3.11.7 Communications

Tinian's information technology and communications infrastructure includes telephone, internet, cable television, and satellite service. IT&E and Docomo Pacific provide commercial information technology and communications services. Both companies provide phone, internet, and cellular phone service through overhead distribution lines and towers in the southern part of Tinian. Marianas Cable Vision Broadband and Docomo Pacific provide cable television service through overhead distribution lines in the southern part of Tinian. The Military Lease Area has no commercial or military information technology and communications infrastructure.

Two undersea fiber optic cable links, one owned by IT&E and one owned by Docomo Pacific, connect Tinian and Saipan to the Trans-Pacific Cable hub on Guam, enabling phone, internet, cellular phone, and high-definition television services. A microwave system provides alternative connectivity if the cables fail. The USAGM Tinian site has thirteen towers, and the USAGM site on Saipan has four.

3.12 Topography, Geology, and Soils

Topography, geology, and soils describe surface and subsurface features of land. Topography is typically described with respect to the elevation, slope, and surface features found within a given area. Geology is characterized by the physical features of the earth and includes rock type, geologic structure (e.g., faults, folds, and tilting of rocks) and mineral deposits. Soil is the unconsolidated mineral or organic material on the top layer of the earth that serves as a natural medium for the growth of plants.

The USAGM Saipan site is not discussed further under the existing environment section for topography, geology, and soils. USMC would repurpose existing communication towers at the USAGM Saipan site, and no clearing or new construction would be required.

3.12.1 Topography

Tinian is approximately 12 miles long and 6 miles wide. The island is composed of a series of limestone plateaus separated by steep slopes and cliffs (U.S. Department of Agriculture 1989). The northern portion of the Military Lease Area is generally level with elevations that range between 30 and 100 feet above mean sea level, except for Lake Hagoi, where the elevation is approximately at sea level. The southern portion of the Military Lease Area and TNI is a broad and gently sloping plateau. Within the northern part of this plateau is a highland with a maximum elevation of 545 feet above mean sea level at Mount Lasso. From Unai Dankulo and Unai Masalok in the southeastern portion of the Military Lease Area, a low, broad depression extends southward past Marpo Marsh and includes San Jose Village and the area around the Port of Tinian. This area has a maximum elevation of 150 feet above mean sea level. To the east of this broad depression are the Pina Plateau and Carolinas ridges that extend to the southern tip of Tinian and includes Kastiyu, the highest part of the island at 614 feet above mean sea level. It has steep slopes and cliffs as high as 500 feet above mean sea level. Wetland topographic features including Lake Hagoi and Marpo Marsh are discussed in Section 3.14.1 (Surface Water). Topographic contours are shown in Figure 3.12-1.

