USDA Natural Resources
Conservation Service

Ecological site QX191X01X004
Somewhat Poorly and Poorly Drained Limestone Basins

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General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

MLRA notes

Major Land Resource Area (MLRA): 191X–High Limestone Plateaus of the Mariana Islands

This MLRA consists of the northern half of Guam and the islands of Saipan), Tinian, Rota, and Aguijan. Topography consists mostly of limestone plateaus. The highest elevations are 1,700 feet (520 meters) on Rota, 1,485 feet (450 meters) on Saipan, 655 feet (200 meters) on Tinian, and 860 feet (260 meters) in the northern part of Guam. The limestone plateaus were uplifted by tectonic activity. Deeply weathered volcanic rock is exposed on some ridges and slopes. Average annual rainfall is 100 inches (2,540 millimeters) on northern Guam and 80 inches (2,030 millimeters) on Saipan, Tinian, Aguijan, and Rota. The rainy season occurs from July through November; the dry season occurs from December through June. Trade winds blow from the northeast. Average annual temperature is 79 degrees F (26 degrees C). Typhoons are frequent. Soils are Alfisols, Andisols, Entisols, Mollisols, or Oxisols. The dominant soil moisture regime is ustic. The soil temperature regime is isohyperthermic. Native vegetation consists of mixed tropical hardwoods; introduced white leadtree or tangantangan trees (*Leucaena leucocephala*) are abundant. Introduced deer, pigs, goats, and water buffalo are common (USDA-NRCS, 2006). The main human disturbance is clearing land for cultivation. Feral pigs, feral cattle, brown tree snakes, stray dogs (Boonie dogs), and introduced deer are destructive to the native forest (Amand, 2000; CNMI SWARS Council, 2010; Donnegan et al., 2011; Liske-Clark, 2015; Willsey et al., 2019).

Classification relationships

This ecological site occurs within Major Land Resource Area (MLRA) 191 – High Limestone Plateaus of the Mariana Islands.

Ecological site concept

This ecological site occurs on the islands of Guam, Saipan, and Tinian in the Mariana Islands. It occurs in basin floor positions on limestone plateaus and coastal plains on nearly level to gently slopes (0 to 5 percent slopes) at elevations ranging from 0 to 500 feet (0 to 150 meters) (Amidon et al., 2017; Liu and Fischer, 2008; USDA-SCS, 1988; USDA-SCS, 1989).

Soils range from moderately deep to very deep. They are somewhat poorly or poorly drained Alfisols (Oxyaquic Vertic Paleustalfs) that formed in alluvial sediments and volcanic saprolite overlying limestone. Soil temperature regimes are isohyperthermic; soil moisture regimes are aquic. The mean annual precipitation is 92 inches (2,340 millimeters) (PRISM, 2006). Water runoff ranges from very low to very high; permeability is very slow. Effective rooting depth is 39 inches or greater (100 centimeters). Available water-holding capacity is low (about 5 inches or 13 centimeters). Groundwater is fresh (EC 0 mmhos/centimeter). The water table fluctuates seasonally between 0 and 36 inches or greater; (0 and 79 centimeters). Flooding is rare and brief. Ponding is rare but can occur for short to extended periods after heavy rainfall (USDA-SCS, 1988; USDA-SCS, 1989). Most of the area is vegetated by water-tolerant grasses and forest (Fosberg, 1960; USDA-SCS, 1988; USDA-SCS, 1989).

Associated sites

QX191X01X503	**Very Shallow to Moderately Deep Soils on Limestone Plateaus** Soils of QX191X01X503 (The Very Shallow to Moderately Deep Soils on Limestone Plateaus Ecological Site) formed in fine materials over porous coralline or argillaceous limestone. Effective rooting depth is very shallow to moderately deep (2 to 20 inches) and available water holding capacity is very low. Areas not farmed are vegetated by mostly introduced grass, forb, and tree species, with some areas of native upland forest. White leadtree or tangantangan (Leucaena leucocephala) is abundant in places. Soils of QX191X01X004 (The Somewhat Poorly Drained and Poorly Drained Limestone Basins Ecological Site) occur in concave basins, depressions, and on foot slopes on limestone plateaus. Soils formed in mixed alluvium over limestone, have aquic moisture regimes, very shallow to moderately deep water tables, low available water capacity (5 inches), and undergo rare flooding and ponding. Most of the area is vegetated by water-tolerant grasses and forest.

