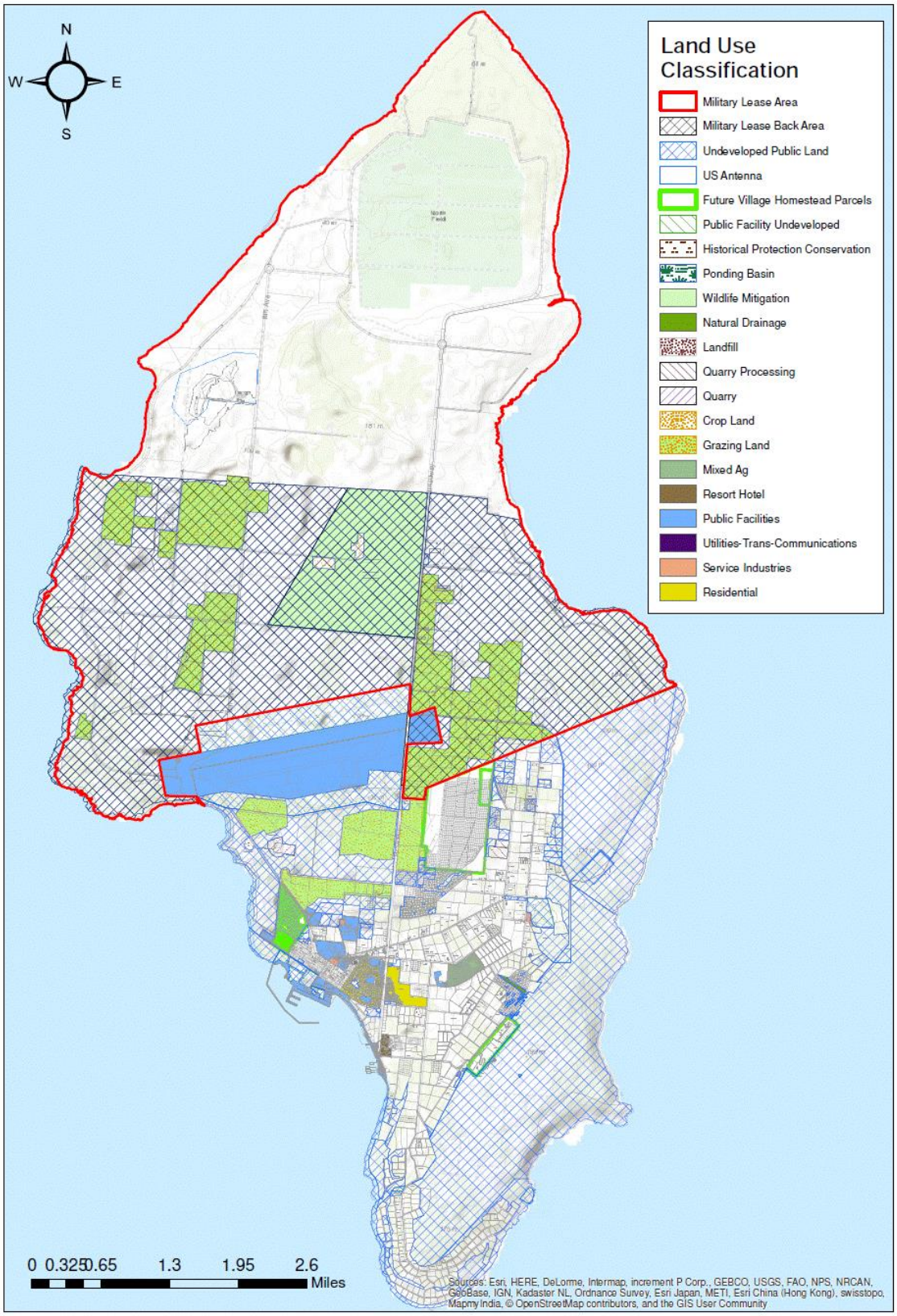


Figure 3. Tinian Land Use Classifications

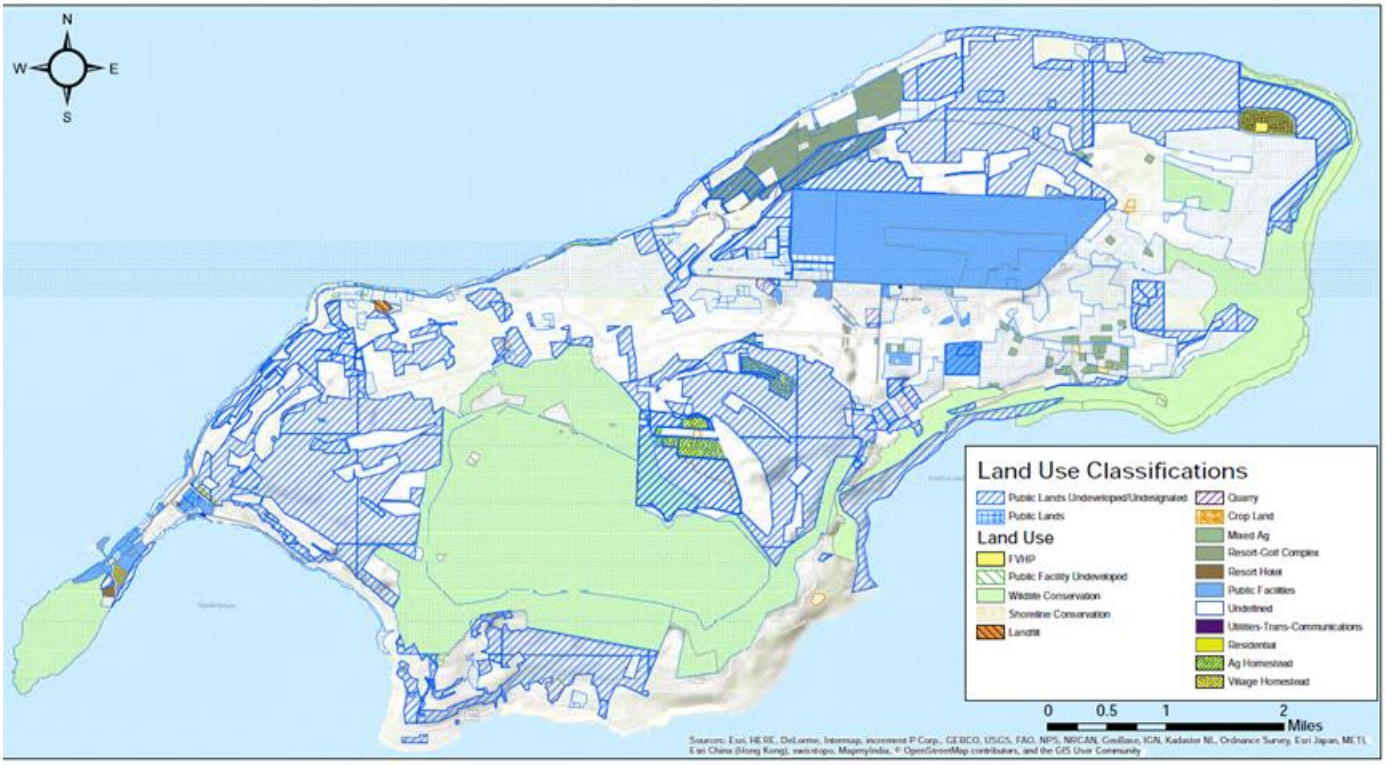


Figure 4. Rota Land Use Classifications

"Land clearing and development" has been identified as an environmental driver that in some cases may lead to negative impacts to important resource categories such as native forest cover, water quality, and biodiversity. Numerous federal and state regulations are in place to support wise development that does not compromise the values of these precious natural resources. Land development in CNMI starts with obtaining land rights and permitting. On Saipan, a development permit from Zoning must be obtained before the environmental clearance application process begins. Bureau of Environmental and Coastal Quality (BECQ) and Department of Environmental Quality (DEQ) review permits to ensure compliance with wastewater and stormwater management standards and that the development compliant with related air, water, and land regulations. As established by a Memorandum of Understanding, DEQ also manages the "One-Start" process by routing the application to partner regulatory agencies – Department of Land and Natural Resources (DLNR) Division of Fish and Wildlife reviews the proposal to ensure no significant negative impacts to wildlife or important habitat; the Historic Preservation Office (HPO) reviews for compliance with cultural resource management standards; and the Division of Coastal Resources Management (DCRM) reviews to ensure no significant negative impacts to coastal resources. If a project is in an "Area of Particular Concern" (APC), DCRM will issue an "APC" permit with additional conditions to protect important coastal resources such as corals and seagrass and wetlands, and to ensure early coordination with the Department of Public Work's (DPW) Floodplain Administrator and Building Code Division (BCD) if a project is in a high hazard flood zone. The BCD also issues final Certificates of Occupancy to completed developments to uphold Public Law No. 6-45 and ensure that all buildings are held to minimum safety standards of the International Building Code. Through enforcement and inspection, DPW-BCD works to promote the health, safety, and general welfare of the people of the Commonwealth of the Northern Mariana Islands in the built environment. For projects that exceed certain size, utility demand, or operational

thresholds, a "Major Siting" permit is required. This triggers a more extensive application and review process with the Coastal Resources Management Agency Board (CRM Board). The CRM Board is composed of appointed representatives from DCRM, DEQ, DPW, DLNR, HPO, and the Commonwealth Utilities Corporation (CUC). The Major Siting permit is issued to ensure the project avoids, minimizes, or mitigates all agency and public concerns regarding significant impacts (see Public Law 3-47, 2 CMC §§ 1500 et seq.) (DPL, 2019).

Land use management planning works to balance the needs of development with the maintenance of critical ecosystem services. The natural world provides many protective functions to the built environment for little or no cost. These services can degrade over time if natural resources are not protected, conserved, and managed. Also, as the climate changes and new weather patterns develop, the level of protection provided by natural features may change. For example, as sea levels rise, waves may overtop the barrier reef with more energy, resulting in more wave-run up and beach erosion. Establishing living shorelines by planting native coastal vegetation (or selected introduced species) is an example of green infrastructure that can slow coastal erosion. Watersheds provide other essential ecosystem services such as increased water infiltration, reduced stormwater run-off, increased water recharge potential, and improved near-shore water quality. Increasingly, "nature-based solutions" are being hailed as interventions that provide cost-efficient and long-lasting co-benefits to people, economies, and the environment. Under Public Law 20-20, 2017, which established the Office of Planning and Development for CNMI, the CNM Comprehensive Sustainable Development Plan was enacted and a clearing house of existing plans established, which are listed in Table 1 below (CSDP, 2021).

Table 1. Relevant Plans from Office of Planning and Development Comprehensive Sustainable Development 2021

PLANNING AREA PUBLIC LAW 20-20 § 20176	RELEVANT PLANS AND STANDARDS	PLANNING AND POLICY RECOMMENDATIONS
(A) LAND USE	2019 DPL Public Land Use Plan Saipan Zoning Plan & Regulations BECQ-DCRM & DEQ Management Standards and Requirements DLNR-DFW State Wildlife Action Plan HPO – Management Plan and Regulations	• Include SSG considerations in PLUP and SSMP updates • Continue using watershed management planning to integrate development policies and identify priority actions with incorporation of these plans by reference as they are completed • Incorporate updated HPO plan and regulatory requirements into cultural resources section by 2022 • Include OPD as Ad Hoc member for Zoning Board and CRM Agency Board to support
(B) COMMUNITY DESIGN	CNMI Smart Safe Growth Guidance NMHC Disaster Action Plan State Standard Mitigation Plan	• Incorporate SSG policy throughout planning, project prioritization, and implementation across sectors • Include updated asset vulnerability assessments to be produced in 2020 PDM grant task into geospatially reference "Resilience Hubs" data set to support planning, project scoping, and early issue identification
(C) TRANSPORTATION	DPW Territorial Highways Plan (THP) and Implementation Plan COTA – Territorial Implementation Plan CPA	• Projects are listed in THP as well as COTA and CPA planning documents by 2025 unified comprehensive transportation planning element for endorsement with decadal updates starting in 2030
(D) REGULATIONS	See SSG recommendations	• Line agencies include planning periods in ongoing regulation updates to solidify planning horizons and coordination with OPD and partners
(E) PUBLIC FACILITIES	SSG, CEDS	• OMB/CIP have endorsed use of SSG in project planning; by 2025 work with OGM, NMHC, and CEDS Commission to update public buildings and utilities plan with inclusion of prioritized projects list

