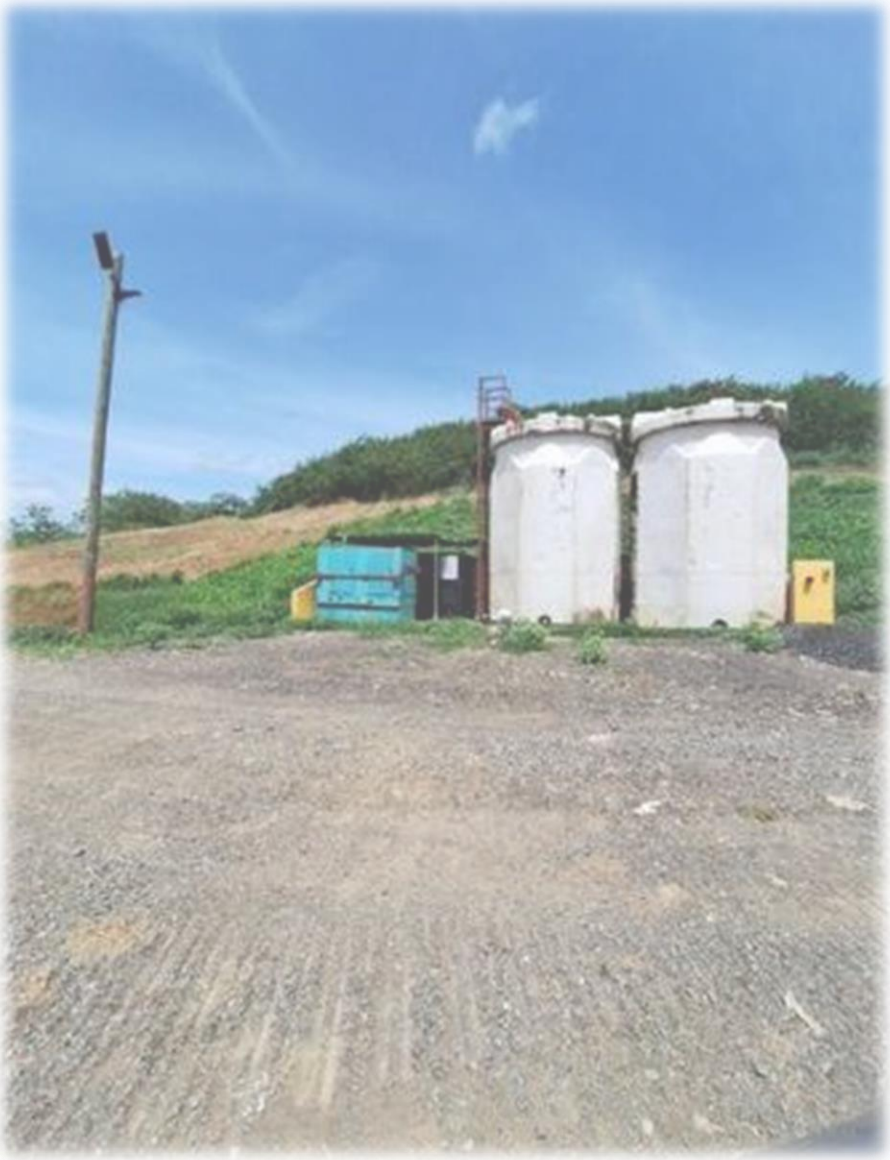
AUGUST 30, 2024



MUNICIPALITY OF TOA ALTA JUNE 2024

MONTHLY REPORT

CIV. NO. 3:21-01087-DRD

NIVIA I. AYALA, PE
TERRATEK ENGINEERING GROUP, PSC
P.O. Box 367445 San Juan, PR 00936

Contents

I. DISTRIBUTION LIST

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jramirez@amrclaw.com
cagosto674@gmail.com

II. REPORT ORGANIZATION

As part of the USA-MTA Civ. No. 3:21-01087-DRD Stipulation and Preliminary Injunction Order, MTA shall prepare and submit monthly reports regarding the performance of its obligations under this Order until completion of the requirements of Paragraphs 3 through 10 of this Order. Each report shall cover the period ending on the last day of each month. Each report must be sent to DOJ, EPA, and DNER on or before the 15th day of the month following the reporting period. Each monthly report shall include:

i. Description of compliance with each requirement of this Order;

ii. the volume, acreage, and location of the Intermediate Cover that was applied;

iii. the volume and disposition of leachate and leachate-contaminated stormwater collected;

iv. results of any sampling analysis performed; and

v. Notification of any noncompliance with this Order, including a statement describing the noncompliance and its underlying causes, proposed measures, and an implementation schedule to correct the noncompliance.