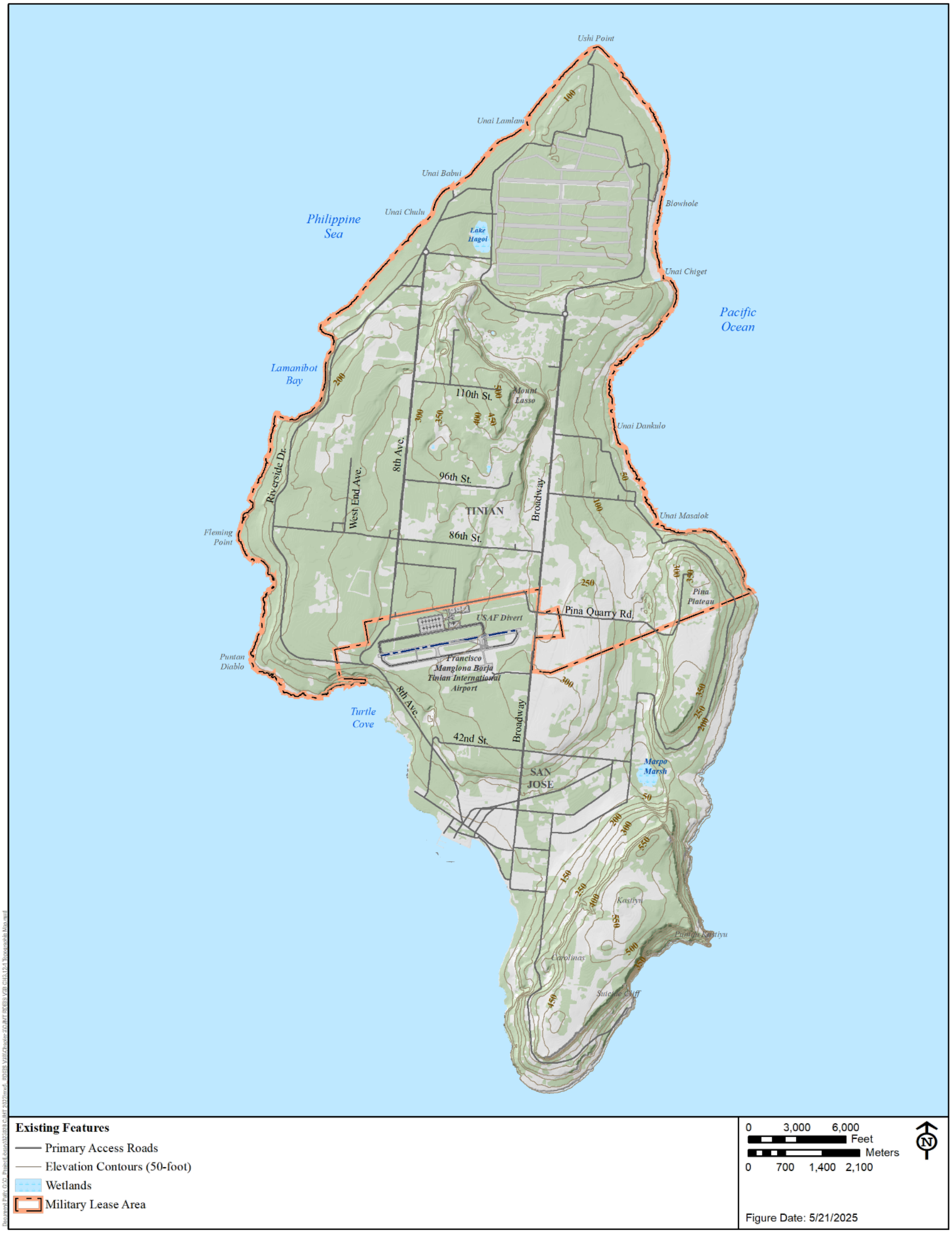

Figure 3.12-1 Tinian Topographic Map

3.12.2 Geology

Tinian is a volcanic arc island formed by the Pacific Plate subduction under the Philippine Plate, approximately 100 miles west of the Mariana Trench. The foundation of the island, predominantly below sea level, is composed of low-permeability volcanic rock. However, the dominant lithology above sea level overlying the volcanic material is high-permeability, coralline limestone from Plio-Pleistocene carbonate facies and raised Holocene beach and reef deposits. Tectonic uplift and high-angle, normal faulting impacted these sequences, as evidenced by fault transects observed throughout the island, creating complex dynamics in the permeability and structure of Tinian's rock units (USGS 2000 and Stafford, et al. 2005).

Four major geologic units make up the island; the Tinian Pyroclastic Rocks, the Tagpochau Limestone, the Mariana Limestone, and unconsolidated sediments consisting of beach deposits, alluvium, and colluvium. The porous nature of coral reefs, and the high susceptibility of limestone to solution weathering favor high hydraulic conductivities in the limestone units. In contrast, hydraulic conductivities of the pyroclastic rocks tend to be low due to poor sorting and the high susceptibility of some volcanic minerals to chemical weathering and alteration to clays. (Gingerich, 2002). Beach deposits are mostly medium-to-coarse grain calcareous sands, gravels, and rubble interspersed over exposed limestone.

Karst geology is present on Tinian in the Mariana and Tagpochau Limestone formations. Karst is a distinctive geologic formation created when surface or groundwater dissolves soluble rocks such as limestone. Karst features include large voids, such as sinkholes and caves. Sinkholes can act as catchments for surface water. Caves (i.e., banana holes, flank margin caves, and fracture caves) (Stafford et al. 2002) can form in limestone deposits in the zone of mixing of salt and freshwater. Epikarstis, defined as the upper layer of eroded rock, is characterized by rough surfaces, little soil, and small cavities.

On Tinian, sinkholes and collapsed surface features suggest the presence of channeled internal drainage and cavernous subgrade conditions (Doan et al. 1960). Subgrade conditions have not been mapped to assess the actual conditions including any potential effects to the stability of the limestone. Epikarst is present in all limestone rock formations on Tinian, and its characteristics vary based on proximity to the coast, appearing more jagged toward the coast as a result of physical and chemical interactions with the saltwater ocean and sea spray (Stafford et al. 2004). Caves, notches, cuts, and slumped materials (i.e., materials that have collapsed or fallen) are present along the Tinian coast. Figure 3.12-2 provides the locations of known karst features on Tinian. Although this figure depicts a specific recharge feature (i.e., Lasu recharge cave, as described in Stafford et al. 2002) south of Mount Lasso, groundwater recharge occurs throughout Tinian in areas of limestone formations.