PLANNING AREA PUBLIC LAW 20-20 § 20176	RELEVANT PLANS AND STANDARDS	PLANNING AND POLICY RECOMMENDATIONS
(F) PUBLIC LANDS	PLUP, CEDS	• Work with DPL to incorporate watershed management plan components into 2030 update of PLUP
(G) PUBLIC BUILDINGS	SSG, CEDS	• OMB/CIP have endorsed use of SSG in project planning; by 2025 work with OGM, NMHC, and CEDS Commission to update public buildings and utilities plan with inclusion of prioritized projects list
(H) HOUSING	NMHC	• NMHC to include plan updates in CEDS project listings and CSDP goals and objectives by 2030
(I) REDEVELOPMENT	NMHC, Zoning, DPL, Garapan CID*	• Incorporate CIDs into CSDP by reference as they are adopted • Work with Zoning, DPL, and NMHC to create and fund revitalization incentives and requirements under the Blighted Buildings Zoning Law to support reuse of existing resources • Identify and fund brownfield remediation on public lands and in identified redevelopment opportunity areas (in and in proximity to CIDs) • By 2025 include expanded, targeted redevelopment planning elements in CSDP
(J) CONSERVATION	SWAP, SLUMP, SCORP, HPO	• Work with BECQ, DLNR, DPL, HPO, and other partners to align planning priorities and implement Specific, Measurable, Achievable, Realistic, and Time-bound Objectives
(K) RECREATION	SCORP, SLUMP	• Continue to work to assess and build site carrying capacity and invest in development and maintenance of priority recreation facilities
(L) SAFETY	CHCC	• CHCC planning updates are incorporated by reference into CSDP
(M) TOURISM	MVA	• MVA updates and incorporates Strategic • Plan Toward Sustainable Tourism • Industry by 2026
(N) DEVELOPMENT POLICY	CSDP, CEDS	• Incorporate CIDs into CSDP by reference as they are adopted • Include SSG principles and prioritized projects in CEDS updates every five years

PLANNING AREA PUBLIC LAW 20-20 § 20176	RELEVANT PLANS AND STANDARDS	PLANNING AND POLICY RECOMMENDATIONS
(O) CAPITAL IMPROVEMENTS		• OMB/CIP have endorsed use of SSG in project planning; by 2025 work with OGM, NMHC, and CEDS Commission to update public buildings and utilities plan with inclusion of prioritized projects list ◦ Integrated Solid Waste Management Plan for Saipan, Tinian, Rota, and the Northern Islands is drafted and approved by PDAC for incorporation into CSDP by 2023
(P) LABOR WORK FORCE	CEDS	• DOL and DOC to work with OPD and CEDS commission to develop Labor Work Force plan with contingencies for CW expiration addressed and included by 2025 • To improve intra-government training and staffing patterns, a formal desk audit of all CNMI agencies that includes assessment of compensation rates and benefits as well as incentives for continuing education and training plan recommendations is suggested
(Q) POLICY STATEMENTS		• Policy statements are regularly reviewed and updated on a five-year planning cycle with changes incorporated by reference and explicitly into decadal CSDP updates
R) OTHER ELEMENTS:		
I. EDUCATION	PSS, NMC Strategic Plans	• Regularly convene education partners to share and build on updated goals and objectives.
II. HEALTHCARE	CHCC Strategic Plan	• Mainstream SSG policies across planning sectors
III. COMPREHENSIVE RESILIENCY	Standard State Hazard Mitigation Plan, SSG Guidance	• Support Resiliency Taskforce to mainstream sustainability objectives

The CSDP outlines goals and principles for Smart, Safe Growth, Adaptive Management Planning, and Sustainable Development. Sustainable Development Goals (SDG) for land use management in the next 10 years includes integration of CNMI's State Outdoor Recreation Plan (SCORP) into public land use and transportation planning. The SCORP aims to ensure wise use of resources and positive growth outcomes for the people, environment, and the economy. The primary purpose of the SCORP is to lay out a vision for future parks, recreation, and open space and serve as a roadmap to guide future funding priorities across a range of stakeholders with a focus on conservation planning and alignment with local watershed and zoning plans. As referenced in the begging of this land use section FUDS, UXOs and brownfields are present throughout CNMI. The USACE maintains a list of FUDS. A property is eligible for inclusion in the Defense Environmental Restoration Program – FUDS if the property was under the jurisdiction of the Secretary of Defense and owned by, leased to, or otherwise possessed by the U.S. and transferred prior to 17 October 1986. The CNMI FUDS list is accessible at https://www.usace.army.mil/Missions/Environmental/Formerly-Used-Defense-Sites/FUDS-Inventory. A total of 25 FUDS locations were listed (22 on Saipan and three on Rota).

The CNMI BECQ DEQ maintains a Brownfields Hazardous Substances and Petroleum Sites inventory. A total of 30 were listed in the BECQ's website with 28 sites of concern. Saipan alone had 23 brownfield sites due to soil contamination from UXO, fuels, illegal dumping, transformer oil, and unknown contaminants. The following figures, 5 – 8, show land use areas of concern - FUDS, Brownfield Hazardous Substances & Petroleum Sites - for Saipan, Tinian, and Rota. Most of the hazardous waste is shipped off island for disposal.

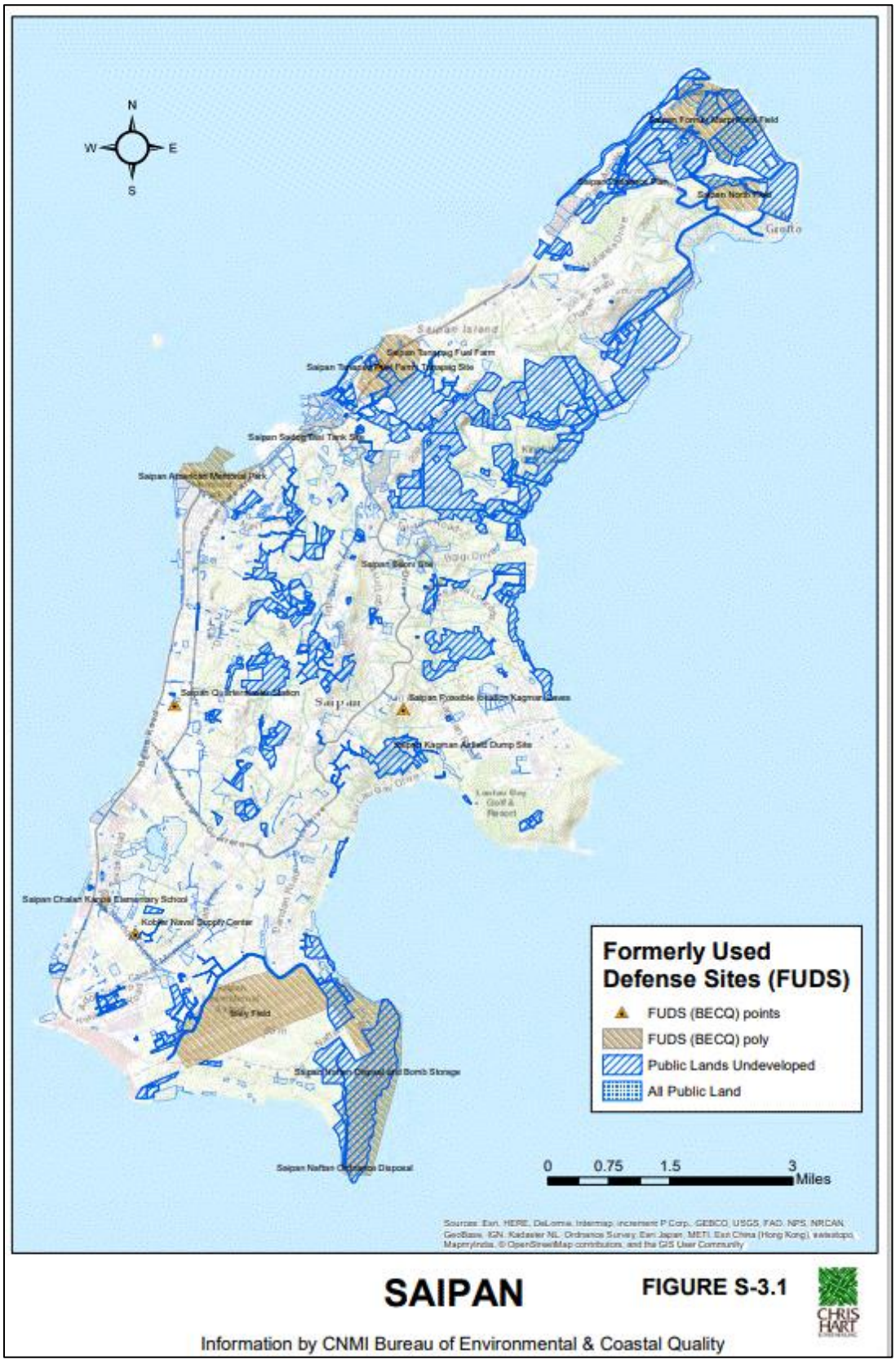
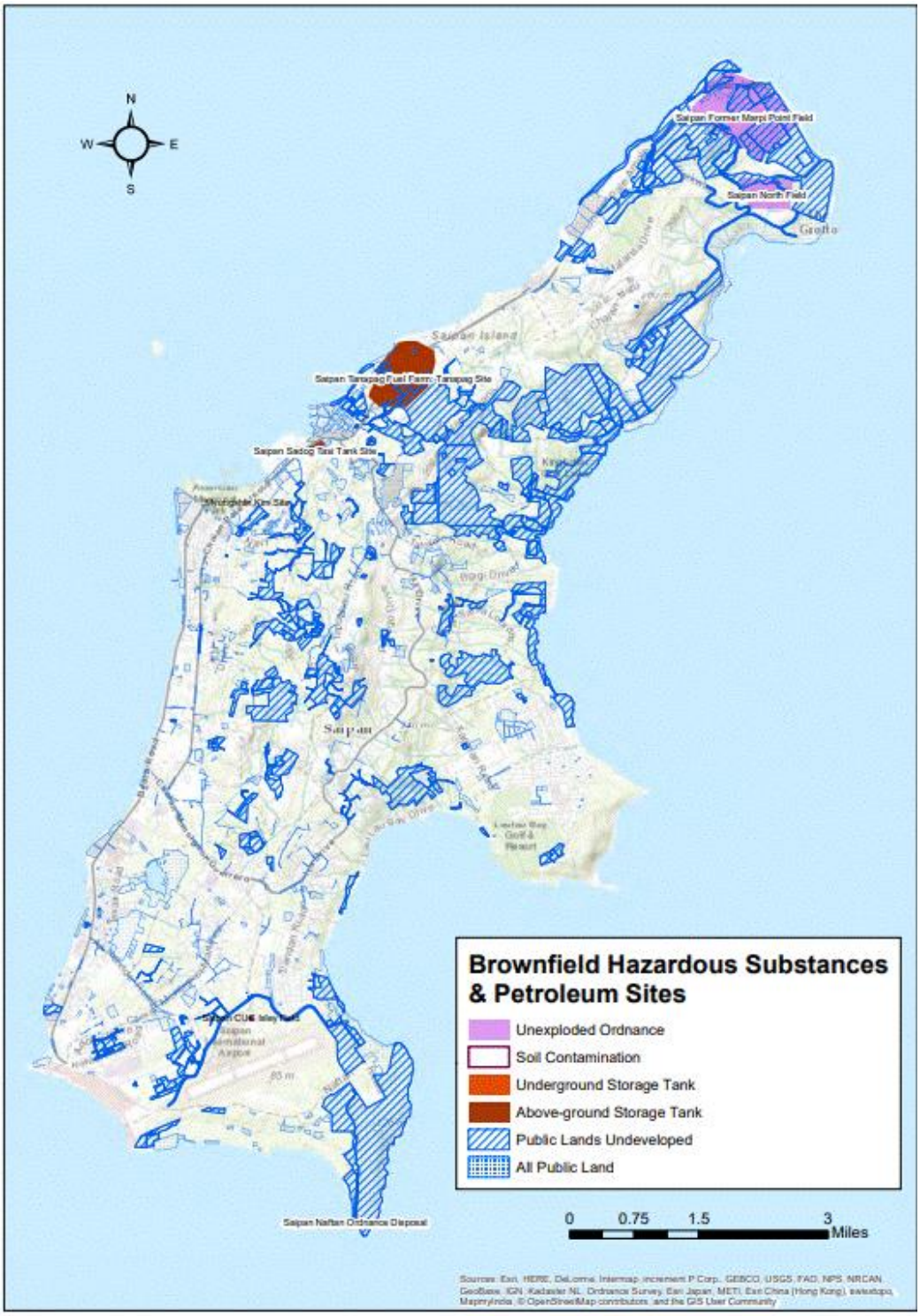


Figure 5. Saipan FUDS (DPL, 2019)



SAIPAN **FIGURE S-3.4**

Information by CNMI Bureau of Environmental & Coastal Quality

Figure 6. Saipan (DPL, 2019)