The monthly report is divided into four sections.

Section 1 summarizes the order requirements and the compliance status for each requirement. *Please note that Task IDs are unrelated to the paragraphs assigned to the order.*

Section 2 will include detailed information or supporting documentation regarding the compliance status of each requirement, which needs a comprehensive description or status details.

Section 3 is a list of weekly inspections performed, and

Section 4 is the projection of next month's activities.

Section 5 includes all the attachments to the report.

III. Section 1: SUMMARY

Municipality of Toa Alta Civ. No. 3:21-01087-DRD		
Reporting Period:		June 01 to June 30, 2024
Reporting Number:		21
Reporting Official:		Nivia Ayala, PE/TerraTek
Reporting Date:		08/30/2024
	Description of Compliance with Each Requirement of the Order	
ID	Requirement	Compliance Status
1	Access	In-Compliance
2	Daily Cover	In Compliance
3	Cessation of Waste Disposal	In-Compliance
4	Posting of Signs	In Compliance
5	Intermediate Cover	A new intermediate cover phase covers approx. 4.5 acres, and it is scheduled to start during this quarter.
6	Maintenance of Cover	In-Compliance
7	Slope Stability	In compliance with agreed short-term controls, safety barrier fencing, and H&S program.
8	Leachate Management	
8a	Leachate Management Plan	A formal Leachate Management Plan was submitted with the Preliminary Closure Plan on October 31, 2023.
8b	Management of Leachate Collected from Landfill	Permit Approved GDG-24-706-001
9	Stormwater Management	
9a	Short Term Controls	In- Compliance
9b	Survey of Leachate Seeps	In-Compliance
9c	Stormwater Management Plan	In-Compliance
9d	Discharges of Stormwater Not from Pond	N/A
9e	Discharge/Disposal of Pond Liquid	N/A
Additional Requirements		
The volume, acreage, and location of the Intermediate Cover		None

that was applied.	
The volume and disposition of leachate-contaminated stormwater collected.	None
Results Of Any Sampling Analysis Performed	None
Notification Of Noncompliance	The soil selection for the intermediate cover started during this month. A mixture of Sandy Clay Loam and Silty Clay was found at Naranjito's Quarry.

IV. SECTION 2: DETAIL INFORMATION OR SUPPORTING DOCUMENTATION OF EACH REQUIREMENT IN NEED OF COMPREHENSIVE DESCRIPTION OR STATUS DETAILS

A. COMPLETED REQUIREMENTS

Access:

Access is granted to the United States and the Commonwealth of Puerto Rico and their employees, representatives, and contractors to conduct the necessary inspections and studies, including reviewing the applicable record to evaluate existing conditions, following the agreed terms in the Stipulation.

Daily Cover:

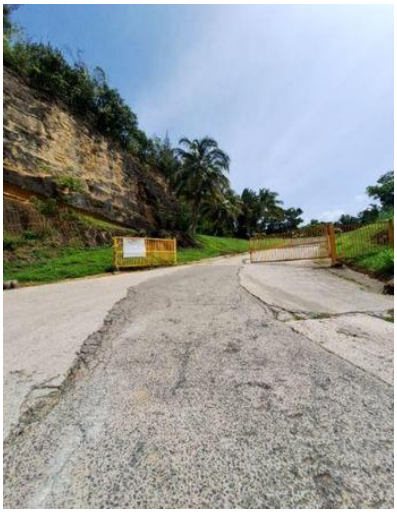
Daily Cover at the facility was completed on April 30, 2022. Daily Cover covered all areas of exposed waste.