QX191X01X505	**Very Low Available Water Capacity Soils on Limestone Plateaus and Escarpments** Soils of QX191X01X505 (Very Low Available Water Capacity Soils on Limestone Plateaus and Escarpments) formed in fine materials over porous coralline limestone. Effective rooting depth is very shallow to shallow (2 to 16 inches); available water holding capacity is very low (1 inch). Most of the area is vegetated by native forest. This ecological site is limited to an area that is often shrouded in clouds and fog. Moisture is added to the soil by fog drip, which maintains soils in moist condition most of the time. This ecological site is mostly forested with native species. Soils of QX191X01X004 (The Somewhat Poorly Drained and Poorly Drained Limestone Basins Ecological Site) occur in concave basins, depressions, and on foot slopes on limestone plateaus. Soils formed in mixed alluvium over limestone, have aquic moisture regimes, very shallow to moderately deep water tables, low available water capacity (5 inches), and undergo rare flooding and ponding. Most of the area is vegetated by water-tolerant grasses and forest.
QX192X01X003	**Shallow Soils on Volcanic Uplands** Soils of QX192X01X003 (The Shallow and Shallow Soils on Volcanic Upland Ecological Site) are very shallow to shallow with very low available water holding capacity (2 inches), high base saturation, and no aluminum toxicity that support upland grasses, forbs, and forest. Soils of QX191X01X004 (The Somewhat Poorly Drained and Poorly Drained Limestone Basins Ecological Site) occur in concave basins, depressions, and on foot slopes on limestone plateaus. Soils formed in mixed alluvium over limestone, have aquic moisture regimes, very shallow to moderately deep water tables, low available water capacity (5 inches), and undergo rare flooding and ponding. Most of the area is vegetated by water-tolerant grasses and forest.
QX191X01X502	**Deep and Very Deep Soils on Limestone Plateaus** Soils of QX191X01X502 (The Deep and Very Deep Soils on Limestone Plateaus Ecological Site) formed in fine materials over porous coralline or argillaceous limestone. Effective rooting depth is 40 to 72 inches and greater; available water holding capacity is low (4 to 6 inches). Much of the areas of both ecological sites is farmed. Where not farmed, vegetation consists of mostly introduced grass, forb, and tree species. White leadtree or tangantangan (Leucaena leucocephala) is abundant in places. Soils of QX191X01X004 (The Somewhat Poorly Drained and Poorly Drained Limestone Basins Ecological Site) occur in concave basins, depressions, and on foot slopes on limestone plateaus. Soils formed in mixed alluvium over limestone, have aquic moisture regimes, very shallow to moderately deep water tables, low available water capacity (5 inches), and undergo rare flooding and ponding. Most of the area is vegetated by water-tolerant grasses and forest.

QX191X01X503	**Very Shallow to Moderately Deep Soils on Limestone Plateaus** Soils of QX191X01X503 (The Very Shallow to Moderately Deep Soils on Limestone Plateaus Ecological Site) formed in fine materials over porous coralline or argillaceous limestone. Effective rooting depth is 2 to 20 inches; available water holding capacity is very low to low (1 to 4 inches). Areas not farmed are vegetated by mostly introduced grass, forb, and tree species, with some areas of native forest. White leadtree or tangantangan (Leucaena leucocephala) is abundant in places. Soils of QX191X01X004 (The Somewhat Poorly Drained and Poorly Drained Limestone Basins Ecological Site) occur in concave basins, depressions, and on foot slopes on limestone plateaus. Soils formed in mixed alluvium over limestone, have aquic moisture regimes, very shallow to moderately deep water tables, low available water capacity (5 inches), and undergo rare flooding and ponding. Most of the area is vegetated by water-tolerant grasses and forest.
QX191X01X002	**Moderately Deep Alfic Soils on Volcanic Uplands** Soils of QX191X01X002 (The Moderately Deep Alfic Soils on Volcanic Uplands Ecological Site) formed in residuum derived from andesitic marine tuff and tuffaceous breccia. They are highly weathered Alfisols that have fairly high base saturation, effective rooting depths between 20 and 40 inches, surface pH ranging from 5.5 to 5.8, and low available water holding capacity (5 inches). Most of the area is vegetated by grasses, forbs, and mixed forest of introduced and native species. Swordgrass (Miscanthus floridulus) is present in some areas. White leadtree or tangantangan (Leucaena leucocephala) is not abundant. Soils of QX191X01X004 (The Somewhat Poorly Drained and Poorly Drained Limestone Basins Ecological Site) occur in concave basins, depressions, and on foot slopes on limestone plateaus. Soils formed in mixed alluvium over limestone, have aquic moisture regimes, very shallow to moderately deep water tables, low available water capacity (5 inches), and undergo rare flooding and ponding. Most of the area is vegetated by water-tolerant grasses and forest.
QX191X01X005	**Very Poorly Drained Muck** Soils of QX191X01X005 (The Very Poorly Drained Muck Ecological Site) occur in depressions near sea level. Soils are very deep organic soils with fresh to saline groundwater that fluctuates near the soil surface. These soils are aquic. Flooding is frequent. Most of the area is vegetated by marsh grasses and, in a few locations, small stands of hibiscus (Hibiscus tiliaceus) or mangrove (Rhizophora) forest. Soils of QX191X01X004 (The Somewhat Poorly Drained and Poorly Drained Limestone Basins Ecological Site) occur in concave basins, depressions, and on foot slopes on limestone plateaus. Soils formed in mixed alluvium over limestone, have aquic moisture regimes, very shallow to moderately deep water tables, low available water capacity (5 inches), and undergo rare flooding and ponding. Most of the area is vegetated by water-tolerant grasses and forest.