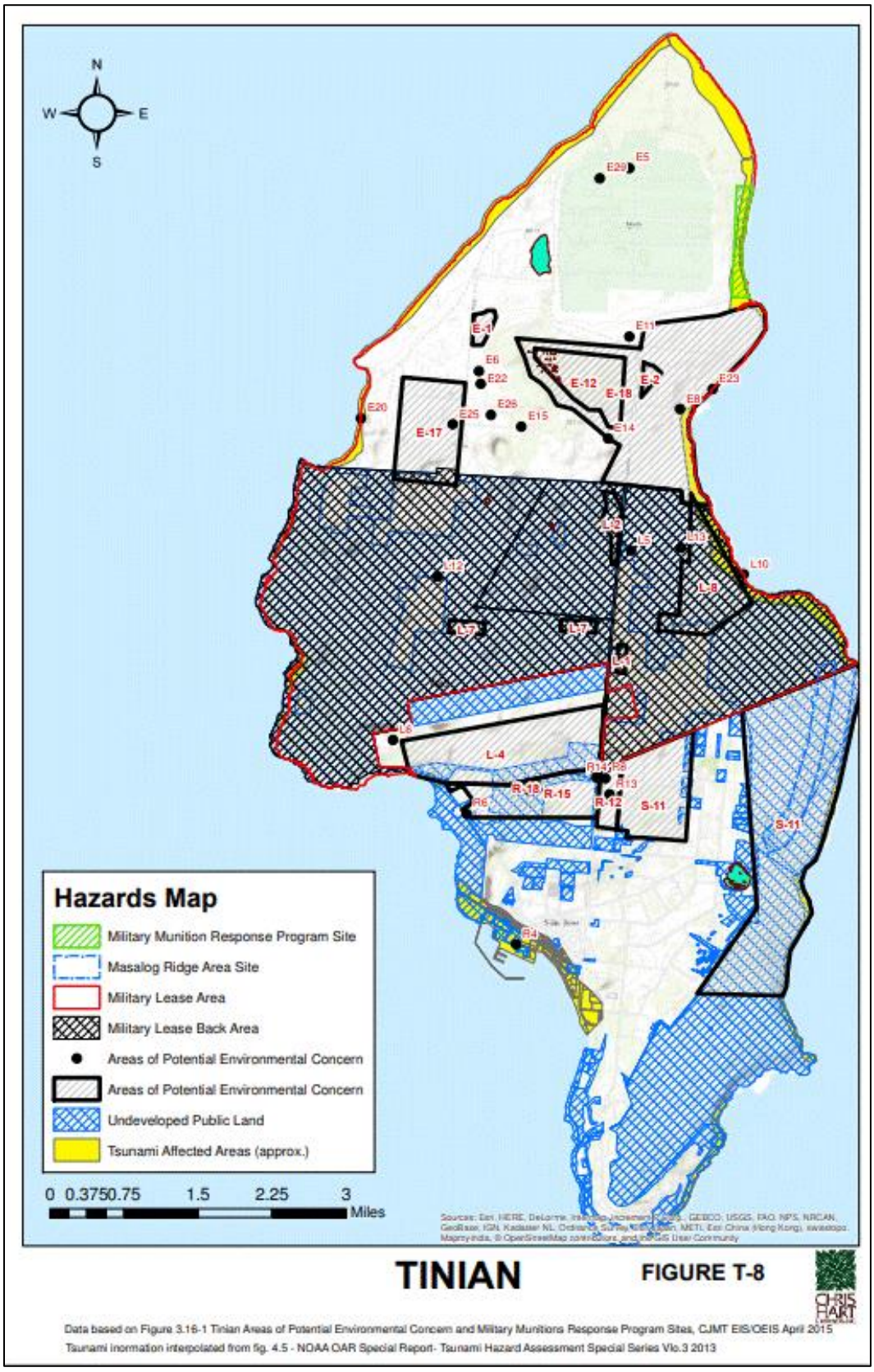


Figure 7. Tinian Environmental Areas of Concern

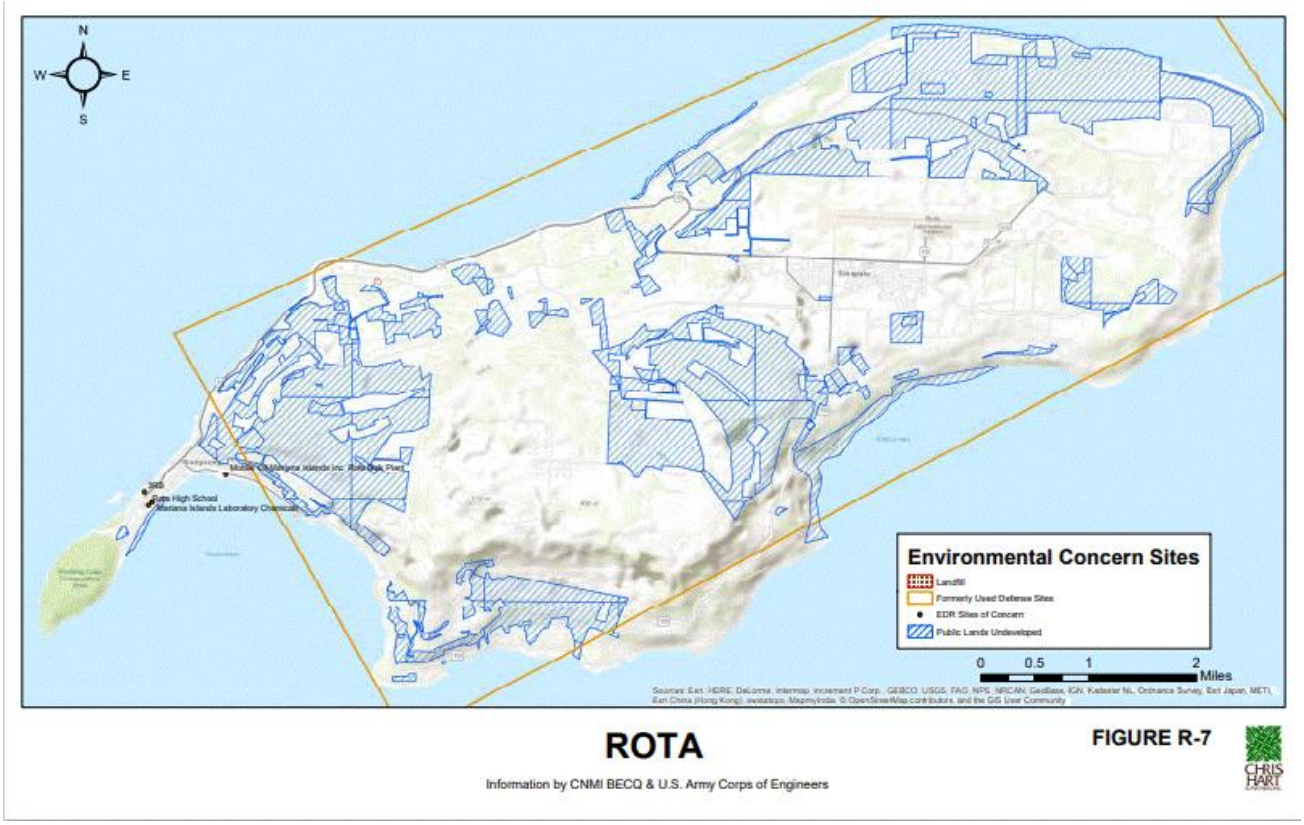


Figure 8. Rota Environmental Areas of Concern

2 Terrestrial Habitats

Forests are the most abundant and valuable terrestrial habitats in CNMI. There are four major classifications of forests in CNMI. Native Limestone Forests which contain a high number of native species, Mixed Forest which contains both native and nonnative species, Tangantangan Forests contain the introduced Tangantangan (*Leucaena leucocephala)* tree, established in the early 1900s following World War II, Agroforest are forested areas that have been planted with tropical food trees. The acres of forest by island are as follows; Saipan 17,101, Tinian 16,436, and Rota 13,111 which equals approximately 75% of all forested lands in CNMI, with approximately 50% being native forest. Limestone forests are most abundant on the less populated island of Rota. Mixed forests occur in areas that were cleared for agriculture or development and have some disturbed soils. Tangantangan forests are abundant on Saipan and Tinian with small patches on Rota. Although introduced these forests provide habitat for protected avian species. Agroforests are present on Saipan, Tinian, and Rota. Figure 101 show Land Cover Classifications (SWAP, 2015).

Land clearing for agriculture, development (residential, commercial, military) is the main driver for decline of native forest. Other factors contributing to loss of native forests includes wildfires, feral ungulates (deer, pigs) which graze on native seedlings, spread invasive species, and contribute to a decline in pollinators.

The CNMI has three Integrated Watershed Management Plans (IWMPs) for adaptive 'ridge to reef' management of three priority watersheds-- Garapan, Lao Lao, and Talakhaya. The Garapan IWMP focuses on urban stormwater management, addressing polluted runoff from Saipan's dense center of commerce and tourism. The Lao Lao IWMP helps protect the coral of

Lao Lao Bay—a prized cultural, recreational, and tourism resource—from upland erosion and sedimentation. The Talakhaya IWMP highlights reforestation of highly erodible soils in a remote watershed on the island of Rota. Illegal fires, set by hunters to expose deer, have created large barren areas that cause erosion. Over the past ten years, volunteers have re-planted rocky badlands with almost 400,000 vetiver plants, a grass renowned for its ability to naturally prevent erosion. As a result, less harmful sediment washes onto the reef below. The rows of grass also help retain nutrient-rich soil for the establishment of native forest. Currently updates are underway for all these watersheds. While these updates have all been delayed due to Covid-19, publications are forthcoming.

The following tables are taken from the 2015 - 2025 State Wildlife Action Plan. These display threats to terrestrial and marine species. Threats were scored based on irreversibility of the negative effects of the threat on the species.

Very High	Effects of the threat cannot be reversed, and it is very unlikely the species can be restored, and/or it would take more than 100 years to achieve this (e.g., wetlands converted to a shopping center)
High	Effects of the threat can technically be reversed, and the species restored, but it is not practically affordable and/or it would take 21 – 100 years to achieve this (e.g., wetland converted to agriculture)
Moderate	Effects of the threat can be reversed, and the species restored with a reasonable commitment of resources and/or within 6 - 20 years (e.g., ditching and draining of a wetland)
Low	Effects of the threat are easily reversible and the species can easily be restored at a relatively low cost and/or within 0 – 5 years (e.g., off-road vehicles trespassing in a wetland)

Table 2. Threats to Terrestrial Species

Threats Across Terrestrial Species	Micronesian Megapode	Wedge-tailed Shearwater	White-tailed Tropicbird	Red-tailed Tropicbird	Masked Booby	Brown Booby	Red-footed Booby
Brown Tree Snake	Medium		Medium	Medium	Medium	Medium	Medium
Invasive vines	High						
Commercial development (e.g. resorts)	Medium	Low					
Volcanic activity	High	Medium	Medium	Medium	Medium	Medium	Medium
Military expansion	Low	Low	Low	Low	Low	Low	Low
Typhoons (climate change)	Medium	Low	Low	Low	Low	Low	Low
Altered precipitation patterns (climate change)							
Curious Skink, Carlia ailanpalai							
Sea level rise (climate change)		Low					
Feral ungulates/deer	Low						
New invasive ants (i.e. little fire ant)	Medium		Medium	Medium	Medium	Medium	Medium
Marine debris		Medium	Medium	Medium	Medium	Medium	Medium
Poaching/human persecution							
Invasive flatworm, Platydemus manokwari							
Oceanic Skink, Gehyra oceanica							
Residential development	Low						
Cat predation	Medium						
Agricultural homestead development	Low						
Non-native insects							
Temperature rise (climate change)							
Wildfire	Low						
Pesticide use							
Rats		Medium	Medium	Medium	Medium	Medium	Medium
Incompatible recreational use (human disturbance)		Low					
Unsustainable or unknown harvest							
Black drongos							
Cockroaches							
Invasive snail, Euglandina rosea							
Shrew, Suncus marinus							
Vegetation encroachment							
Artificial lighting							
Monitor lizards							
Overall Threat Status	High	Medium	Medium	Medium	Medium	Medium	Medium

Threats Across Terrestrial Species	Great Frigatebird	Yellow Bittern	Pacific Reef-heron	Mariana Common Moorhen	Grey-backed Tern	Sooty Tern	Brown Noddy	Black Noddy
Brown Tree Snake	Medium	High		High	Medium	Medium	Medium	Medium
Invasive vines		High						
Commercial development (e.g. resorts)		Medium	Low	Medium				
Volcanic activity	Medium		Medium		Low	Medium	Medium	Medium
Military expansion	Low	High	Low	Medium	Low	Low	Low	Low
Typhoons (climate change)	Low	Medium	Medium		Low	Low	Low	Low
Altered precipitation patterns (climate change)				Medium				
Curious Skink, Carlia ailanpalai								
Sea level rise (climate change)			Medium					
Feral ungulates/deer		Low						
New invasive ants (i.e. little fire ant)	Medium				Medium	Medium	Medium	
Marine debris	Medium		High		Medium	Medium	Medium	Medium
Poaching/human persecution								
Invasive flatworm, Platydemus manokwari								
Oceanic Skink, Gehyra oceanica								
Residential development		Medium		Medium				
Cat predation				Medium				
Agricultural homestead development		Medium		Low				
Non-native insects								
Temperature rise (climate change)								
Wildfire		Low						
Pesticide use				Medium				
Rats	Medium				Medium	Medium	Medium	Medium
Incompatible recreational use (human disturbance)			Low					
Unsustainable or unknown harvest								
Black drongos								
Cockroaches								
Invasive snail, Euglandina rosea								
Shrew, Suncus marinus								
Vegetation encroachment				Low				
Artificial lighting								
Monitor lizards								
Overall Threat Status	Medium	High	Medium	High	Medium	Medium	Medium	Medium