Cessation of Waste Disposal:

The cessation of waste disposal at the facility was completed by March 30, 2022. However, as agreed in the Stipulation, the temporary storage of construction and demolition (C&D) waste, bulk household waste (durable goods such as mattresses, furniture, and appliances), or yard waste (vegetation waste generated by land maintenance) for final disposal at a different landfill is active and been performed daily.

Posting of Signs:

A sign size of four feet by five feet was installed at the landfill entrance. See the attached pictures.



Safety Barrier Fencing

Completed on April 28, 2023. However, presents signs of wear and tear. It should be replaced.

B. Supporting documentation of each requirement in need of comprehensive description or status details

1. ID 5: Intermediate Cover

The following is a chronological order of the Municipality performed steps to negotiate and acquire the funds to perform this task:

Rural Development:

1. On May 18, 2020, the Municipality submitted a Notice of Intent to Rural Development requesting the award of funds under the Disaster Mitigation Assistance Grant for the Landfill.
2. On September 4, 2020, the Municipality amended its request to include the landfill closure, post-closure activities, and expansion.
3. On August 16, 2021, the Municipality received a Rural Development email confirming that all the documents for the appropriate Disaster Mitigation Assistance Grant for the Landfill were completed.
4. On August 22, 2022, the Municipality held a Public Hearing about the requested grant funds.
5. USDA Rural Grant Program, MTA submitted a final Environmental Assessment to Quiles, Danna - RD, San Juan, PR <danna.quiles@usda.gov>; Cabrera, Jose - RD, San Juan, PR <Jose.Cabrera@usda.gov>; Davila, Sandimary - RD, San Juan, PR <Sandimary.Davila@usda.gov>; Gonzalez, Melvin - RD, SAN JUAN, PR <Melvin.Gonzalez@usda.gov>. The document was submitted on September 30, 2022.
6. As of today, the Rural Development process is still ongoing but has not yet been completed.
7. The Municipality of Toa Alta, in its continued effort to receive assistance for obtaining the funds required for the landfill closure, received a letter from the Department of Housing informing the designation of the Community Development Block Grant - Mitigation Program (CDBG-MIT) funds for strategic, transformative, and high-impact projects that will strengthen the island's resilience to future natural disasters by improving critical infrastructure. As part of this analysis, the Toa Alta Solid Waste Management Project was selected as a strategic project that will receive funds from this program to implement landfill closure activities. Based on this designation, the

Municipality of Toa Alta has commenced meetings with the Department of Housing to complete all the required documentation required for the final issuance of the award. The Municipality will continue working with the Department of Housing to complete the required processes to receive the grant funds for this vital project.

8. Additional meetings and information requests have occurred between the MTA and PRDOH to complete the award issuance of CDBG-MIT funds.

9. The next meeting is programmed for May 22, 2024.

10. On May 29, 2024, we submitted the final LOERD document for the Toa Alta Landfill Project. We are awaiting HUD approval.

11. The Toa Alta Municipality has started the Environmental Review Process while waiting for the LOERD Approval.

Department of Natural and Environmental Resources (DNER)

1. A letter dated January 26, 2023, was directed to the MTA Mayor, approving $1.3M for planning and design of the closure activities. No disbursement has been received yet.
2. The Municipality designated $3 Million of their ARPA funds to commence the execution of the required Intermediate Cover tasks.
3. The $1.3M was reimbursed for planning and design in February 2023.
4. The MTA commenced in January 2023 an RFQ process for a Landfill Contractor to implement the Intermediate. Unfortunately, no contractor submitted a proposal for the RFQ.
5. Thus, a new formal drawing was developed to identify the specific project specifications to issue an RFP purpose that would allow more flexibility for contractors to participate. The MTA prepared a new RFP that was published in May 2023.
6. The MTA had two contractors participate in the RFP process, and it is evaluating the proposals to issue the final determination that would allow the commencement of the work during August 2023.
7. The RFP was awarded to LC Group on August 16, 2023.
8. The Intermediate Cover activities started on August 29, 2023.

