Ecological site QX192X01X004
Very Deep Soils on Volcanic Uplands

Last updated: 5/08/2025
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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): 192X–Volcanic Highlands of the Mariana Islands

This MLRA is in the southern half of Guam. Topography consists of mountains and plateaus that are dissected by streams. The highest elevation is 1,336 feet (410 meters). The geology consists of deeply weathered volcanic rock with some limestone inclusions. Average annual rainfall ranges from 85 to 100 inches (2,160 to 2,540 millimeters) in the northern half of this MLRA and from 95 to 118 inches (2,410 to 3,000 millimeters) in the southern half. Average annual temperature is 79 degrees F (26 degrees C). The dry season occurs from January through April, the rainy season occurs from July through November. Trade winds are persistent during the dry season. Typhoons are frequent. Soils are Entisols, Alfisols, Inceptisols, Mollisols, or Oxisols. The dominant soil moisture regime is ustic. The soil temperature regime is isohyperthermic. Except for remnants of native forest in gulches and river valleys, forest vegetation has been largely replaced by grasses through repeated burning. Introduced deer, pigs, goats, and water buffalo are common (USDA-NRCS, 2006).

Classification relationships

This ecological site occurs within Major Land Resource Area (MLRA) 192 – Volcanic Islands of the Mariana Islands.

Ecological site concept

This ecological site occurs on the island of Guam in the Mariana Islands. It occurs on gently sloping to moderately sloping (3 to 15 percent slopes) lower slopes, concave areas, and drainageways on volcanic uplands at elevations ranging from 98 to 984 feet (30 to 300 meters) (USDA-SCS, 1988). Soils are very deep, well drained Inceptisols that formed in slope alluvium derived weathered from tuff and tuff breccia (USDA-SCS, 1988; Soil Survey Staff, 2025). Soil temperature regimes are isohyperthermic; soil moisture regimes are ustic. Mean annual precipitation is about 102 inches (2,590 millimeters) (PRISM,2006). Water runoff is medium; permeability is moderately slow (USDA-SCS, 1988). Available water-holding capacity is low (4 inches). Some lower areas are saturated with water for brief periods during the rainy season. Soil pH is high enough (5.6) that aluminum toxicity is not a major limiting factor on plant growth (USDA-SCS, 1988). Most of the area is vegetated by grasses and forbs (Amidon et al., 2017; Fosberg, 1960; USDA-SCS, 1988).

Associated sites

QX192X01X501	**Somewhat Poorly Drained Alluvium** Soils of QX192X01X501 (The Somewhat Poorly Drained Alluvium Ecological Site) occur in depressions, stream channels, and seeps surrounded by this ecological site, have effective rooting depths greater than 72 inches, moderate available water holding capacity (7 inches), a water table as shallow as 30 inches below the surface, experience rare and brief flooding, and support wetland forest, grasses, and sedges. Soils of QX192X01X004 (The Very Deep Soils on Volcanic Uplands Ecological Site) are very deep Inceptisols on lower slopes, concave areas, and drainageways, have low available water holding capacity (4 inches), and a water table greater than 72 inches, does not experience flooding or ponding, and it supports a variety of upland grasses and forbs.