Threats Across Terrestrial Species	White Tern	White-throated Ground Dove	Mariana Fruit Dove	Mariana Swiftlet	Collared Kingfisher ssp. albicilla	Collared Kingfisher ssp. orii (Rota)	Collared Kingfisher ssp. owstoni
Brown Tree Snake	Medium	Very High	Very High	High	High	Very High	
Invasive vines		High	High				
Commercial development (e.g. resorts)		Low	Medium	Medium	High		
Volcanic activity	Medium	Medium					High
Military expansion	Medium	Medium	Medium		High		Medium
Typhoons (climate change)	Low	Medium	Low	Low	High	High	Medium
Altered precipitation patterns (climate change)							
Curious Skink, Carlia ailanpalai							
Sea level rise (climate change)							
Feral ungulates/deer		Medium	Medium	Low			
New invasive ants (i.e. little fire ant)							
Marine debris	Medium						
Poaching/human persecution							
Invasive flatworm, Platydemus manokwari							
Oceanic Skink, Gehyra oceanica							
Residential development		Low	Medium	Low			
Cat predation							
Agricultural homestead development		Low	Low				
Non-native insects							
Temperature rise (climate change)							
Wildfire		Low	Low				
Pesticide use				Low		Medium	
Rats				Low	Medium	Medium	Medium
Incompatible recreational use (human disturbance)				Low			
Unsustainable or unknown harvest							
Black drongos						Medium	
Cockroaches				Medium			
Invasive snail, Euglandina rosea							
Shrew, Suncus marinus							
Vegetation encroachment							
Artificial lighting							
Monitor lizards							
Overall Threat Status	Medium	High	High	Medium	High	High	Medium

Threats Across Terrestrial Species	Micronesian Honeyeater ssp. asuncionis	Micronesian Honeyeater ssp. saffordi	Rufous Fantail ssp. mariae (Rota)	Rufous Fantail ssp. saipanensis	Tinian Monarch	Mariana Crow
Brown Tree Snake		Very High	Very High	Very High	Very High	Very High
Invasive vines		High	Medium	High	High	High
Commercial development (e.g. resorts)		High		High	High	Medium
Volcanic activity	Medium					
Military expansion	Medium	Low		High	High	
Typhoons (climate change)	Low	Medium	Medium	Medium	Medium	Medium
Altered precipitation patterns (climate change)						
Curious Skink, Carlia ailanpalai						
Sea level rise (climate change)						
Feral ungulates/deer			Low			Medium
New invasive ants (i.e. little fire ant)						
Marine debris						
Poaching/human persecution						High
Invasive flatworm, Platydemus manokwari						
Oceanic Skink, Gehyra oceanica						
Residential development		Medium		Medium	Medium	Medium
Cat predation		Medium	Low	Medium		High
Agricultural homestead development		Medium	Low	Medium	Medium	Low
Non-native insects						
Temperature rise (climate change)						
Wildfire		Low	Low	Low	Low	Medium
Pesticide use						
Rats						
Incompatible recreational use (human disturbance)						
Unsustainable or unknown harvest						
Black drongos						
Cockroaches						
Invasive snail, Euglandina rosea						
Shrew, Suncus marinus						
Vegetation encroachment						
Artificial lighting						
Monitor lizards						
Overall Threat Status	Medium	High	High	Very High	Very High	Very High

Threats Across Terrestrial Species	Nightingale Reed-warbler	Bridled White-eye	Rota White-eye	Golden White-eye	Micronesian Starling ssp. aeneus	Micronesian Starling ssp. guami	Pacific Sheath-tailed Bat
Brown Tree Snake	Very High	Very High	Very High	Very High			
Invasive vines	High	High	High	High			
Commercial development (e.g. resorts)	High	High		Medium			
Volcanic activity	Low				Low		
Military expansion		Medium			Medium	Medium	
Typhoons (climate change)	Medium	Medium	High	Low	Low	Medium	Medium
Altered precipitation patterns (climate change)							
Curious Skink, Carlia ailanpalai							
Sea level rise (climate change)							
Feral ungulates/deer			Medium	Medium			Low
New invasive ants (i.e. little fire ant)							
Marine debris							
Poaching/human persecution	Low						
Invasive flatworm, Platydemus manokwari							
Oceanic Skink, Gehyra oceanica							
Residential development	Low	Medium		Medium			
Cat predation							
Agricultural homestead development	Low	Medium	Low	Low			
Non-native insects							
Temperature rise (climate change)							
Wildfire	Low	Low	Low	Low			
Pesticide use			Medium				
Rats							
Incompatible recreational use (human disturbance)	Low						Low
Unsustainable or unknown harvest							
Black drongos							
Cockroaches							
Invasive snail, Euglandina rosea							
Shrew, Suncus marinus							
Vegetation encroachment							
Artificial lighting							
Monitor lizards							
Overall Threat Status	High	High	High	High	Low	Medium	Low

Threats Across Terrestrial Species	Mariana Fruit Bat	Oceanic Snake-eyed Skink	Littoral Skink	Pacific Blue-tailed Skink	Mariana Skink	Common House Gecko	Mourning Gecko	Pacific Slender-toed Gecko
Brown Tree Snake	High	High						High
Invasive vines	Medium				High			High
Commercial development (e.g. resorts)								
Volcanic activity	Low	Low		Low	High	Low	Low	Low
Military expansion	Medium			Low		Low		Medium
Typhoons (climate change)	Medium							
Altered precipitation patterns (climate change)								High
Curious Skink, Carlia ailanpalai		High	Very High	High				High
Sea level rise (climate change)		Medium	High					
Feral ungulates/deer	Medium				Medium			Medium
New invasive ants (i.e. little fire ant)								
Marine debris								
Poaching/human persecution	Medium							
Invasive flatworm, Platydemus manokwari								
Oceanic Skink, Gehyra oceanica								
Residential development								
Cat predation								
Agricultural homestead development	Low							Low
Non-native insects								
Temperature rise (climate change)								
Wildfire								Low
Pesticide use								
Rats								
Incompatible recreational use (human disturbance)								
Unsustainable or unknown harvest								
Black drongos								
Cockroaches								
Invasive snail, Euglandina rosea								
Shrew, Suncus marinus				Medium				
Vegetation encroachment								
Artificial lighting								
Monitor lizards								
Overall Threat Status	High	High	High	Medium	High	Low	Low	High

Threats Across Terrestrial Species	Micronesian Gecko	Brahminy Blindsnake	Green Sea Turtle (terrestrial only)	Hermit Crab Coenobita spp.	Coconut Crab	Mangrove Crab	Rock Crab Grapsus spp.
Brown Tree Snake	Very High						
Invasive vines	High				Medium		
Commercial development (e.g. resorts)	Medium		High	Medium	Medium	Medium	
Volcanic activity					Medium		
Military expansion	Medium		Low				
Typhoons (climate change)							
Altered precipitation patterns (climate change)	High						
Curious Skink, Carlia ailanpalai							
Sea level rise (climate change)			Medium			Very High	Medium
Feral ungulates/deer							
New invasive ants (i.e. little fire ant)			Low		High		
Marine debris							
Poaching/human persecution			High	Low	High	Low	Low
Invasive flatworm, Platydemus manokwari							
Oceanic Skink, Gehyra oceanica	Very High						
Residential development	Medium				Low		
Cat predation							
Agricultural homestead development	Low						
Non-native insects			Low				
Temperature rise (climate change)			High				
Wildfire							
Pesticide use							
Rats							
Incompatible recreational use (human disturbance)			Medium				
Unsustainable or unknown harvest				Low	Medium	Low	Low
Black drongos							
Cockroaches							
Invasive snail, Euglandina rosea							
Shrew, Suncus marinus							
Vegetation encroachment			Low				
Artificial lighting			Low				
Monitor lizards			Low				
Overall Threat Status	Very High	None	High	Low	High	High	Low

Threats Across Terrestrial Species	Ghost Crab Ocypode spp.	Mariana Wandering Butterfly	Rota Damselfly	Humped Tree Snail	Langford's Tree Snail	Rota partulid snail	Fragile Tree Snail
Brown Tree Snake							
Invasive vines				Medium	Medium	Medium	Medium
Commercial development (e.g. resorts)	High			Medium		Medium	Medium
Volcanic activity				High			
Military expansion	Low			Low			
Typhoons (climate change)				Low	Low	Low	Low
Altered precipitation patterns (climate change)			Medium	High	High	High	High
Curious Skink, Carlia ailanpalai							
Sea level rise (climate change)	Medium						
Feral ungulates/deer			Low	High			High
New invasive ants (i.e. little fire ant)				Low		Medium	Medium
Marine debris							
Poaching/human persecution	Low						
Invasive flatworm, Platydemus manokwari				Medium			Very High
Oceanic Skink, Gehyra oceanica							
Residential development				Low		Medium	Medium
Cat predation							
Agricultural homestead development				Low		Low	Low
Non-native insects		High					
Temperature rise (climate change)							
Wildfire			Low	Low		Low	Low
Pesticide use							
Rats				Medium	Medium	High	High
Incompatible recreational use (human disturbance)							
Unsustainable or unknown harvest	Low						
Black drongos							
Cockroaches							
Invasive snail, Euglandina rosea				Medium			
Shrew, Suncus marinus							
Vegetation encroachment							
Artificial lighting							
Monitor lizards							
Overall Threat Status	Medium	Medium	Low	High	High	Very High	Very High

Table 3. Threats to Marine Species

Threats Across Marine Species	Grey Reef Shark	Napoleon Wrasse	Steephead Parrotfish	Seagrass Parrotfish	Spinner Dolphin	Hawksbill Turtle (marine only)	Green Sea Turtle (marine only)	Collector Urchin	Surf Redfish	Black Teatfish	Longlegged Spiny Lobster P. longipes
Ocean acidification (climate change)			Medium					Very High	Medium	Medium	Very High
Temperature rise (climate change)			Medium								Very High
Unsustainable or unknown harvest		Medium	Low	Low				Very High	Medium	Medium	High
Poaching/illegal harvest	Low	Medium	Medium	Low		Low	High	Very High	Low	Low	High
Land-based sources of pollution		Low	Low	Low	Low			Medium	Low	Low	Medium
Military expansion					Low	Low	Low		Medium	Medium	Medium
Typhoons (climate change)											
Trophic effects of fishing	Low										
Incompatible recreational use				Low							
Marine debris					Medium	Low	Low				
Commercial shipping activities						Low	Low				
Dredging					Low						
Boat strikes					Low						
Commercial development (e.g. resorts)											
Sea level rise (climate change)											
Overall Threat Ranking	Low	Medium	Medium	Low	Low	Low	Medium	Very High	Medium	Medium	Very High

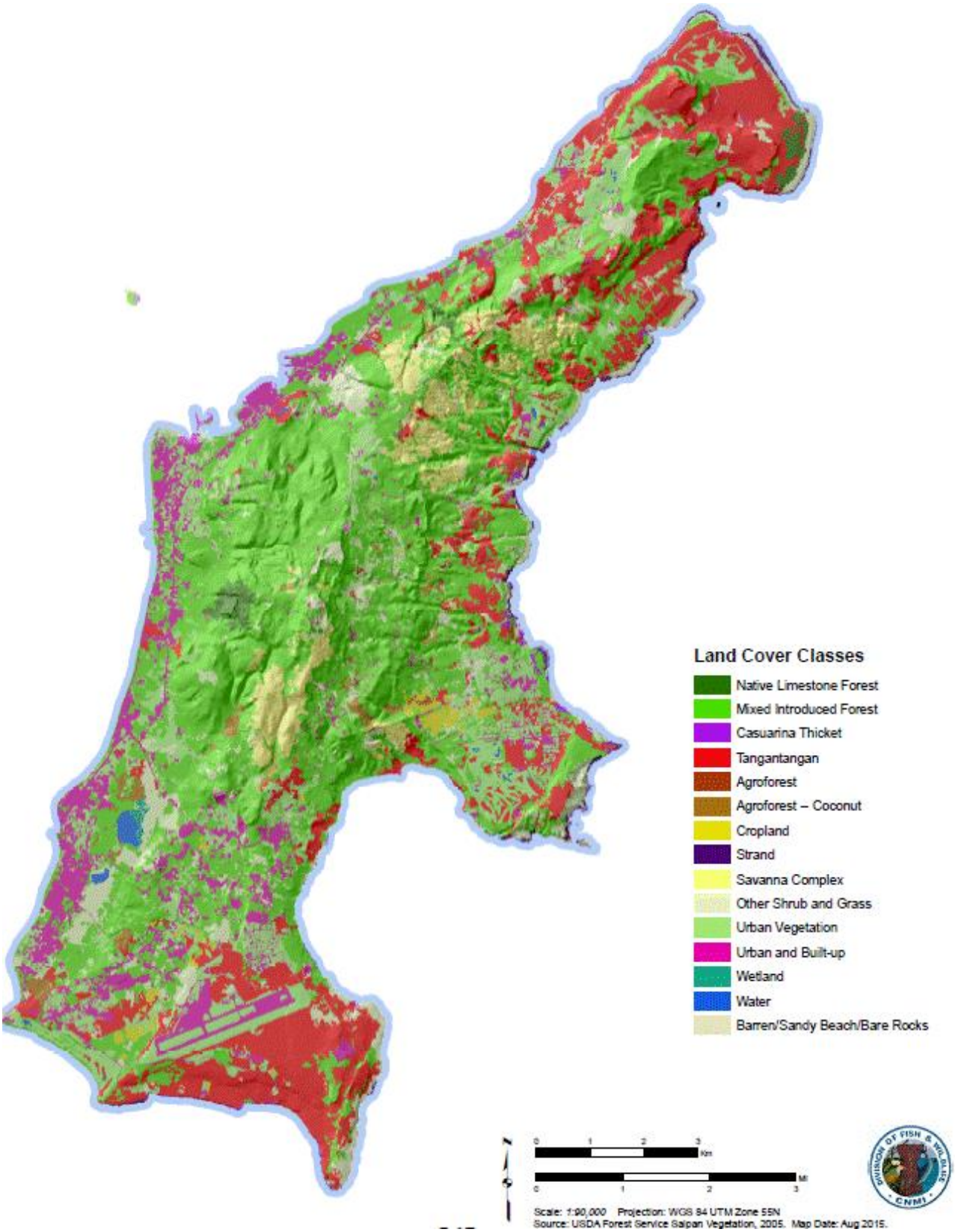


Figure 9. Saipan Land Cover Classes (SWAP, 2015)