QX191X01X501	**Excessively and Somewhat Excessively Drained Coastal Strand** Soils of QX191X01X501 (The Excessively Drained Coastal Strand Ecological Site) formed in coral sand near the sea and fine materials over limestone where it borders inland limestone plateaus and escarpments. Effective rooting depth is 4 to greater than 72 inches; available water holding capacity is very low to low (0 to 3 inches). Windborne salt spray and rare flooding by seawater affect the entire area. It is mostly forested with native, species. Soils of QX191X01X004 (The Somewhat Poorly Drained and Poorly Drained Limestone Basins Ecological Site) occur in concave basins, depressions, and on foot slopes on limestone plateaus. Soils formed in mixed alluvium over limestone, have aquic moisture regimes, very shallow to moderately deep water tables, low available water capacity (5 inches), and undergo rare flooding and ponding. Most of the area is vegetated by water-tolerant grasses and forest.
QX192X01X001	**Moderately Deep Oxic Soils on Volcanic Uplands** Soils of QX192X01X001 (The Moderately Deep Oxic Soils Ecological Site) on Volcanic Uplands formed in volcanic materials and have effective rooting depths ranging from 16 to 45 inches, low to moderate available water holding capacity (2 to 7 inches), low base saturation, extremely acidic to very strongly acidic pH (4.5 to 6.0), and aluminum toxicity. Most of the area is vegetated by Pacific Island silvergrass or swordgrass (Miscanthus floridulus). Soils of QX191X01X004 (The Somewhat Poorly Drained and Poorly Drained Limestone Basins Ecological Site) occur in concave basins, depressions, and on foot slopes on limestone plateaus. Soils formed in mixed alluvium over limestone, have aquic moisture regimes, very shallow to moderately deep water tables, low available water capacity (5 inches), and undergo rare flooding and ponding. Most of the area is vegetated by water-tolerant grasses and forest.
QX192X01X002	**Deep Alfic Soils on Volcanic Uplands** Soils of QX192X01X002 (The Deep Alfic Soils on Volcanic Uplands Ecological Site) formed in volcanic materials and have effective rooting depths ranging from 20 to 40 inches, low available water holding capacity (4 inches), fairly high base saturation, pH above 5.0, such that there is no aluminum toxicity. Most of the area is vegetated by forest, grasses, and forbs. Soils of QX191X01X004 (The Somewhat Poorly Drained and Poorly Drained Limestone Basins Ecological Site) occur in concave basins, depressions, and on foot slopes on limestone plateaus. Soils formed in mixed alluvium over limestone, have aquic moisture regimes, very shallow to moderately deep water tables, low available water capacity (5 inches), and undergo rare flooding and ponding. Most of the area is vegetated by water-tolerant grasses and forest.

Table 1. Dominant plant species

Tree	(1) *Leucaena leucocephala*
Shrub	Not specified

Herbaceous	(1) *Urochloa mutica* (2) *Urochloa maxima*

Legacy ID

R191XY004MP

Physiographic features

This ecological site occurs in basins on limestone plateaus (USDA-SCS, 1988; USDA-SCS, 1989). While the depth to water table ranges from 0 to greater than 36 inches (0 to 90 centimeters).

Table 2. Representative physiographic features

Landforms	(1) Island > Basin floor (2) Island > Plateau
Runoff class	Very low to very high
Flooding frequency	None to rare
Ponding frequency	None to rare
Elevation	0–152 m
Slope	0–5%
Water table depth	46–91 cm
Aspect	Aspect is not a significant factor

Table 3. Representative physiographic features (actual ranges)

Runoff class	Not specified
Flooding frequency	Not specified
Ponding frequency	Not specified
Elevation	Not specified
Slope	Not specified
Water table depth	0–183 cm

Climatic features

Summary for this Ecological Site

Rainfall statistics were determined from PRISM rainfall raster data (PRISM, 2006). Representative (20th and 80th percentiles) values for mean annual precipitation range

from 91 to 100 inches (2,310 to 2,540 millimeters) while actual (10th and 90th percentiles) values for mean annual precipitation also range from 73 to 104 inches (1,855 to 2,640 millimeters). Extreme values range from 70 to 104 inches (1,780 to 2,640 millimeters). The mean annual precipitation is 92 inches (2,335 millimeters) and the median annual average precipitation is also 95 inches (2,410 millimeters).