QX191X01X505	**Very Low Available Water Capacity Soils on Limestone Plateaus and Escarpments** Soils of QX192X01X505 (The Very Low Available Water Holding Capacity Soils on Limestone Plateaus and Escarpments Ecological Site) occur on limestone plateaus that may border QX192X01X004 (The Very Deep Soils on Volcanic Uplands Ecological Site) which occurs on volcanic uplands. Depending on slope (0 to 99 percent), water runoff ranges from very slow to rapid, available water holding capacity is very low (1 inch), pH is neutral (7.0 To 7.2). and the area is mostly vegetated by native forest. While soils of QX192X01X004 (The Very Deep Soils on Volcanic Uplands Ecological Site) are very deep Inceptisols on lower slopes, concave areas, and drainageways, have a higher available water holding capacity (4 inches), moderately acidic soils (5.6) moderate base saturation, no aluminum toxicity, and supports a variety of grasses and forbs.
QX192X01X001	**Moderately Deep Oxic Soils on Volcanic Uplands** Both ecological sites occur adjacent to each other on volcanic uplands. Soils of QX192X01X001 (The Moderately Deep Oxic Soils on Volcanic Uplands Ecological Site) are primarily moderately deep Oxisols on upland slopes with low available water holding capacity (3 inches), very strongly acidic soils (4.9 to 5.1), low base saturation, with an aluminum toxicity that supports mostly Pacific Island silvergrass (swordgrass). Soils of QX192X01X004 (The Very Deep Soils on Volcanic Uplands Ecological Site) are very deep Inceptisols on lower slopes, concave areas, and drainageways, have a slightly higher available water holding capacity (4 inches), moderately acidic soils (5.6) moderate base saturation, no aluminum toxicity, and supports a variety of grasses and forbs.
QX192X01X002	**Deep Alfic Soils on Volcanic Uplands** Both ecological sites occur adjacent to each other on volcanic uplands. Soils of QX192X01X002 (The Deep Alfic Soils on Volcanic Uplands Ecological Site) are primarily deep Alfisols on mountain slopes with low available water holding capacity (4 inches), moderately acidic soils (5.5 to 5.8), high base saturation, occur on strongly sloping to very steep (0 to 60 percent) slopes, no aluminum toxicity, and support forest, grasses, and forbs. Soils of QX192X01X004 (The Very Deep Soils on Volcanic Uplands Ecological Site) are very deep Inceptisols on lower slopes, concave areas, and drainageways, have a slightly higher available water holding capacity (4 inches), moderately acidic soils (5.6), moderate base saturation, no aluminum toxicity, and supports a variety of grasses and forbs.
QX192X01X003	**Shallow Soils on Volcanic Uplands** Both ecological sites occur adjacent to each other on volcanic uplands. Soils of QX192X01X003 (The Shallow Soils on Volcanic Uplands Ecological Site) are shallow Mollisols with very low available water holding capacity (2 inches), high base saturation, and no aluminum toxicity and supports upland grasses, forbs, and forest. Soils of QX192X01X004 (The Very Deep Soils on Volcanic Uplands Ecological Site) are very deep Inceptisols on lower slopes, concave areas, and drainageways, have a higher available water holding capacity (4 inches), moderately acidic soils (5.6) moderate base saturation, no aluminum toxicity, and supports a variety of grasses and forbs.
QX191X01X506	**Somewhat Poorly and Poorly Drained Valley Bottoms and Coastal Plains** Soils of QX191X01X506 (The Somewhat Poorly and Poorly Drained Valleys and Alluvial Coastal Plains Ecological Site) occur below QX192X01X004 (The Very Deep Soils on Volcanic Uplands Ecological Site) on nearly level to gently sloping coastal plains and valleys. Its soils are deep to very deep, somewhat poorly to poorly drained Inceptisols with moderate available water-holding capacity (7 inches), pH is slightly acidic to neutral (6.2 to 7.3) and has a moderately high-water table (30 inches). Most of the area is vegetated by grasses, forbs, and wetland forest. While soils of QX192X01X004 are very deep Inceptisols on lower slopes, concave areas, and drainageways, have a lower available water holding capacity (4 inches), moderately acidic soils (5.6) moderate base saturation, no aluminum toxicity, and supports a variety of upland grasses and forbs.

Table 1. Dominant plant species

Tree	Not specified

Shrub	(1) *Spathoglottis plicata*
Herbaceous	(1) *Dimeria chloridiformis* (2) *Miscanthus floridulus*

Legacy ID

R192XY004GU

Physiographic features

This ecological site occurs in uplands on lower slopes, concave areas, and in drainageways, commonly between areas of Akina (uplands) soils and Ylig (bottomlands) soils (USDA-SCS, 1988). The depth to water table is greater than 72 inches (185 centimeters).

Table 2. Representative physiographic features

Landforms	(1) Upland > Mountain slope
Runoff class	Medium
Flooding frequency	None
Ponding frequency	None
Elevation	30 – 300 m
Slope	0 – 20 %
Water table depth	180 cm
Aspect	Aspect is not a significant factor

Climatic features

Summary for this ecological site

Rainfall statistics were determined from Guam PRISM rainfall raster data (PRISM, 2006). Representative (20th and 80th percentiles) values for mean annual precipitation range from 100 to 104 inches (2,540 to 2, 640 millimeters) while actual (10th and 90th percentiles) values for mean annual precipitation range from 98 to 107 inches (2,490 to 2,720 millimeters). Extreme values range from 93 to 113 inches (2,360 to 2,870 millimeters). The average annual precipitation is 102 inches (2,590 millimeters) and the median annual average precipitation is also 102 inches (2,590 millimeters).