3.12.3 Soils

Soil classes across Tinian are depicted in Figure 3.12-3. Soil descriptions and properties characterizing shrink/swell potential and erosion potential are provided in Table 3.12-1.

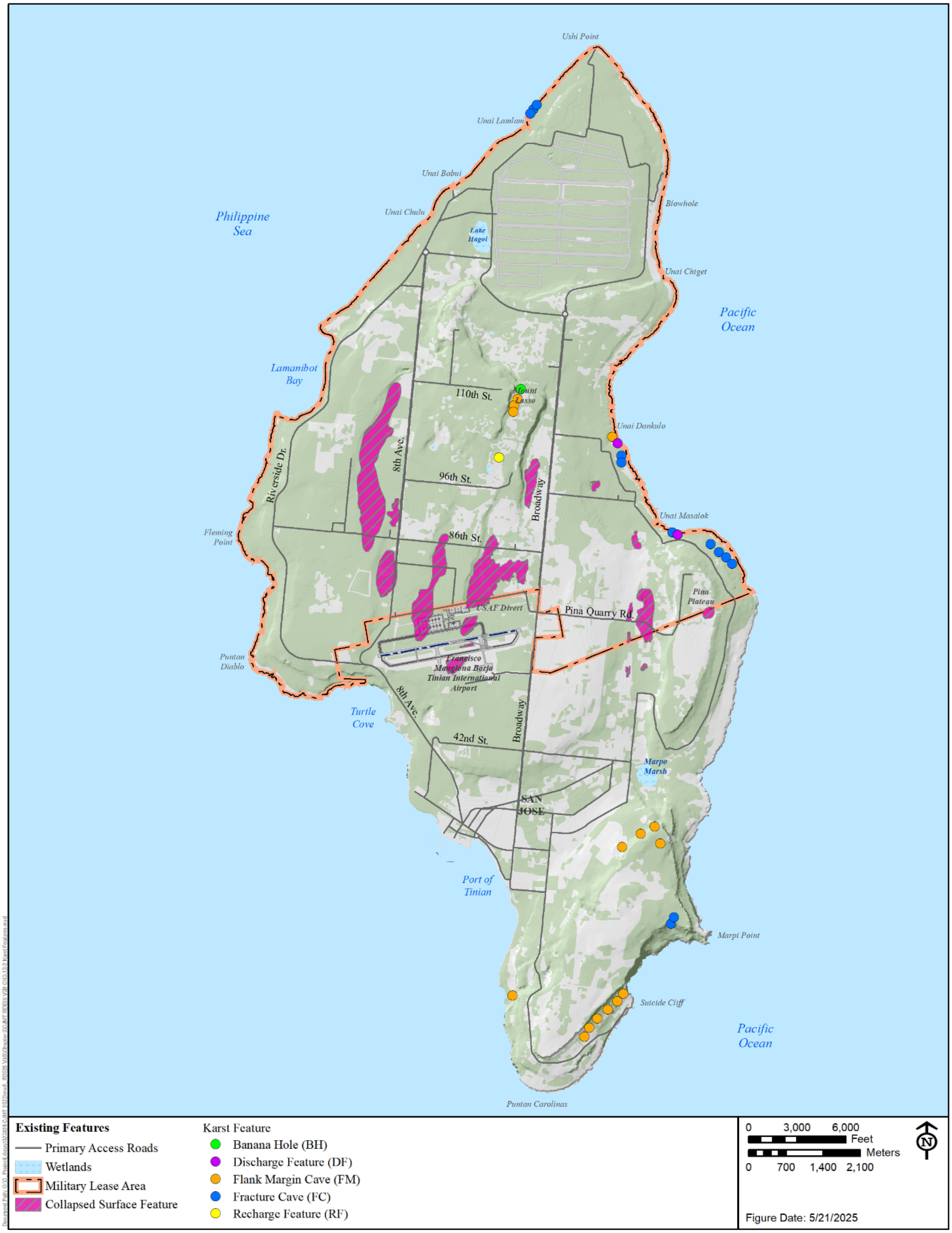

Figure 3.12-2 Tinian Karst Features

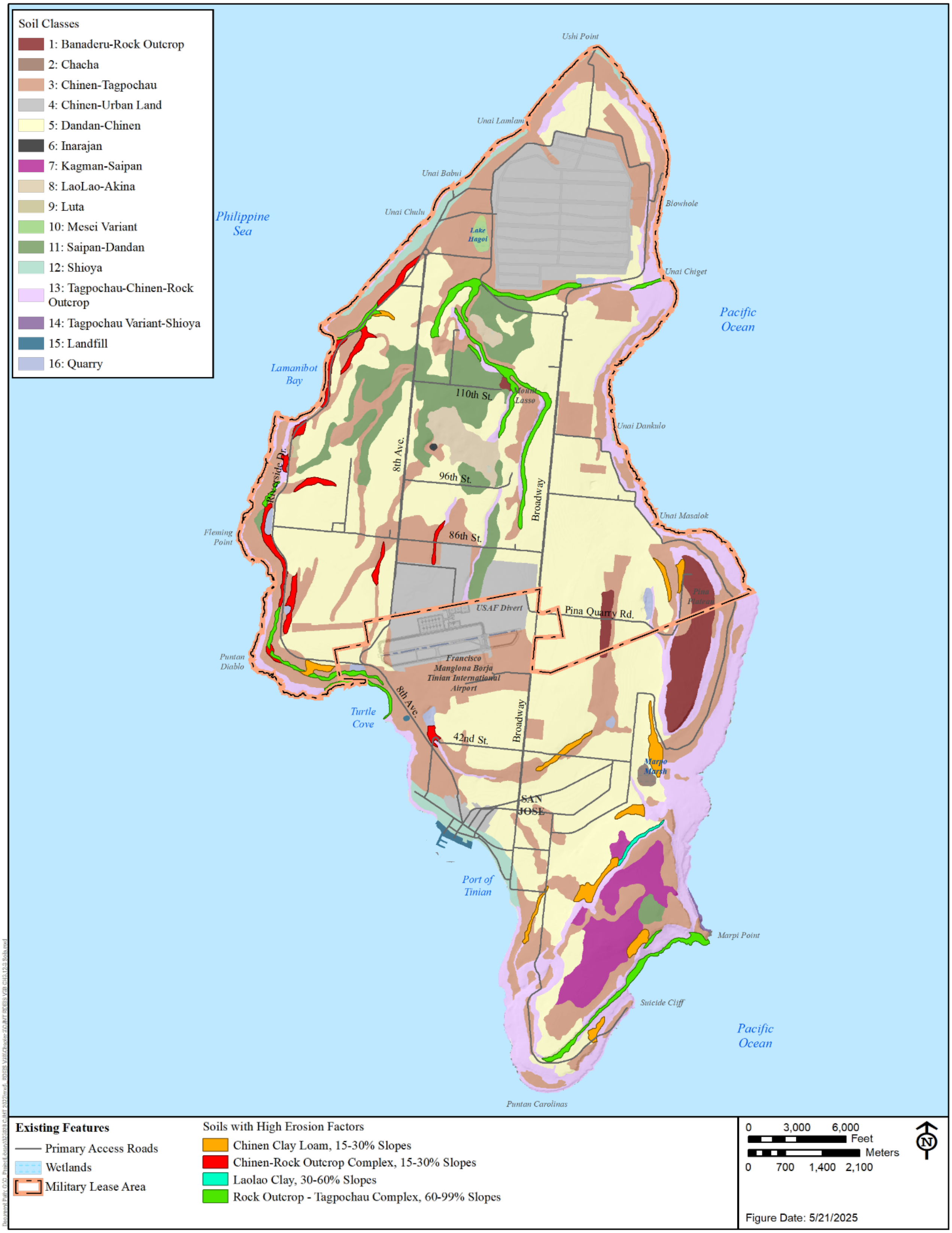

Figure 3.12-3 Tinian Soils

Table 3.12-1 Tinian Soil Classifications and Properties

Soil Class	*Soil Description*	*Shrink/ Swell Potential*	*Erodibility Factor (K)*	*Location*
Banaderu-Rock Outcrop	Shallow, well drained, nearly level to moderately steep soils and rock outcrop.	Moderate	0.20	Limestone Plateaus
Chacha	Shallow and deep, poorly drained, and found on steep slopes, plateaus, and hills.	High	0.15	Limestone Uplands
Chinen-Tagpochau	Very shallow and shallow, well drained, nearly level to strongly sloping soils, and found on plateaus and side slopes.	Moderate	0.10	Limestone Plateaus
Chinen-Urban Land	Shallow, well drained, nearly level soils and urban areas.	Moderate	0.15	Limestone Plateaus
Dandan-Chinen	Shallow and moderately deep, well drained, nearly level to strongly sloping soils.	Moderate	0.15	Limestone Plateaus
Inarajan	Very deep, poorly drained soils.	High	0.24	Valley Bottoms and Coastal Plains
Kagman-Saipan	Deep and very deep, well drained, nearly level to strongly sloping soils.	Moderate	0.15	Limestone Plateaus
Laolao-Akina	Moderately deep, well drained, strongly sloping to steep soils found on volcanic uplands.	Moderate	0.15	Uplands
Luta	Very shallow, well drained, nearly level to strongly sloping soils.	Low	0.10	Limestone Plateaus
Mesei Variant	Moderately deep, very poorly drained, level soils.	Low	0.05	Depressional Areas
Saipan-Dandan	Moderately deep and very deep, well drained, nearly level to gently sloping soils.	Moderate	0.15	Limestone Plateaus
Shioya	Very deep, excessively drained, level to nearly level soils, found on coastal strands.	Low	0.15	Coastal Limestone Sands