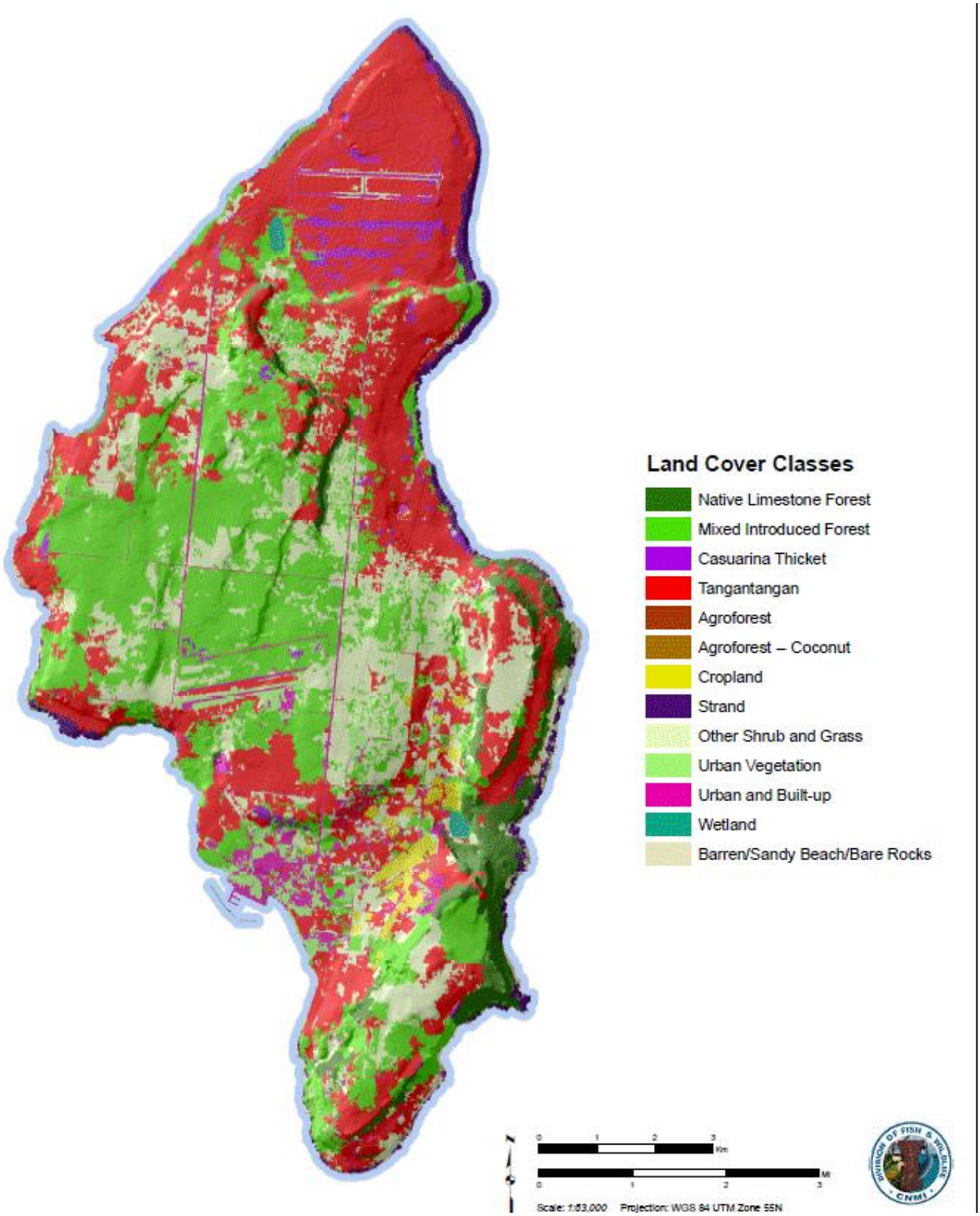


Figure 10. Tinian Land Cover Types

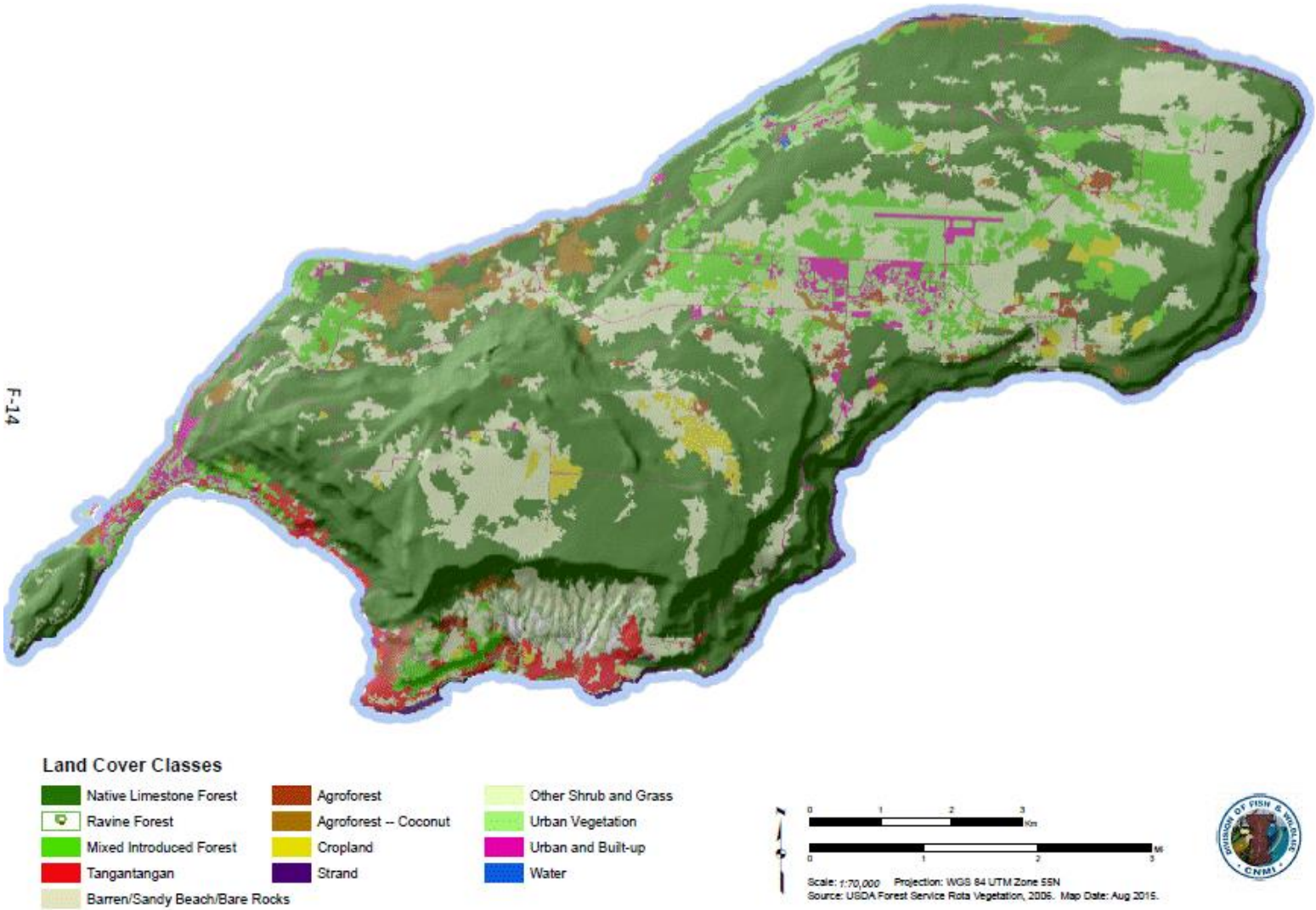


Figure 11. Rota Land Cover Types

3 Wildfires

Almost all wildfires in CNMI are caused by humans, either accidently by barbeques, cigarette butts, unattended fires or set intentionally by hunters for land clearing. Hunters on the southern inhabited islands start grassland fires to attract deer or other ungulates since these species forage on the new grass shoots following a fire, and the lack of heavy vegetation makes them easier prey. The lack of rainfall during the dry season desiccates grasses, trees, and leaf litter providing additional fuel for fires. These fires, which are often set in the dry season, can spread, and cause significant damage to adjacent forests converting these forests to bare ground and facilitating the colonization of invasive plants. In addition to habitat losses and threats to businesses and human safety, wildfires create barren lands ripe for erosion/landslide conditions. Lack of funding for personnel employed in firefighting combined with lack of readily available water sources increase wildfire hazards. Wildfire Loss or destruction of native forest and its ecosystem increases by approximately 2% annually. (BECQ, 2020). CNMI encourages and allows for hunting/removal of brown tree snakes and feral pigs to help control these destructive invasive species.

The Division of Coastal Resources Management (DCRM) has successfully raised awareness and reduced the number of intentionally set wildfires with campaigns such as “Real Hunters Don’t Burn!” and watershed revegetation projects. Management actions such as fire breaks, policy changes, and increased funding for training and recruitment of fire fighters and equipment are outlined in the CNMI State Wildland Fire Plan 2014 – 2024.

4 Water Quality

Water quality data is collected in accordance with the Clean Water Act (CWA) regulated by the Environmental Protection Agency (EPA). Section 303(d) of the CWA requires identification of impaired waters. The 303(d) program requires monitoring of impaired water bodies that do not meet their designated uses, such as recreation, fishing, drinking, or other uses and water quality standards (WQS) (bacteria, metals, dissolved oxygen, for example). EPA approved the Commonwealth of the Northern Mariana Islands (CNMI) Section 303(d) list of impaired water bodies in 2016. To improve water quality and to better understand and manage water resources, the Bureau of Environmental and Coastal Quality (BECQ) collects annual data on surface waters (freshwater and marine), potable water, wastewater, and aquatic animal tissue samples. EPA uses the Consolidated Assessment and Listing Methodology (CALM) to document water quality data analyses under the CWA for listing or removal of water bodies on the 303(d) list. Observed trends are assigned one of the five EPA recommended CALM Categories. These range from CALM Category 1 where all designated uses (DUs) are supported, to Category 5 where at least one DU is not being supported. Category 5 requires that a total maximum daily load (TMDL) be established for each pollutant in the waterbody. The TMDL is used to focus natural resource management and restoration efforts to minimize the sources of impairment.

Findings from this water quality section are largely from the 2020 Commonwealth of the Northern Mariana Islands’ (CNMI) 305(b) and 303(d) Water Quality Assessment Integrated Report that summarizes water quality data collected during October 1, 2017 through September 30, 2019.

Results from the 2020 report show that 99.8 miles (42%) of CNMI’s 240.5 shoreline miles fully support all the designated uses set forth in the CWA, which make them “fishable and swimmable”. These designated uses include Support and Propagation of Aquatic Life, Fish and Shellfish Consumption, Recreational Use, and Aesthetic Enjoyment. The remaining 140.7 shoreline miles do not support of at least one designated use or lacked sufficient information to

assess their attainment. Coastal water impairments were caused either by pollutant concentrations exceeding the CNMI WQS and/or by a non-pollutant, for example, diminished Aquatic Life Support Function, alteration of hydrology, invasive species, or low diversity.

Coastal waters within CNMI showed a marked decrease in the percent of Enterococci violations since the last BECQ report in 2015. Upgrades to the municipal sewer system, construction of roadway stormwater Best Management Practices (BMPs), as well as a reduction in rainfall are likely contributors. The most common sources of Enterococci contamination are from point sources, failing sewer lines, wastewater collection systems, or individual onsite wastewater collection systems.

The more developed beach areas in CNMI have frequently exceeded allowable Enterococci levels. These sites are suspected of being contaminated by fecal waste from humans or feral dogs and cats. Enterococci contamination observed on some of Saipan's remote western and eastern beaches are likely due to livestock, birds, and sediment-laden runoff containing naturally occurring Enterococci, rather than human waste. However, unrestricted cattle grazing, and feral pigs have been observed in several of Saipan's eastern watersheds resulting in moderate to severe erosion and the likely transport of fecal matter into the coastal waters where these streams discharge, Figure 12. The continued observance of Enterococci exceedances on the eastern shoreline, along with a handful of suspected leptospirosis infections resulted in at least one death in 2000. It is likely that restrictions on grazing in these watersheds could significantly reduce the problem, although leptospirosis carried by feral wildlife in addition to livestock, remains an issue.