Temperature statistics were determined from PRISM temperature raster data (PRISM, 2006). Representative (20th and 80th percentiles) values for mean annual temperatures range from 81 to 81 degrees F (27 to 27 degrees C) while actual (10th and 90th percentiles) values for mean annual temperatures also range from 81 to 81 degrees F (27 to 27 degrees C). Extreme values range from 79 to 82 degrees F (26 to 28 degrees C). The average annual temperature is 81 degrees F (27 degrees C), and the median annual temperature is also 81 degrees F (26 degrees C).

The data presented in the climate normals tables below are from climate stations in Guam and Saipan. I used the data from these stations because they are representative of the spatial distribution of this ecological site and because the values for mean annual precipitation (92 inches or 2,335 millimeters) and the mean annual temperature (about 80 degrees F or 27 degrees C) are reasonably comparable to the PRISM values presented above.

General Principles

The climate is uniformly warm and humid throughout the year. Afternoon temperatures typically are about 86 degrees F (30 degrees C); nighttime temperatures are about 68 degrees F (20 degrees C). Relative humidity is 65 to 75 percent in the afternoon to 85 to 100 percent at night. Though temperature and humidity vary only slightly throughout the year, rainfall and wind conditions vary markedly. There are two main seasons, the dry season from December through June and the rainy season from mid-July to mid-November. Moisture deficit occurs between January and June. Mean annual rainfall ranges from about 98 inches (2,490 millimeters) on the windward (eastern) side of the higher mountains to about 79 inches (2,005 millimeters) along the coast of the western side of the islands. On average, about 15 percent of the annual rainfall occurs during the dry season and 55 percent during the rainy season (Fosberg, 1960; USDA-SCS, 1988; USDA-SCS, 1989).

Throughout the year, the dominant winds are the trade winds that blow from the east or northeast. The trade winds are strongest and most constant during the dry season, when windspeeds of 15 to 25 mph (25 to 40 kph) are common. Coastal areas that have east, and northeast exposures are subject to salt spray and buffeting winds (Fosberg, 1960; USDA-SCS, 1988; USDA-SCS, 1989).

During the rainy season the trade winds may break down and be replaced by a weak, westerly monsoon influence that brings heavy showers or steady and sometimes torrential rains. The islands lie in the path of typhoons from the southeast and east. They bring

heavy rains and violent winds that may result in a surge of water onto low-lying coastal areas. They occur most frequently during the latter half of the year. The chance of having one or more typhoons pass close to the islands in any particular year is about once in three years. The chance of having a typhoon move directly across an island is about once in eight years (Fosberg, 1960; USDA-SCS, 1988; USDA-SCS, 1989).

Table 4. Representative climatic features

Frost-free period (characteristic range)	365 days
Freeze-free period (characteristic range)	365 days
Precipitation total (characteristic range)	2,311-2,540 mm
Frost-free period (actual range)	365 days
Freeze-free period (actual range)	365 days
Precipitation total (actual range)	1,854-2,642 mm
Frost-free period (average)	365 days
Freeze-free period (average)	365 days
Precipitation total (average)	2,337 mm