Tagpochau-Chinen-Rock Outcrop	Shallow, well drained, strongly sloping to extremely steep soils and rock outcrop, found on limestone escarpments and plateaus.	Moderate	0.10	Uplands
Tagpochau Variant-Shioya	Very shallow to very deep excessively drained, levels to gently sloping soils, found on coastal stands and plateaus.	Low	0.15	Lowlands

Source: U.S. Department of Agriculture 1989.

Soil erosion occurs naturally on the islands due to the effects of wind and water but can be accelerated by human and wildlife activities (U.S. Department of Agriculture 2004). Banaderu and Inarajan soil units in the Military Lease Area are characterized as having the greatest susceptibility for soil erosion. The higher the "K" value in the table, the more susceptible the soil is to erosion (U.S. Department of Agriculture 1989). In addition, soil units located in areas with slopes greater than 15 percent have higher susceptibility to erosion. Within the Military Lease Area, these steep areas tend to be in the vicinity of Mount Lasso and along the western edge of the island (Figure 3.12-3).

Soils that are best suited to producing sustained high yields of crops are identified as prime farmland (U.S. Department of Agriculture 1989). Prime farmland soils do not have to currently be used for cropland. Areas with these soils can be forest land, pastureland, cropland, or other land (Natural Resources Conservation Service 2012). Prime farmland soils on Tinian are shown in Figure 3.12-4. Within the Military Lease Area, prime farmland soils include Saipan-Dandan clays (0 to 5 percent slope) and Saipan clays (0 to 5 percent slope) and comprise approximately 71 percent (1,054 acres) of prime farmland soils on Tinian.

3.13 Groundwater and Hydrology

This section describes Tinian groundwater and hydrology conditions, which is the occurrence, movement, and quality of water beneath the surface.

3.13.1 Groundwater Availability