9. A meeting with DNER Technical Personnel was held on February 29, 2024, regarding formal comments regarding the Preliminary Closure Report submitted on October 31, 2023. After the DNER evaluation, the following are the discussed comments:
    1. Verify Closure Turf Stability Safety Factor calculated for the North Slope (2.4:1?)
    2. Verify the results of the static and seismic Safety Factors.
    3. Revise and include HELP Assumptions and used factors.
    4. Revise Help Calculation results *227 ft^3 or 2.267x10^3 ft^3
    5. Clarify if the Stormwater Pond capacity calculation was performed using the existing water level or on an empty pond.
    6. Verify profile A' used on Drawing 8.

A revised Preliminary Closure Plan was to be submitted by April 15, 2024.

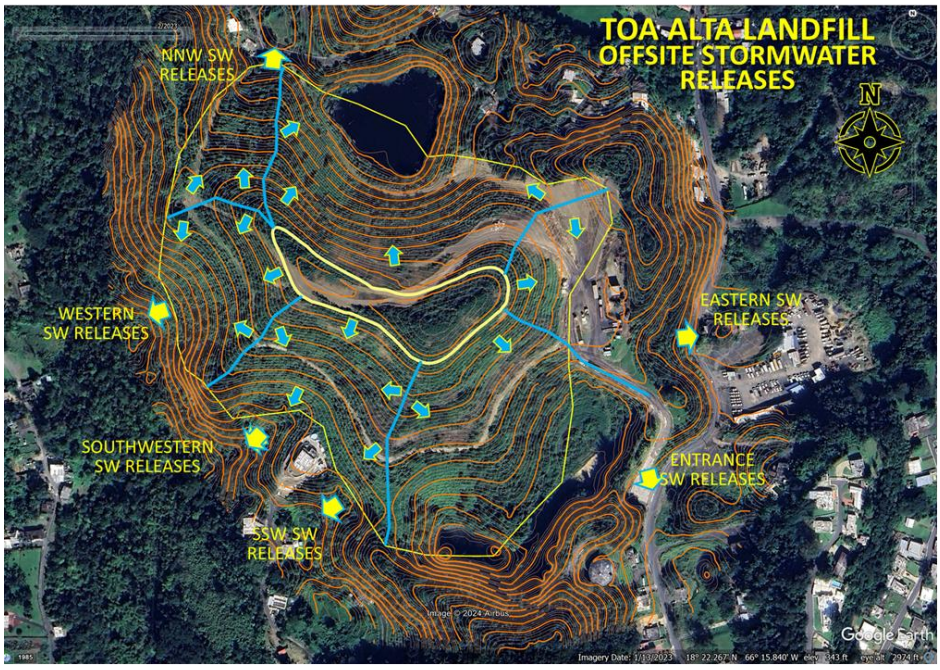
1a. ID 5: Intermediate Cover

The initial phase of intermediate cover started on August 29, 2023, and ended on February 23, 2024, covering 5.24 acres. 8264 cubic meters had been applied as intermediate cover at the facility. A new intermediate cover phase will cover approx. 4.5 acres, as we have agreed to use ET Cover material for the Intermediate Cover, we have started the soil selection process using the Soil Survey Resources available. A copy of the Soil Survey is included in Attachment 2. Next month, we will start the clearing and grubbing tasks.

C. EPA REVISIONS, REQUESTS, AND VIRTUAL MEETINGS

- On February 22, 2024, a 2-hour discussion of the EPA HELP Model as it pertains to the Toa Alta Landfill was organized by Mr. Carl Plossl. The first hour was a general presentation of the suitability and use of the HELP Model in estimating leachate generation, stormwater flows, and other water flows in and out of Puerto Rico's landfills. The second hour was focused on aspects of the Toa Alta Landfill.
- On February 23, 2024, a discussion was held at the request of Mr. Carl Plossl regarding the Stormwater Management Plan submitted in July 2023. An extensive list of comments was discussed. MTA submitted a revised Plan on February 26, 2024.
- On February 27, 2024, a kmz file containing the second phase intermediate cover information was submitted to Mr. Carl Plossl.
- We want to thank Mr. Plossl for preparing and Updating the ET Cover Design Elements for the Toa Alta Landfill Intermediate Cover received on January 23, 2024.
- On March 4, 2024, we had a telephone conference call with Mr. Carl Plossl to discuss the Stormwater Management Plan Update. Mr. Plossl, kindly share with us the following documents:
    - Toa Alta Landfill SWPPP prepared in 2021.