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

The data presented in the climate normals table below are from the PRISM rainfall raster data presented above (PRISM, 2006). I did not

use the Western Region Climate Center weather stations which were available for Guam as they did not provide a good representation of the spatial distribution of this ecological site (Western Regional Climate Center, 2020).

General Concepts

The climate of Guam 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 on Guam, the dry season from January through April 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 (east) side of the higher mountains to about 79 inches (2,005 millimeters) along the coast of the west side of the southern half of the island. 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).

Throughout the year, the dominant winds in Guam 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).

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. Guam lies 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 Guam in any particular year is about once in three years. The chance of having a typhoon move directly across Guam is about once in eight years (Fosberg, 1960; USDA-SCS, 1988).

Table 3 Representative climatic features

Frost-free period (characteristic range)	370 days
Freeze-free period (characteristic range)	370 days
Precipitation total (characteristic range)	2,540-2,640 mm
Frost-free period (actual range)	370 days
Freeze-free period (actual range)	370 days
Precipitation total (actual range)	2,490-2,720 mm
Frost-free period (average)	370 days
Freeze-free period (average)	370 days
Precipitation total (average)	2,590 mm

Influencing water features

Ravines in this ecological site carry water during the rainy season. This ecological site consists of the uplands surrounding stream courses; the ravines support other ecological sites (USDA-SCS, 1988).

Number of National Wetland Inventory (NWI) features overlapping ecological site: Riverine (121), freshwater emergent wetland (65), freshwater forested/shrub wetland (29), and freshwater pond (2) (USFWS, 2023).

Soil features

The soil components associated with this ecological site are all Togcha series, which are in the Inceptisol soil order.

These soils are Udertic Haplustepts (USDA-SCS, 1988, Soil Survey Staff, 2025). Soil temperature regimes are isohyperthermic; soil moisture regimes are ustic. They are very deep, well drained, and have vertic (shrink-swell) properties. They are acidic, but pH (5.6) is high enough so that aluminum toxicity is not a limiting factor to plant growth. These soils are susceptible to erosion and slumping that can lead to formation of badlands. Some lower lying areas are saturated with water for brief periods during the rainy season (USDA-SCS, 1988).

Table 4. Representative soil features

Parent material	(1) Alluvium – tuff (2) Alluvium – tuff breccia
Surface texture	(1) Silty clay
Family particle size	(1) Very-fine
Drainage class	Well drained
Permeability class	Moderately slow
Depth to restrictive layer	180 cm
Soil depth	180 cm
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (0-101.6cm)	10.16 cm
Calcium carbonate equivalent (0-101.6cm)	Not specified
Electrical conductivity (0-101.6cm)	Not specified

Sodium adsorption ratio (0-101.6cm)	Not specified
Soil reaction (1:1 water) (0-25.4cm)	5.6
Subsurface fragment volume <=3" (0-101.6cm)	Not specified
Subsurface fragment volume >3" (0-101.6cm)	Not specified

Ecological dynamics

The main human disturbance is intentional and frequent burning of highly flammable grasses, especially Pacific Islands silvergrass or swordgrass (Miscanthus floridulus); this prevents survival of trees and increases erosion and the likelihood of badlands formation (Amidon et al., 2019; Amidon et al., 2017; Fosberg, 1960; Stone, 1970; USDA-SCS, 1988; Wagner and Grether, 1948; Willsey et al., 2019).

The main natural disturbance is strong storms that can damage or kill vegetation by high wind speeds (Amidon et al., 2019; Amidon et al., 2017; Fosberg, 1960; Stone, 1970; USDA-SCS, 1988; Wagner and Grether, 1948; Willsey et al., 2019).

State and transition model

Figure 1. State-and-Transition Model for the Very Deep Soils on Volcanic Uplands Ecological Site (R192XY004GU).

Additional community tables

Table 5. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 6. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 7. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 8. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 9. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 10. Community 4.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 11. Community 5.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Other references

References for the Very Deep Soils on Volcanic Uplands Ecological Site (R192XY004GU)

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Approval

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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	11/01/2026
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

   _____

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:**

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

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

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

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

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

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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:**