Rainfall is the primary source of fresh groundwater on Tinian. This rainwater percolates downward into porous limestone rock (Doan et al. 1960) and recharges Tinian's freshwater aquifer. Fresh groundwater on Tinian is primarily classified as basal (a body of fresh groundwater that floats on saline groundwater). The portion of the basal freshwater lens that is usable for potable water (groundwater with chloride concentrations less than 250 parts per million) is thickest south and southwest of Mount Lasso and thins approaching the coastline (Figure 3.13-1). Tinian relies on groundwater for all of its water supply. The basal freshwater lens underlying Tinian meets the definition of an aquifer found in CNMI Title 65, Chapter 65-90-010 and is the principal source of drinking water for the island's residents.

The groundwater table on Tinian (the underground area where water fills the spaces between sediment layers), ranges from sea level around the perimeter of the island to over 3 feet above mean sea level in the central portions of the island. The U.S. Geological Survey estimates the average annual groundwater recharge for Tinian to be approximately 30 inches per year (Gingerich 2002). This translates into approximately 20 billion gallons per year of recharge. Groundwater flows outward from the North Central Highland and the Southeastern Ridge and generally seaward around the island (Appendix M). Figure 3.13-1 depicts groundwater table elevation contours and the general direction of groundwater flow. Most of the fresh groundwater slowly discharges naturally from springs around the perimeter of the island and submarine coastal springs.

Numerous wells have been installed on Tinian, beginning with potentially more than 100 wells installed by the Japanese from 1914 to 1944. Most of these wells were reportedly filled. Between 1944 and 1945, the U.S. installed approximately 40 wells, including Maui Well Number 1. The majority of these wells have been inactive since shortly after World War II, except Maui Well Number 1. Between 1993 and 1997, the U.S. Geological Survey installed 17 wells and rehabilitated 16 World War II-era wells for groundwater monitoring; all of which remain open.