- A drawing showing what he understands to be the stormwater offsite release points/areas at the Toa Alta Landfill.



Needs to be reviewed and corrected

- On April 16, 2024, Mr. Carl Plossl informed us of the following:

  Intermediate cover is required under the 1st Stip to be installed at 1 acre/month for the 1st year and then at the rate of 2 acres/month after that. By the end of March 2024, some 24 acres were to be installed. As only 5.24 acres are currently covered, the Municipality of Toa Alta is not in compliance. Your reports must reflect this lapse in compliance.

V. SECTION 3: WEEKLY INSPECTIONS PERFORMED DURING THE REPORTING PERIOD

Inspections were performed by TerraTek Engineering Group personnel on the following days:

June 7, 2024 and June 21, 2024

VI. SECTION 4: PROJECTION OF NEXT MONTH'S ACTIVITIES

July 5, 2024	Weekly Inspection

July 12, 2024 Weekly Inspection July 19, 2024 Weekly Inspection July 26, 2024 Weekly Inspection	These dates are subject to change. Follow up on the next phase of the intermediate cover RFP process. Continue with the HUD CDBG-MIT Environmental Review Process. Submit the project status report to the OGP (Puerto Rico's Office of Management and Budget).

VII. Section 4: Attachments

Attachment 1: Weekly Inspections

Attachment 2: Soil Survey Report

Attachment 3: ET Cover Elements for the Toa Alta Landfill

ATTACHMENT 1

Christian Villalta Calderón

cristhianvillalta@gmail.com

Submission Date	Jun 7, 2024 10:54 AM
Nombre de la persona que hace la inspeccion	Christian Villalta Calderón
Email	cristhianvillalta@gmail.com
Fecha	Jun 7, 2024
Hora	10:34 AM
Condicion del Clima	Soleado
Esta la entrada limpia y libre de basura?	Si
Foto Entrada	

Hay Personal en la caseta de seguridad?	SI
Cuantos vagonetas han salido en la semana que cubre este dia de inspección?	5
Datos de eventos de lluvia	Ya se instaló el instrumento. No hay datos registrados
Incluir Foto de los datos del pluviometro	
Fecha de la ultima verificacion del sistema de manejo de lixiviados Celda Sur?	Jun 7, 2024
Horas de operacion de la planta electrica	8
Estan las areas verdes limpias y se ha realizado mantenimiento?	SI
Estan los diques limpios y sus valvulas cerradas con candado?	SI
Take Photo	

Se está aplicando cubierta intermedia en areas cerradas?	No
Existen areas de que tengan ya Cubierta Intermedia que necesiten mantenimiento	No
Condicion de Cubierta Talud Norte	Excelentes condiciones
Incluir foto	

Foto de verja divisora

Tomar foto de las pendientes y la vegetacion

Condicion Operacion Recibo de Escombros

Buena

Tomar foto de la estacion de trasbordo

Tomar foto de las medidas de control (bermas, piso, etc.)

Equipos Operando

Una retroexcavadora y un bulldozer al momento de la inspección.

Condicion de medidas de control de erosion y sedimentacion

Buena

Tomar foto de bermas y canales

Tomar foto de bermas y canales o cualquier medida de control que necesite mantenimiento.

Se pueden notar brotes de lixiviado?

SI

Añadir fotos deal area de brotes visibles

Condicion de los caminos internos	Excelentes condiciones
Añadir fotos sobre las condiciones del camino perimetral.	
Condicion de areas de desvio de materiales, si existe	Area completamente limpia.
Fotos Adicionales	

Fotos Adicionales

Favor verificar que ha inspeccionado todas estas areas y/o condiciones.