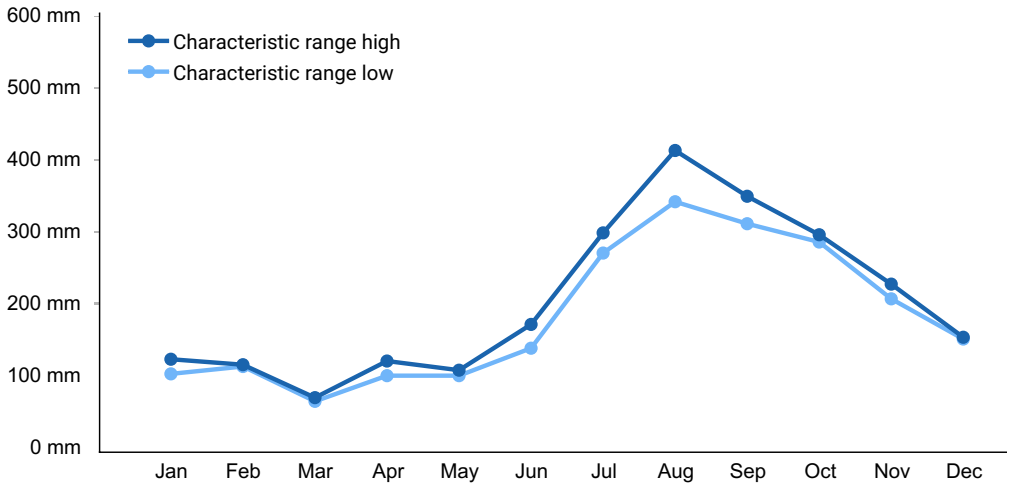


Figure 1. Monthly precipitation range

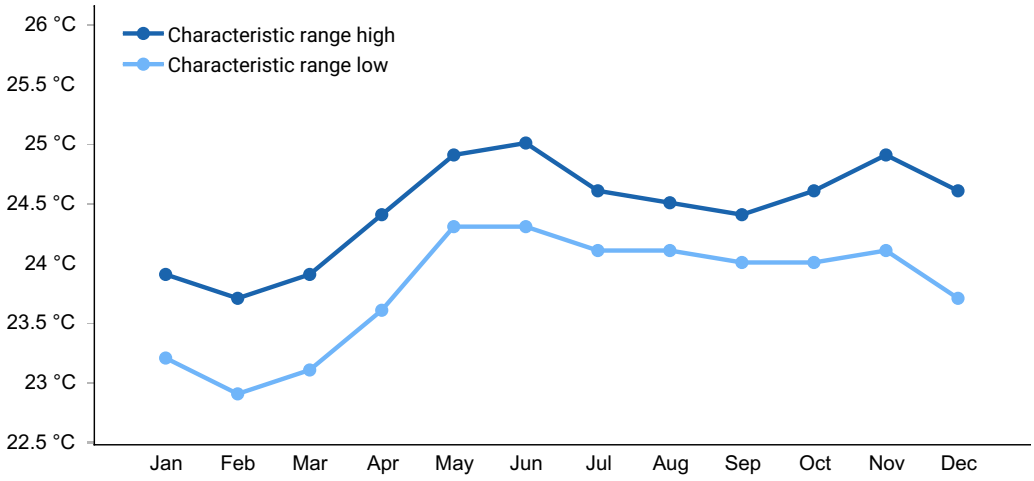


Figure 2. Monthly minimum temperature range

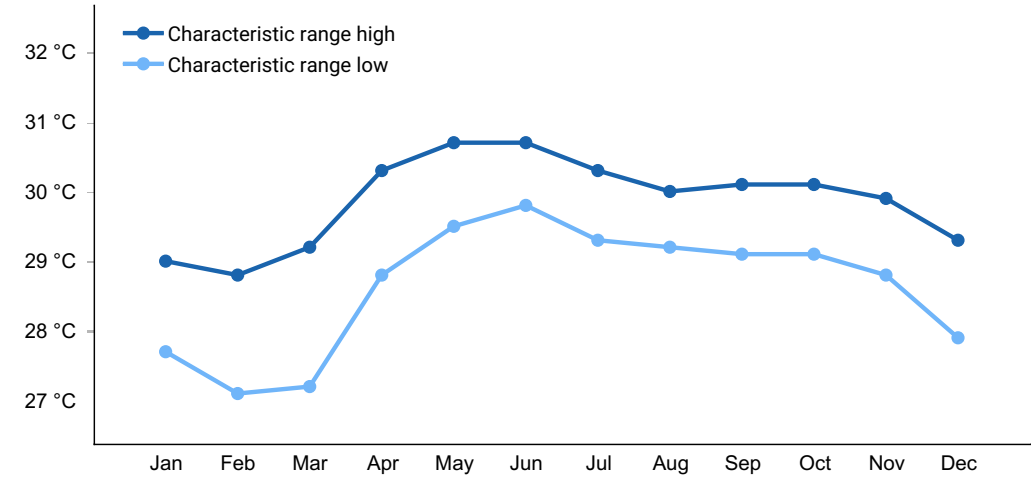


Figure 3. Monthly maximum temperature range

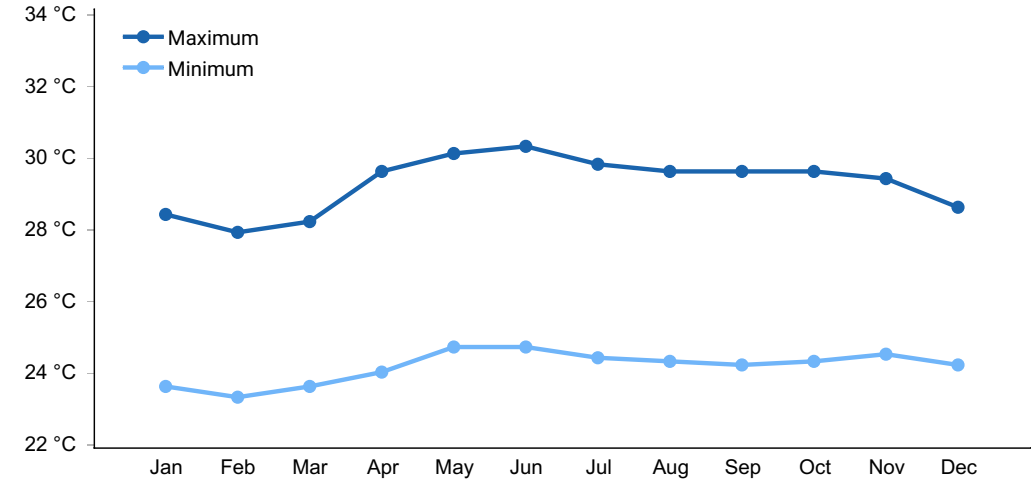


Figure 4. Monthly average minimum and maximum temperature

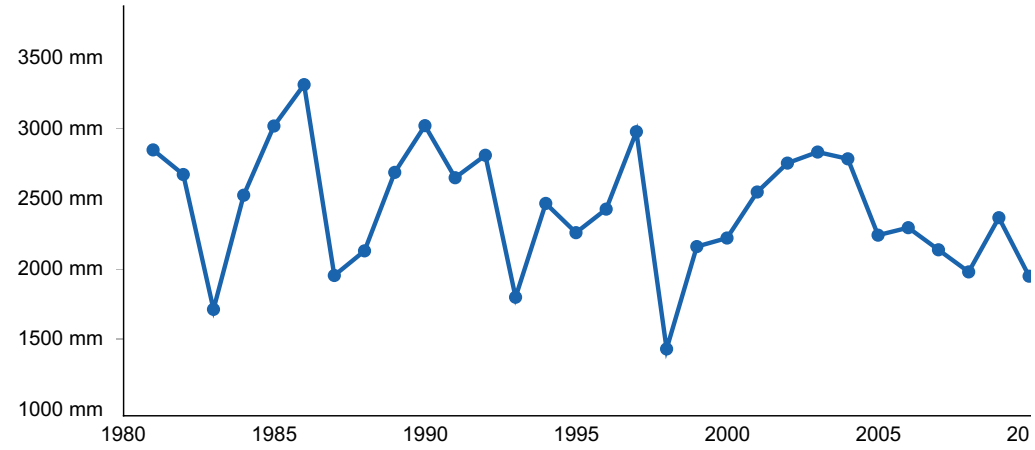


Figure 5. Annual precipitation pattern

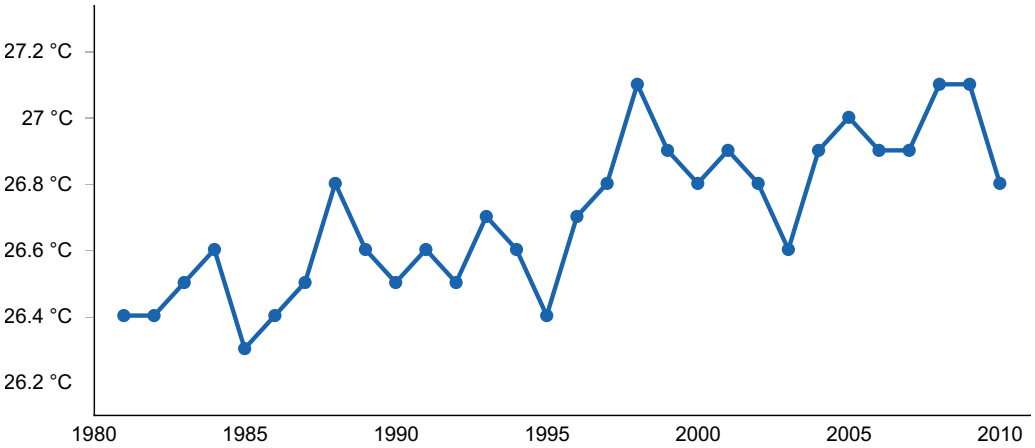


Figure 6. Annual average temperature pattern

Climate stations used

- (1) GUAM INTL AP [GQW00041415], GU
- (2) CAPITOL HILL 1 [CQC00914080], MP

Influencing water features

The basins that make up this ecological site are sometimes flooded or ponded. Detailed information is not available about depth and duration (USDA-SCS, 1988; USDA-SCS, 1989).

Number of National Wetland Inventory (NWI) features overlapping ecological site: Freshwater emergent wetland (50), riverine (27), freshwater forested/shrub wetland (20), and freshwater pond (6) (USFWS, 2023).

Soil features

Soils associated with this ecological site are Chacha and Chacha Variant. They are Alfisols (Oxyaquic Vertic Paleustalfs) which formed in alluvium derived from argillaceous

limestone and volcanic saprolite deposited over limestone. Soil temperature regimes are isohyperthermic; soil moisture regimes are aquic. They are deep to very deep and somewhat poorly or poorly drained (USDA-SCS, 1988; USDA-SCS, 1989).