To address microbial beach advisories, the EPA approved the "*Total Maximum Daily Loads (TMDL) for Coastal Waters Impaired by Bacteria on Saipan*", in 2018. The TMDL recommendations have been shared with policy makers to inform decisions on where best to use funding for water quality protection infrastructure projects and resource agencies in ongoing efforts to improve water quality.

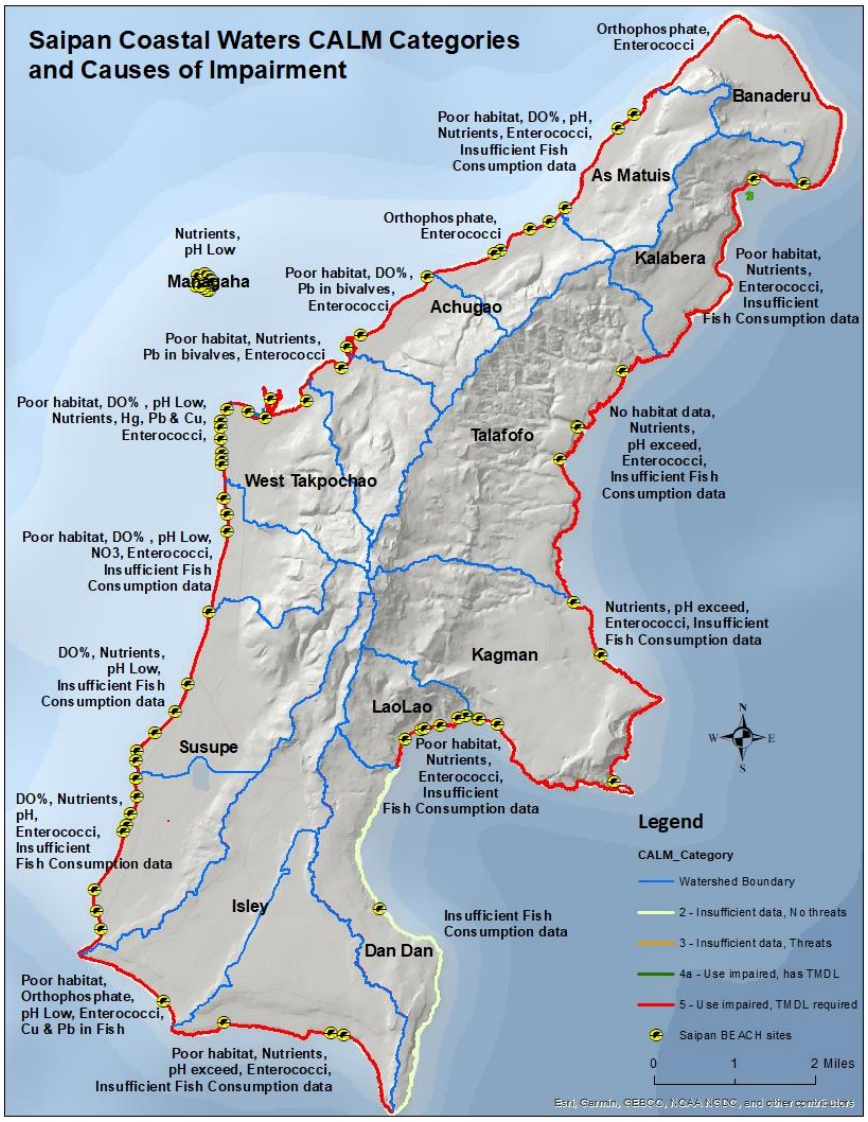


Figure 12. Saipan Water Quality Impairments (BECQ, 2020)

Rota and Tinian's reduced violations of Enterococci are associated with reduced rainfall in 2017, as well as a substantive decrease in the islands' visitation numbers and wastewater production. The reduction is associated with a downturn in the economy, decreased tourism, and a decrease in number of foreign workers allowed to remain in the CNMI by the Federal government. Figure 13 and 14 show the status of water quality testing results for Rota and Tinian.

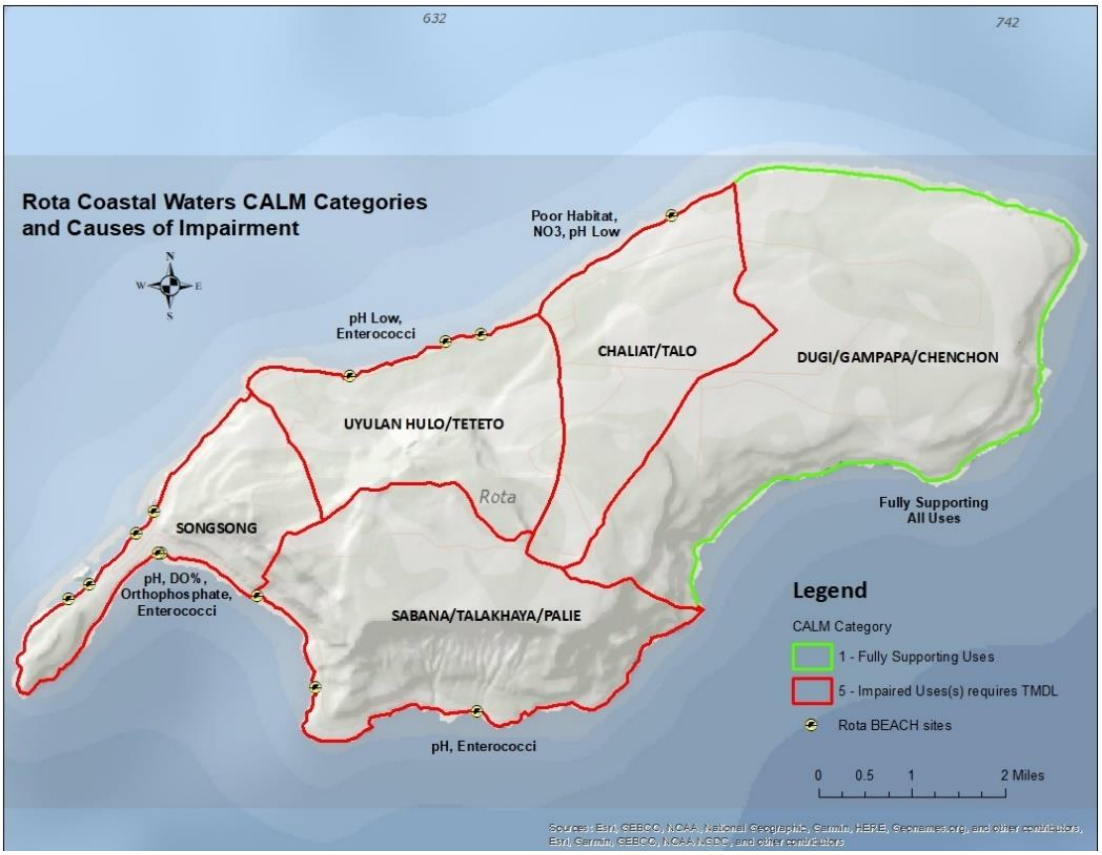


Figure 13. Rota Water Quality Impairments (BECQ, 2020)

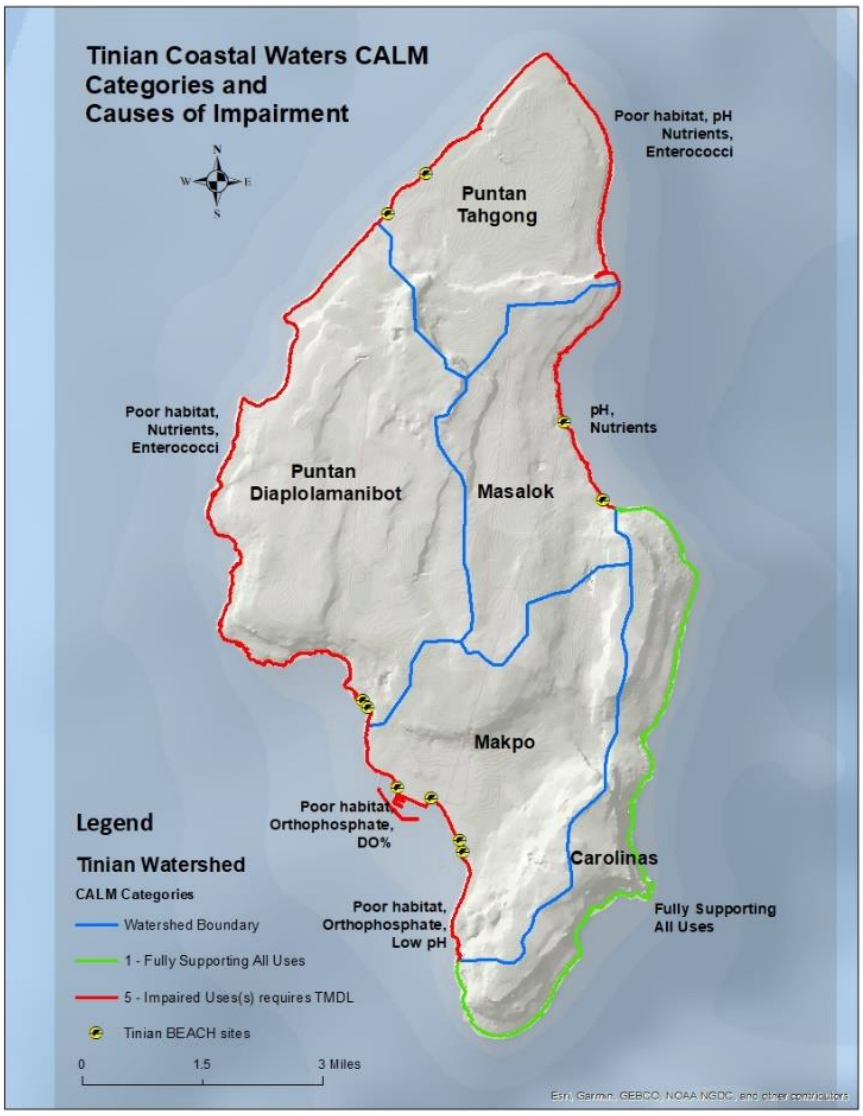


Figure 14. Tinian Water Quality Impairments (BECQ, 2020)

5 Groundwater

Groundwater is the primary source of potable water in CNMI. No surface waters are used for potable water sources. In general, the quality of groundwater used for Public Water Systems (PWS) meets EPAs Primary Drinking Water Standards. Incidents of groundwater contamination from underground or aboveground storage tanks have occurred. CNMI regulates storage tanks under the Storage Tanks, Assessment, and Remediation (STAR) Program for planning, enforcement, and monitoring tank integrity to prevent leaks and spills.

The U.S. Geological Survey (USGS) and Water and Environmental Research Institute (WERI) identified anthropogenic causes and potential solutions to CNMI's groundwater contamination. The primary groundwater quality concerns include.

1. Leaking septic tanks and other waste disposal systems. This causes ammonium, nitrogen, and phosphate to enter surrounding soils, groundwater, and drinking water production wells making drinking water unsafe.
2. Urban runoff, storm water induced overflows in the wastewater systems, unregulated wastewater discharges, and illegal hook-ups into storm water drainage systems. This results in compromised ecological health of nearshore environments.
3. Aquaculture effluent containing antibiotic additives and nutrients discharging into groundwater may compromise drinking water quality and harm nearshore ecosystems.
4. Impacts of land use activities on ground and surface water quality.
5. Formerly used defense sites (FUDS) and other waste disposal sites release of contaminants into the aquatic environment.
6. Impact of ocean outfalls and dumpsites on benthic communities and aquatic resources in coastal waters.
7. Residential septic systems impacts on beach degradation and declining coral reef diversity in CNMI.
8. El Nino and other longer-scale drought/storm cycles on aquifer and/or surface catchment recharge, groundwater salinity, and other water quality/quantity parameters.

5.1 Surface water and riverine pollution

Of the 100.5 miles of streams within the CNMI, 50.3 miles do not support at least one type of DU. Most commonly, the recreational DU is not supported. There is insufficient water quality data to assess all DUs on most streams. Of those streams that could be assessed, the most frequent causes for 303(d) listing were exceedances of the WQS for Enterococci, Orthophosphate (PO_4), Nitrate as Nitrogen (NO_3-N), and Dissolved Oxygen (DO%). Most of these stream water microbial violations are from:

- NPS discharges such as those from deteriorating sewer lines and manhole cover overflows during rain events.
- poorly constructed or aging homes and businesses, with failing on-site wastewater collection systems.
- stormwater drainages near heavily populated areas.
- collection sites near subsistence farms that lack BMPs to capture waste from free roaming domestic or feral livestock; or,
- waste from free roaming feral dogs and cats. (BECQ, 2020)

5.2 Water Supply

The Commonwealth Utility Corporation (CUC's) supplies power, water, and sewer services to Saipan, Tinian, and Rota. Though the CUC drinking water on Saipan complies with all EPA

regulated contaminants and is considered safe for human consumption, most people on Saipan do not drink the water provided because they find it unpalatable due to the high chloride concentration (an unregulated contaminant). Instead, residents rely on locally produced treated bottled water or rainwater. Hotels on Saipan use reverse osmosis to provide palatable drinking water to tourists. The CUC is developing a groundwater management plan to improve saltwater intrusion. The plan will identify wells with high chloride concentrations so they can be removed from the system and inform future well depths, spacing, and pumping rates.