- Entrada
- Pluviometro
- Registro de Entrada y Salida
- Area de Trasbordo
- Aplicacion de Cubierta Intermedia
- Mantenimiento de Cubierta Intermedia
- Canales de Escorrentia
- Brotes de Lixiviados
- Caminos Internos
- Equipos de Control de Erosion y Sedimentacion
- Area de Almacenamiento de Vegetativo

Proxima Inspeccion Programada

06/14/2024

Submissions Counter

79

Signature

Christian Villalta Calderón

cristhianvillalta@gmail.com

Submission Date	Jun 21, 2024 1:07 PM
Nombre de la persona que hace la inspeccion	Christian Villalta Calderón
Email	cristhianvillalta@gmail.com
Fecha	Jun 21, 2024
Hora	12:45 PM
Condicion del Clima	Soleado
Esta la entrada limpia y libre de basura?	Si
Foto Entrada	

Hay Personal en la caseta de seguridad?	SI
Cuantos vagonetas han salido en la semana que cubre este dia de inspección?	6
Datos de eventos de lluvia	El pluviometro ha registrado 0.5 in el día 20 de junio de acuerdo al testimonio del guarda de seguridad encargado de llevar el conteo.
Incluir Foto de los datos del pluviometro	
Fecha de la ultima verificacion del sistema de manejo de lixiviados Celda Sur?	Jun 21, 2024
Horas de operacion de la planta electrica	8
Estan las areas verdes limpias y se ha realizado mantenimiento?	SI
Estan los diques limpios y sus valvulas cerradas con candado?	SI
Take Photo	

Take Photo

Se está aplicando cubierta intermedia en areas cerradas? No

Existen areas de que tengan ya Cubierta Intermedia que No

necesiten mantenimiento

Condicion de Cubierta Talud Norte	Excelentes condiciones

Incluir foto

Foto de verja divisora

Tomar foto de las pendientes y la vegetacion

Condicion Operacion Recibo de Escombros

Necesita Limpieza

Tomar foto de la estacion de trasbordo

Tomar foto de las medidas de control (bermas, piso, etc.)

Equipos Operando

Una,retroexcavadora y un D4.

Condicion de medidas de control de erosion y sedimentacion

Buena

Tomar foto de bermas y canales

Se pueden notar brotes de lixiviado?	SI
Añadir fotos deal area de brotes visibles	
Condicion de los caminos internos	Excelentes condiciones
Añadir fotos sobre las condiciones del camino perimetral.	

Condicion de areas de desvio de materiales, si existe

Area completamente limpia.

Fotos Adicionales

Fotos Adicionales

Fotos Adicionales

Favor verificar que ha inspeccionado todas estas areas y/o condiciones.

- Entrada
- Pluviometro
- Registro de Entrada y Salida
- Area de Trasbordo
- Aplicacion de Cubierta Intermedia
- Mantenimiento de Cubierta Intermedia

Canales de Escorrentia
Brotes de Lixiviados
Caminos Internos
Equipos de Control de Erosion y Sedimentacion
Area de Almacenamiento de Vegetativo

Proxima Inspeccion Programada	06/28/2024
Necesitas compartir alguna informacion con nosotros?	/widget-uploads/voiceRecorder/222905932455863/6675b3411efaa_171898963366675b34127e09.wav
Submissions Counter	80
Signature	