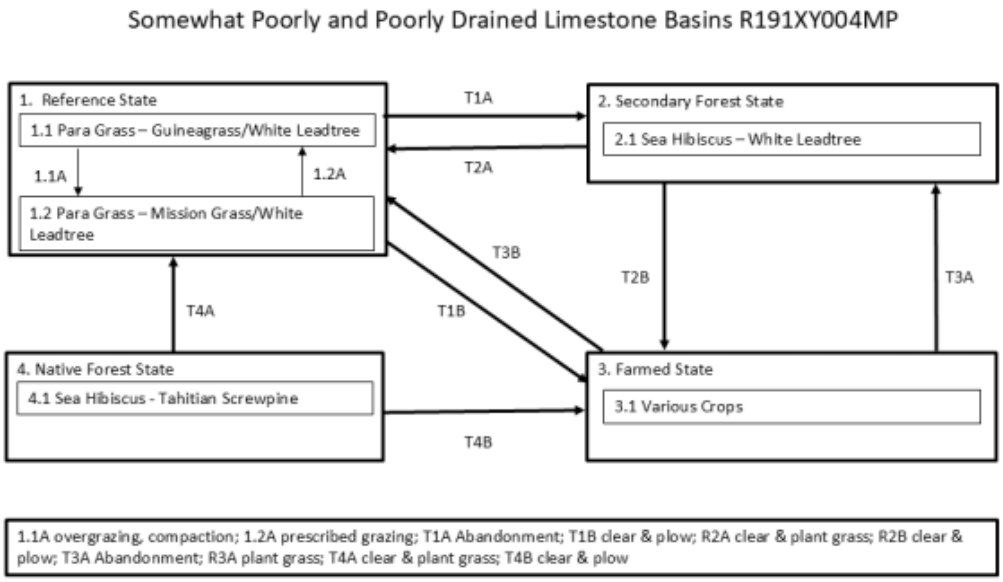
Table 5. Representative soil features

Parent material	(1) Alluvium–argillaceous limestone
Surface texture	(1) Clay
Family particle size	(1) Very-fine
Drainage class	Somewhat poorly drained to poorly drained
Permeability class	Slow
Depth to restrictive layer	99–183 cm
Soil depth	99–183 cm
Surface fragment cover <=3"	0–5%
Surface fragment cover >3"	0–5%
Available water capacity (0-101.6cm)	9.91–14.99 cm
Calcium carbonate equivalent (0-101.6cm)	0%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–1
Soil reaction (1:1 water) (0-25.4cm)	5.1–7.8
Subsurface fragment volume <=3" (0-101.6cm)	0–5%
Subsurface fragment volume >3" (0-101.6cm)	0%

Ecological dynamics

The main natural disturbance is strong storms that can damage or kill vegetation by high wind speeds. The main human disturbance is clearing of native vegetation for agriculture or grazing (Amidon et al., 2019; Athens and Ward, 2004; CNMI SWARS Council, 2010; Donnegan et al., 2011; Falanruw et al., 1989; Fosberg, 1960; Liske-Clark, 2015; Wagner and Grether, 1948; Willsey et al., 2019).

State and transition model



State 1
Reference State

The Reference Sate (1) is naturalized grassland. There are two community phases.

Community 1.1
Para grass – Guineagrass/White Leadtree (Tangantangan)

Dominant grass species are para grass (*Urochloa mutica*) in wetter locations and guineagrass (*Urochloa maxima*) in drier locations. Some white leadtree or tangantangan (*Leucaena leucocephala*) is often present (Amidon et al., 2019; Athens and Ward, 2004; CNMI SWARS Council, 2010; Donnegan et al., 2011; Falanruw et al., 1989; Fosberg, 1960; Kuo and Berry, 2018; Liske-Clark, 2015; Marshall et al., 2020; Stemmermann, 1981; Wagner and Grether, 1948; Willsey et al., 2019).

Dominant plant species

- white leadtree (*Leucaena leucocephala*), tree
- para grass (*Urochloa mutica*), grass
- guineagrass (*Urochloa maxima*), grass

Community 1.2
Para Grass – Mission Grass/White Leadtree

Some para grass (*Urochloa mutica*) and guineagrass (*Urochloa maxima*) from community phase 1.1 remain in phase 1.2, but other grasses that are less palatable to grazing

animals have increased. Common grass species in this community phase are mission grass (*Pennisetum polystachion*) and Johnsongrass (*Sorghum halepense*) (Amidon et al., 2019; Athens and Ward, 2004; CNMI SWARS Council, 2010; Donnegan et al., 2011; Falanruw et al., 1989; Fosberg, 1960; Kuo and Berry, 2018; Liske-Clark, 2015; Marshall et al., 2020; Stemmermann, 1981; Wagner and Grether, 1948; Willsey et al., 2019).