BECQ, CUC, and USGS collect data on groundwater wells and trends for Saipan's extensive well fields. Figure 15 shows the median chloride concentrations of municipal production wells on Saipan for December 2009 to February 2019. Chloride concentrations above 250 mg/L are considered saltwater. About 22 percent of municipal production wells had median chloride concentrations less than 250 mg/L (dark blue dots), and about 43 percent had median chloride concentrations less than 500 mg/L (light blue dots).

Mean groundwater withdrawal rates greater than 50 gal/min (medium to large circles in Figure 4) induces upward flow of saltwater beneath the wells and is one likely cause of high chloride concentrations. Other factors, such as the well spacing, depths, and changes in zonation between fresh and saltwater cause saltwater intrusion (Figure 16). Water wells are an essential resource that are vulnerable to sea level rise and climatic disruptions. Water leaks and management and maintenance challenges due to aged infrastructure impact efficient well production. Production is vulnerable due to lack of power redundancy for pumps, physical vulnerability of the networked infrastructure, and information challenges due to lack of data availability regarding groundwater tables and freshwater inputs. Impacts to well production could cause major economic disruptions, declining water quality, and impacts to daily life and potentially to public health. Strategies and actions that aggressively consider climate scenarios for data collection, during infrastructure design, and in mitigation planning are key to securing potable water supplies.

To reduce impacts of climate change including catastrophic storms and drought, CUC has actively been working to build water system resilience through the installation of back-up generators and improved system redundancy. This includes the pending procurement of granular activated carbon (GAC) filters to ensure high quality water sources are available from well fields. CUC is currently working to upgrade systems, install back-up generators, and harden critical infrastructure to proactively address threats of impacts, however, additional groundwater data and scenario modelling would be helpful for long-term planning. Evaluating vulnerabilities, planning for long-term asset management and project implementation, as well as outreach and communications to raise public awareness and political support for management needs were identified as priorities for next steps to support sustainable water system management. (BECQ, 2020).

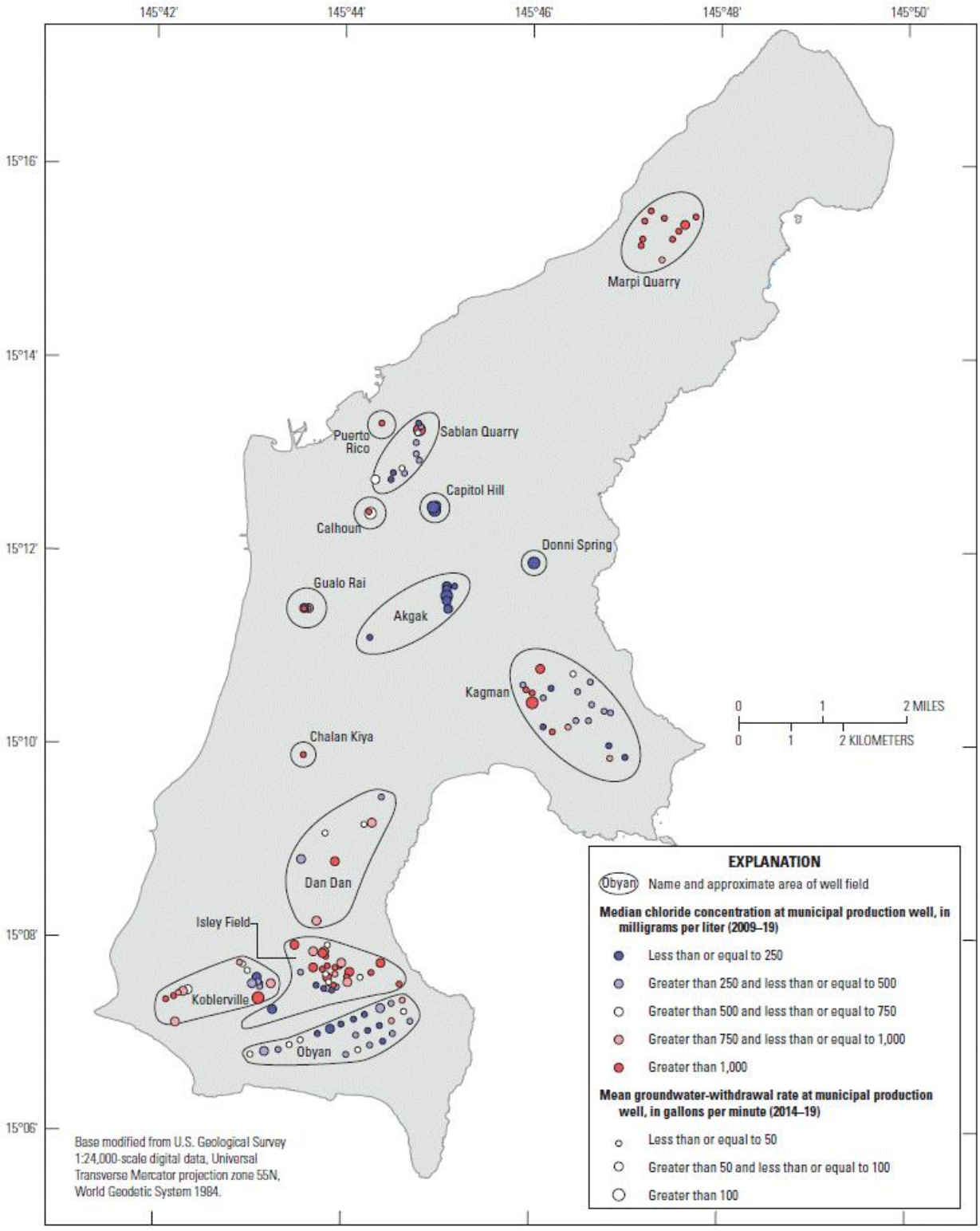


Figure 15. Map of Median Chloride Concentrations and Mean Groundwater Withdrawal Rates (USGS, 2020)

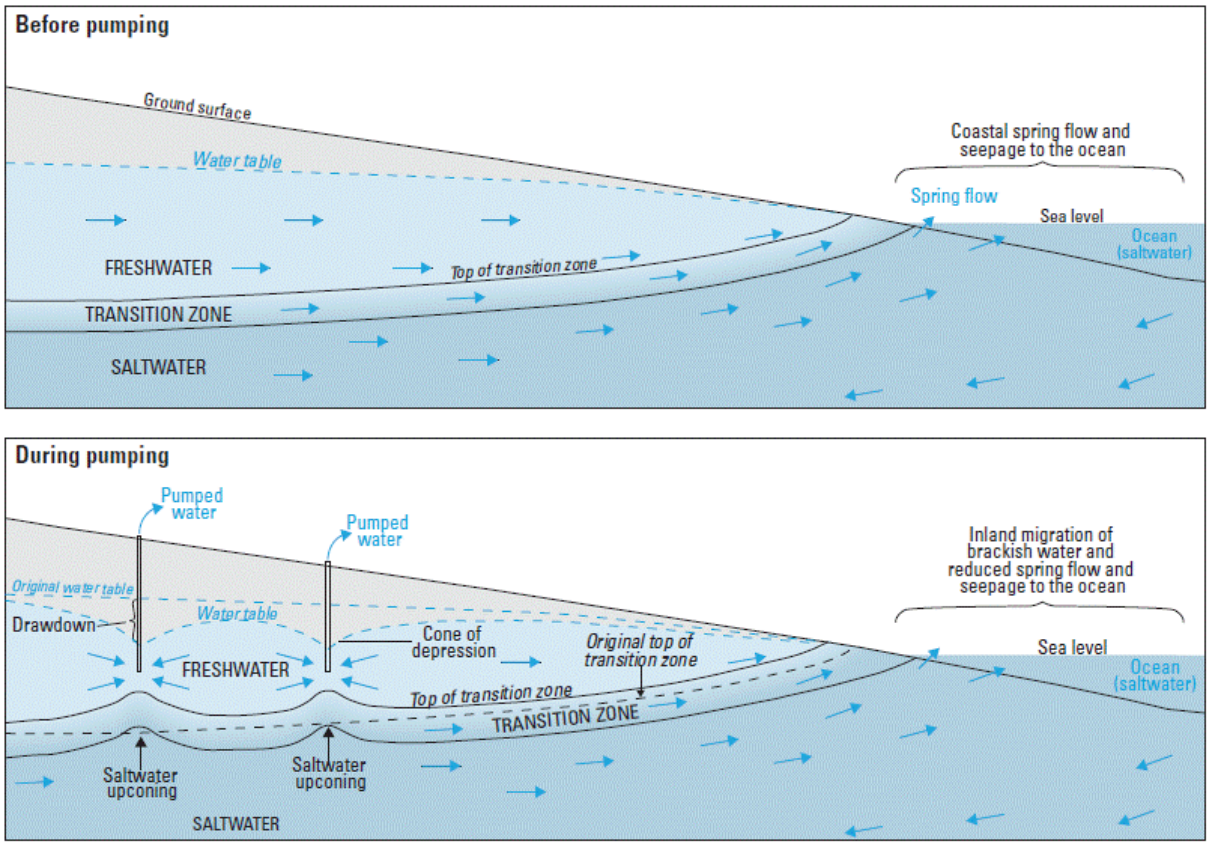


Figure 16. Changes in zonation between fresh and saltwater during pumping (USGS, 2020)

6 Marine Habitats

Saipan has five Marine Protected Areas - Mañagaha Marine Conservation Area, Bird Island Marine Sanctuary, Forbidden Island Marine Sanctuary, Lau Bay Sea Cucumber Sanctuary, and the Lighthouse Reef Trochus Sanctuary. Due to the size of Saipan's population, its annual visitor numbers, and the rapid development on island since 2015, anthropogenic (human caused) threats to Saipan's MPAs' water quality are considered the most significant in the CNMI, relative to other islands. Rota and Tinian each have one MPA, Sasanhaya Bay Fish Reserve, and Tinian Marine Reserve,

Figure **17**. Five of the MPA's are completely no-take reserves. No-take reserves prohibit harvesting, fishing, or any destructive activities. The others 2 MPAs have limited take rules, however no harvesting of trochus or sea cucumber is allowed in any of CNMIs MPAs (P.L. 11-63).

Figure 17. Marine Protected Areas CNMI (Source: DCRM.Gov)

6.1 Coral Reefs and Sea Grasses

The CNMI is part of the Mariana Archipelago in the western North Pacific Ocean. It consists of ten emergent volcanic islands to the north and four geologically older, raised-limestone islands to the south. The human population of the CNMI resides largely on the southern islands of Saipan, Tinian, and Rota. These islands are also home to some of the most highly developed coral reef ecosystems in the CNMI and the U.S. While the reefs of the younger northern volcanic islands are generally less developed, they are relatively free from land-based sources of pollution, over-harvesting, and other local, anthropogenic stressors. The CNMI archipelago boasts relatively high coral reef species diversity, with a total of over 5,600 known reef-associated species. More than 1,000 species of reef associated fish species, 280 species of hard coral, 200 macroalgae species, 1,700 mollusks, 200 echinoderms, and 800 crustaceans have been reported from the Mariana Islands. The actual number of reef-associated species that inhabit the archipelago's varied marine habitats is likely considerably higher than what is currently known. Even at currently reported numbers the coral reef ecosystems of the Mariana Archipelago are among the most biologically diverse of all U.S. States and Territories. A 2019 ecovaluation study of coral reefs and sea grass estimated that together, corals and seagrass provide an annual value of $114.8 million. This value includes benefits from tourism, habitat and fisheries, coastal protection, and other ecosystem benefits.

The southern islands and associated offshore banks lie atop much older, extinct volcanoes and are covered by carbonate formations. Except for the unpopulated island of Aguijan (a small 7 km^2 steep sloped island inhabited by goats), the southern islands are the largest in the CNMI, with land areas of 85 - 544 km^2. In addition, the seafloor around the southern islands is typically more gently sloping than the northern islands, and with step-like limestone topography. These conditions yield a larger range of habitat types and a greater diversity of marine species, but with greater exposure to human stressors (PDAC, 2020). Figure 18 shows the boundary line between the northern and southern islands.

Figure 18. Boundary between Northern and Southern Islands CNMI (BECQ 2020)

Coastal wetland and coral reef ecosystems provide a myriad of benefits in CNMI, coastal protection from storm surge, habitat for numerous endangered and economically important species, and filtration of surface runoff pollutants However, agricultural and commercial development has resulted in dramatic wetland habitat loss throughout CNMI, leaving approximately only 700 acres of wetland habitat today. Most of the remaining wetlands are impaired due to flow alterations and invasive species. Degraded wetland systems have less ability to retain stormwater, which contributes to localized flooding and poor water quality. In turn, poor water quality can compromise the health of nearshore coral reef ecosystems, reducing corals' ability to provide coastal protection and habitat benefits. (Dobson et al., 2020).

The National Coral Reef Monitoring Program (NCRMP) collects data at fixed sites yearly to monitor trends in over time. According to the NOAA Coral Reef Conservation Program (CRCP) Northern Mariana Islands reefs are considered "FAIR" for years 2012 – 2017, Figure 19 (CORIS, 2018).