ATTACHMENT 2

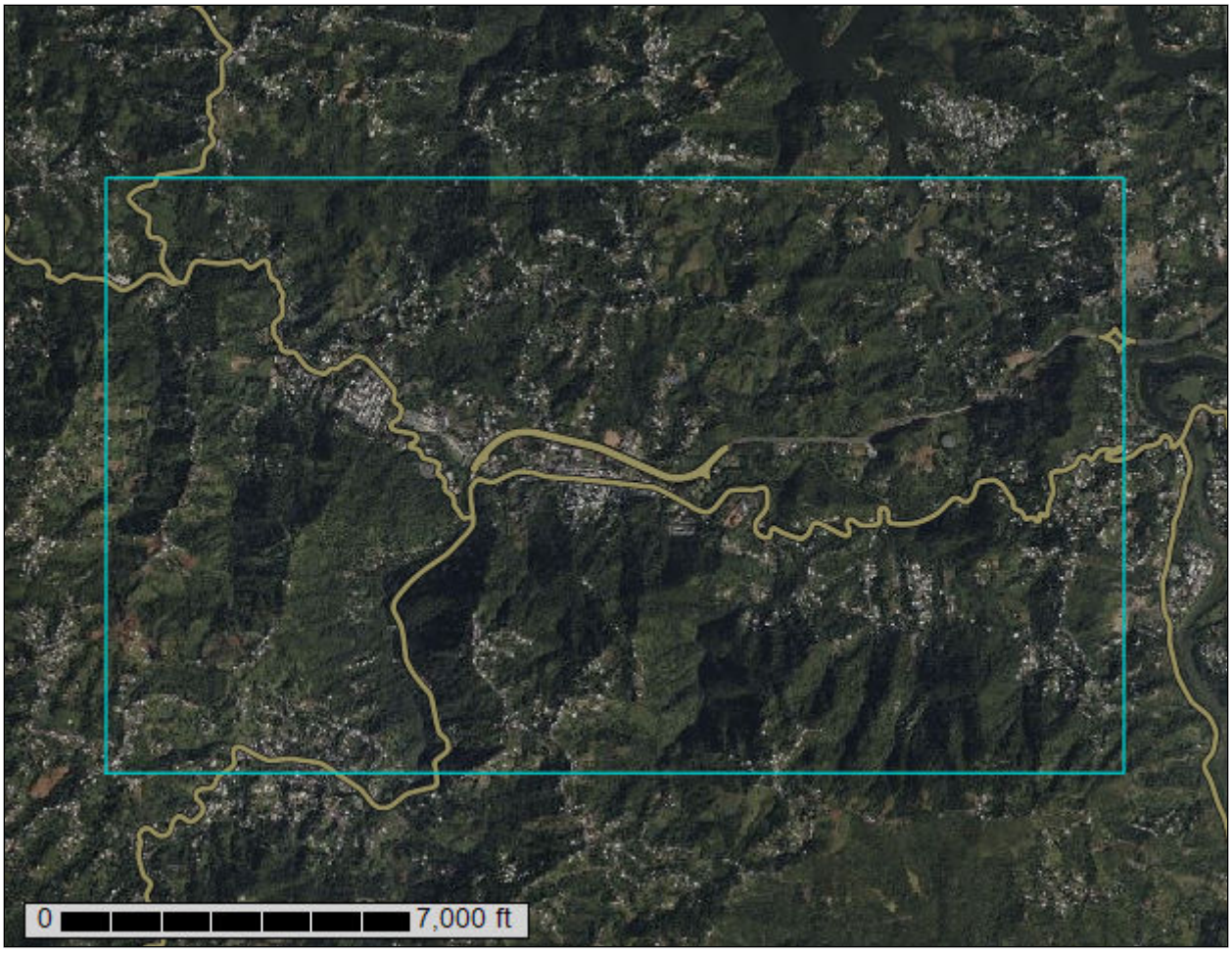
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for San Juan Area, Puerto Rico