Dominant plant species

- white leadtree (*Leucaena leucocephala*), tree
- para grass (*Urochloa mutica*), grass
- mission grass (*Pennisetum polystachion*), grass

Pathway 1.1A
Community 1.1 to 1.2

Overuse by ungulates results in soil compaction and reduction in competitiveness of dominant, desired forage species that brings a phase change from 1.1 to 1.2 typified by a partial shift to plant species that are less impacted by grazing and browsing.

Pathway 1.2A
Community 1.2 to 1.1

Community phase 1.2 will revert to phase 1.1 with grazing management.

State 2
Secondary Forest State

The Secondary Forest State (2) consists of one community phase consisting of a variable array of native and introduced tree species dependent on the species existing in the local area.

Community 2.1
Sea Hibiscus – White Leadtree

This community phase is often dominated by native sea hibiscus (*Hibiscus tiliaceus*). White leadtree or tangantangan (*Leucaena leucocephala*) is also common. Some other species that may occur are native Tahitian screwpine (*Pandanus tectorius*), limeberry (*Triphasia trifolia*), an introduced shrub, and bellyache bush (*Jatropha gossypiifolia*), an introduced forb (Amidon et al., 2019; Athens and Ward, 2004; CNMI SWARS Council, 2010; Donnegan et al., 2011; Falanruw et al., 1989; Fosberg, 1960; Kuo and Berry, 2018; Liske-Clark, 2015; Marshall et al., 2020; Stemmermann, 1981; Wagner and Grether, 1948; Willsey et al., 2019).

Dominant plant species

- sea hibiscus (*Hibiscus tiliaceus*), tree

- white leadtree (*Leucaena leucocephala*), tree

State 3
Farmed State

The Farmed State (3) consists of one community phase dominated by selected crops. This is a very common land use for the soils in this ecological site.

Community 3.1
Various Crops

A wide variety of crops are grown on these soils.

State 4
Native Forest State

The Native Forest State (4) consists of one community phase. Hypothetically, this ecological site was originally vegetated by swamp forest. While the species composition is not known, some native tree species commonly inhabit these sites (Amidon et al., 2019; Athens and Ward, 2004; CNMI SWARS Council, 2010; Donnegan et al., 2011; Falanruw et al., 1989; Fosberg, 1960; Kuo and Berry, 2018; Liske-Clark, 2015; Marshall et al., 2020; Stemmermann, 1981; Wagner and Grether, 1948; Willsey et al., 2019).

Community 4.1
Sea Hibiscus – Tahitian Screwpine

Existing forested sites typically have thickets of sea hibiscus (*Hibiscus tiliaceus*) and some Tahitian screw pine (*Pandanus tectorius*) (Amidon et al., 2019; Athens and Ward, 2004; CNMI SWARS Council, 2010; Donnegan et al., 2011; Falanruw et al., 1989; Fosberg, 1960; Kuo and Berry, 2018; Liske-Clark, 2015; Marshall et al., 2020; Stemmermann, 1981; Wagner and Grether, 1948; Willsey et al., 2019).

Dominant plant species

- sea hibiscus (*Hibiscus tiliaceus*), tree
- Tahitian screwpine (*Pandanus tectorius*), tree

Transition T1A
State 1 to 2

The Reference State (1) transitions to the Secondary Forest State (2) by removal of grazing and browsing ungulates, allowing colonization by local tree species.

Transition T1B

State 1 to 3

The Reference State (1) is restored to the Farmed State (3) by cultivating the soil and then planting crops.

Transition T2A
State 2 to 1

The Secondary Forest State (2) can be restored to the Reference State (1) by burning or mechanically clearing trees, shrubs, and undesirable forbs.

Transition T2B
State 2 to 3

The Secondary Forest State (2) can be restored to the Farmed State (3) by burning or mechanically clearing trees, shrubs, and undesirable forbs and then cultivating the soil and planting crops.

Transition T3B
State 3 to 1

The Farmed State (3) transitions to the Reference State (1) by cessation of cropping activities. Seeding of desired forage species may be needed if they are not present in the local area.

Transition T3A
State 3 to 2

If not artificially drained for crops, the Farmed State (3) will transition to the Secondary Forest State (2) by abandonment.

Transition T4A
State 4 to 1

The Native Forest State (4) can transition to the Reference to the Reference State (1) by burning or mechanical clearing.

Transition T4B
State 4 to 3

The Native Forest State (4) will transition to the Farmed State (3) by burning or mechanical clearing followed by cultivation and planting crops. Artificial drainage is sometimes installed.

Additional community tables

Other references

References for R191XY004MP (The Somewhat Poorly and Poorly Drained Limestone Basins Ecological Site):

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Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	03/18/2026
Approved by	Kendra Moseley
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

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2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

7. **Amount of litter movement (describe size and distance expected to travel):**

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

Dominant:

Sub-dominant:

Other:

Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

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14. **Average percent litter cover (%) and depth (in):**

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

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17. **Perennial plant reproductive capability:**