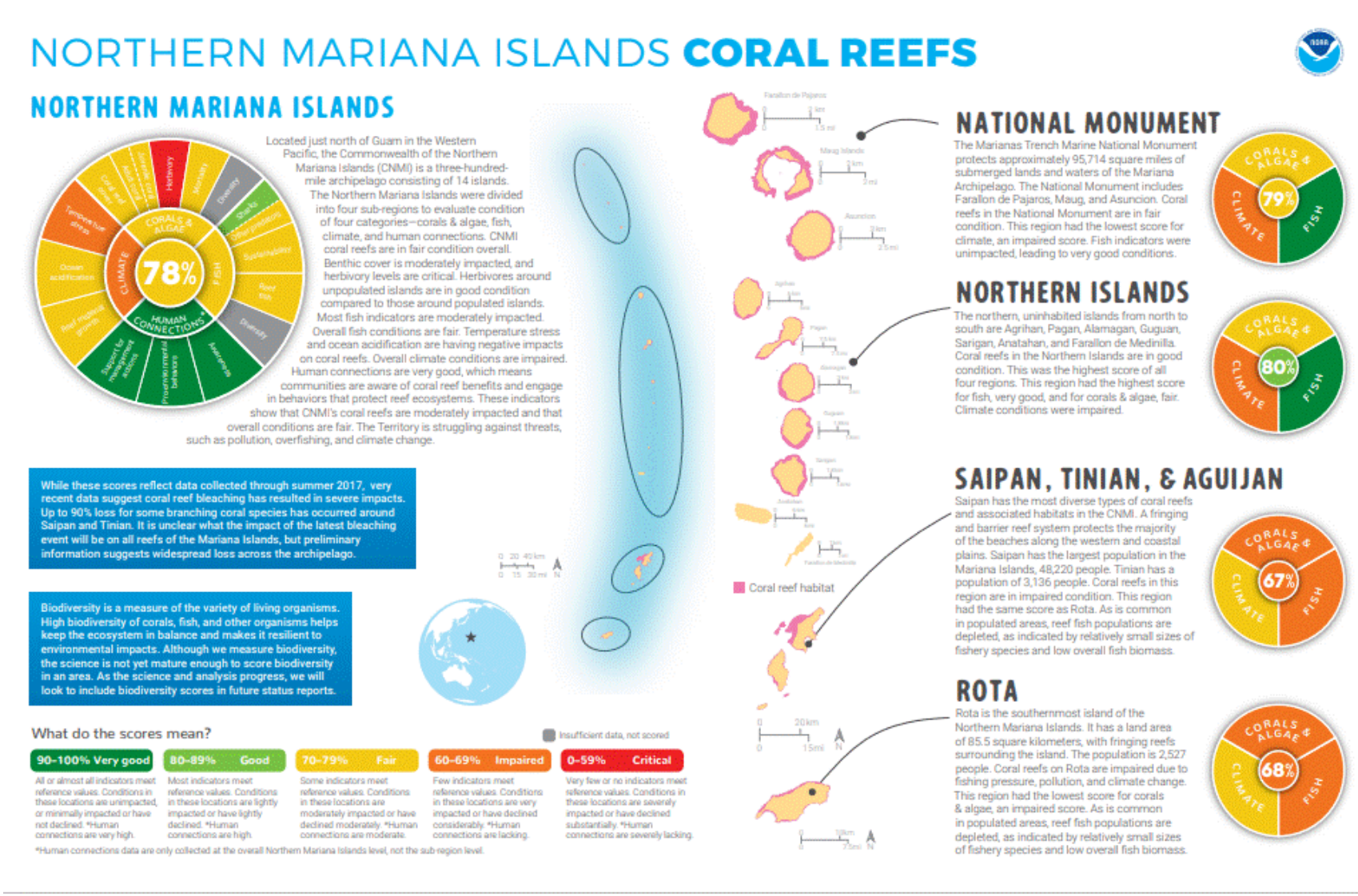


Figure 19. Marianas Islands Coral Reef Score (NOAA CRCP, 2018)

FAIR is derived from monitoring of 5 coral and algae indicator categories.

1. Coral Reef Cover
2. Coral Populations
3. Herbivory
4. Mortality
5. Diversity

Sub-regional scores were evaluated for Saipan, Tinian, and Rota using categories of corals and algae, fish, and climate, Figure 20 and Figure 21. Indicator categories for fish include.

- Number of reef fish
- Sustainability of fish stocks
- Sharks and other predators
- Diversity

Figure 20. Saipan and Tinian Coral Reef Score IMPAIRED

Figure 21. Rota Coral Reef Score IMPAIRED

Climate indicators include.

- Temperature stress
- Ocean acidification
- Reef skeletal growth

A score between 60-69% is ranked impaired. Due to geographic proximity, Saipan, Tinian, and Aguijan were analyzed together for the reef status report card. All three islands in the study area – Saipan, Tinian, and Rota - scored an "Impaired" ranking. Impaired is defined as having few indicators meeting reference values and declining conditions. With these islands having the largest concentrations of humans it's not surprising to see anthropogenic impacts.

6.1.1 Saipan

Saipan is the largest island and contains the largest reef area, 98km^2. The low-lying topography and gentle nearshore bathymetry facilitates reef growth. Saipan hosts the most diverse set of coral reef habitats and reef associated assemblages. Seagrasses and sand habitats dominate the Saipan Lagoon which is 30km^2 and deeper in the central part due to dredging for shipping vessels. The remainder of the lagoon contains all three seagrass species known to occur on Saipan (*Enhalus acoroides, Halodule uninervis, and Halophila minor*) and hosts coral, algal, fish, and other species not found elsewhere in the CNMI.

6.1.2 Tinian

Tinian is the second largest island and has 26km^2 of shallow reef. The topography is flat with a series of uplifted carbonate platforms (coral skeletons). Most of the island is surrounded by raised reef platforms with limited reef flat and mangrove development. Groundwater discharge, high wave exposure, and steep topography contribute to low coral development.

6.1.3 Rota

Rota is the southernmost island of the Northern Mariana Islands. It has a land area of 85.5 km^2, with fringing reefs surrounding the island. The population is 2,527 people. Coral reefs on Rota are impaired due to fishing pressure, pollution, and climate change. As is common in populated areas, reef fish populations are depleted, as indicated by relatively small sizes of fishery species and low overall fish biomass. (SWAP, 2015)

6.1.4 Threats to Coral Reefs

The greatest threats to coral reefs is global climate change and rising sea surface temperatures. Throughout the Marianas chain, increasing ocean temperatures and acidification have increased coral stress and large-scale bleaching events over the last decade. Between 2013 to 2017, the CNMI had four major thermal stress and mass bleaching events, resulting in large-scale coral mortality and changes in community composition. NOAA's Coral Reef Conservation Program (CRCP) and Marine Applied Research Center conducted a resilience assessment to document coral reef resistance and recovery after the bleaching events. Surveys in 2018 revealed a 66 percent reduction in overall coral cover since 2012, with over 90 percent staghorn Acropora spp. corals lost. Figure 22 shows the changes in coral coverage due to the four bleaching events in Saipan.

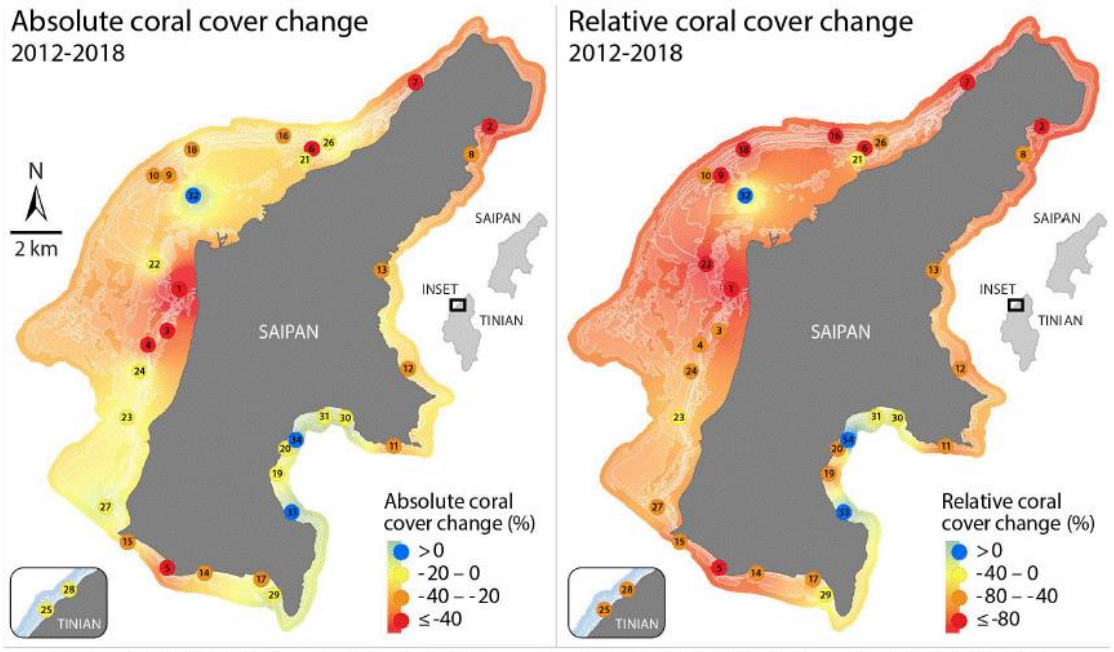


Figure 22. Coral cover change between 2012 - 2018 (NOAA, Maynard et. all, 2018)

Surveys showed CNMI lost 2/3rd of their coral cover between 2012 and 2018. The spatial patterns in coral cover loss reveal greatest losses in the lagoon near Garapan and in the sites east and west of the northern end of Saipan. Losses were generally lower on the exposed eastern side of the island than on the sheltered western side. This could be due to land-based sources of pollution accumulating in areas with less tidal circulation.

Land-based pollution sources are among the primary causes of coral reef degradation around the world and in CNMI. A variety of pollutants, including sediment, organic matter, nutrients, sewage, herbicides, pesticides, petroleum products, and other substances detrimental to marine organisms can enter coastal waters through riverine discharge, stormwater runoff, and sewage outfalls. The presence of these pollutants in nearshore waters is generally a result of coastal development, land clearing, burning, and other activities that alter the landscape, increasing the amount of runoff and introducing pollutants or elevating levels of substances (e.g., sediment) than may occur naturally at lower levels. When too much sediment is discharged into coral reef communities' corals and other benthic organisms are buried, which causes mortality and changes in coral community structure.

Excess nutrients can fuel algal growth, allowing fleshy macrophytes and cyanobacteria to out-compete corals through direct interaction and by making substrate conditions unsuitable for the recruitment of many coral species. Pesticides, herbicides, petroleum products, and other chemicals can interfere with important physiological processes, such as reproduction and growth. Sewage discharge and runoff may also introduce pathogens that directly cause diseases of marine organisms (PDAC, 2020).

While some corals can recover from bleaching, death will occur if the stress persists for a long period of time or is reoccurring frequently. Recent data shows that some pacific coral species may be more resilient to stressor events than others (https://doi.org/10.1073/pnas.1721415116). CNMI is continuing to conduct resilience-based assessments to target and prioritize coral reef management actions.

As described in the 2021 CSDP SDG for sustainable use of ocean resources in the next 10 years includes completion of a Marine Center to support research, education, tourism and coral and mangrove restoration programs; continue to build interagency programs to support active management of marine protected areas, conservation, and management plans; to protect and foster marine resources including fisheries through resource assessments, research, regulations, enforcement, while balancing fishing industry and tourism factors; enhancement of reef biodiversity and health; conduct life history studies on targeted food fish to determine growth rates, longevity, reproduction, and mortality to sustainably manage fisheries.

7 Management Plans

CNMI Coral Reef Management Priorities. 2019 – 2029

2013 Saipan Lagoon Aquatic Ecosystem Restoration Study

BECQ-DCRM 2017 Saipan Lagoon Use Management Plan

DCRM Coastal and Estuarine Land Conservation Plan for CNMI, 2008

BECQ-DEQ 2002 Watershed Restoration Strategy

NOAA Coral Reef Conservation Program

Talakhaya Integrated Watershed Management Plan. 2020.

Garapan Integrated Watershed Management Plan. 2020.

8 Work by Others

- CNMI Comprehensive Outdoor Recreation Plan
- CNMI Comprehensive Sustainable Development Plan
- CNMI 20-Year Highway Master Plan Social Pinpoint | CNMI 20 Year Highway Master Plan Home Page (mysocialpinpoint.com)
- Resources Report
- 2019 Bureau of Environmental and Coastal Quality (BECQ) Citizen Centric Report
- 2019 Division of Coastal Resource Management (DCRM) Citizen Centric Report
- Climate Change in the Commonwealth of the Northern Mariana Islands Vulnerability Assessment. 2021. PIRCA.
- BECQ-DEQ 2020 CNMI 305(b) and 303(d), Water Quality Assessment Integrated Report
- Guidance Manual for Smart Safe Growth
- 2019 CNMI Comprehensive Economic Development Strategy
- DPL 2019 Public Land Use Plan
- https://www.youtube.com/watch?v=ocxNPTPtjBI&list=LL&index=2&t=283s

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