September 4, 2024

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

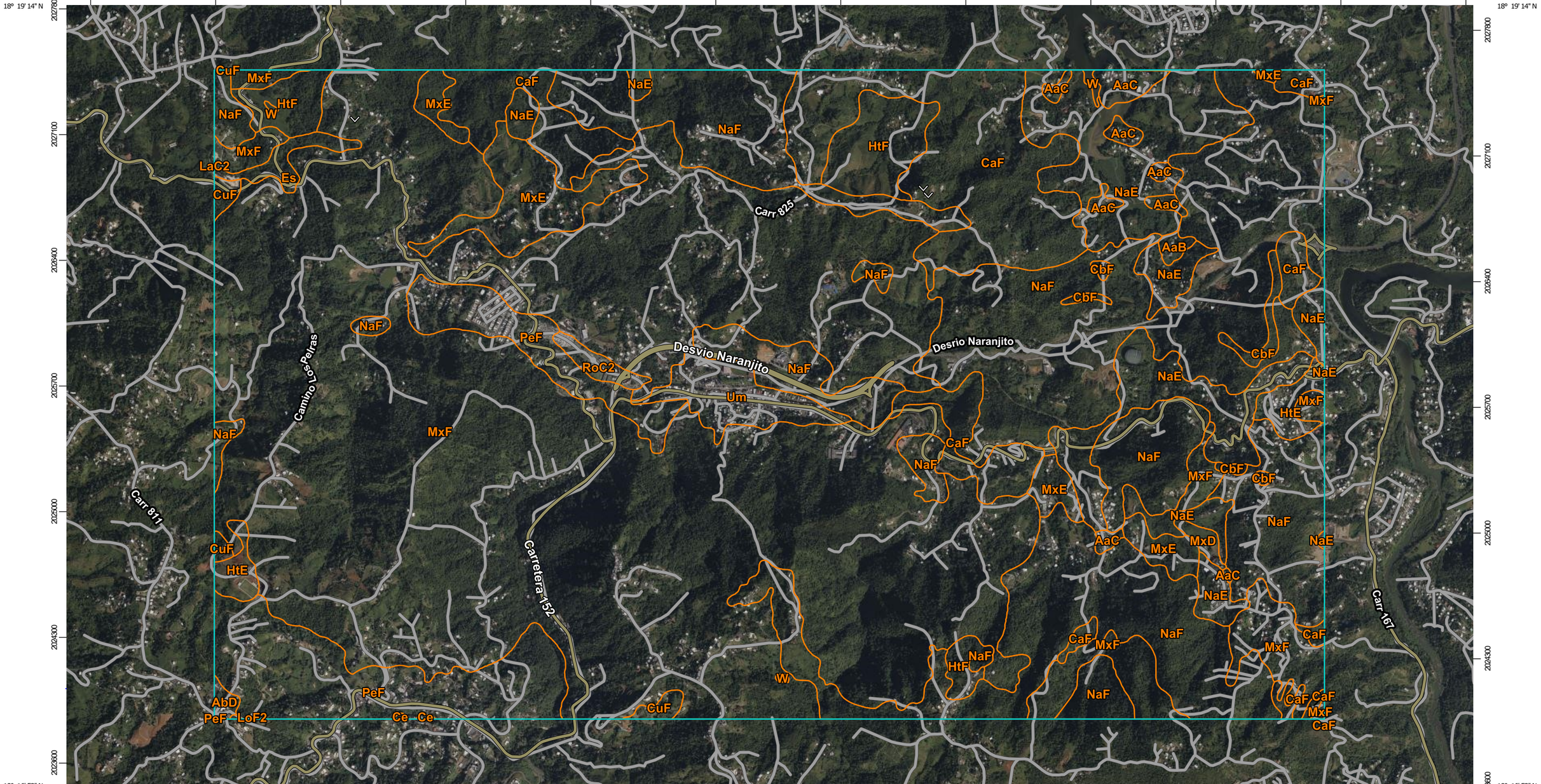
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Juan Area, Puerto Rico
Survey Area Data: Version 17, Sep 13, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jan 23, 2022—Mar 1, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
AaB	Aceitunas clay, 2 to 5 percent slopes	5.7	0.1%
AaC	Aceitunas clay, 5 to 12 percent slopes	36.7	0.7%
AbD	Aibonito clay, 12 to 20 percent slopes	5.4	0.1%
CaF	Caguabo clay loam, 40 to 60 percent slopes	421.7	7.6%
CbF	Caguabo-Rock outcrop complex, 20 to 60 percent slopes	19.6	0.4%
Ce	Candelero loam	0.9	0.0%
CuF	Consumo clay, 40 to 60 percent slopes	15.8	0.3%
Es	Estacion silty clay loam	18.8	0.3%
HtE	Humatas clay, 20 to 40 percent slopes	36.0	0.6%
HtF	Humatas clay, 40 to 60 percent slopes	107.9	1.9%
LaC2	Lares clay, 5 to 12 percent slopes, eroded	0.0	0.0%
LoF2	Lirios silty clay loam, 20 to 60 percent slopes, eroded	0.3	0.0%
MxD	Mucara clay, 12 to 20 percent slopes	7.4	0.1%
MxE	Mucara clay, 20 to 40 percent slopes	131.3	2.4%
MxF	Mucara clay, 40 to 60 percent slopes	2,744.7	49.4%
NaE	Naranjito silty clay loam, 20 to 40 percent slopes	350.4	6.3%
NaF	Naranjito silty clay loam, 40 to 60 percent slopes	1,298.6	23.4%
PeF	Pellejas clay loam, 40 to 60 percent slopes	278.8	5.0%
RoC2	Rio Arriba clay, 5 to 12 percent slopes, eroded	14.4	0.3%
Um	Urban land-Mucara complex, 12 to 40 percent slopes	62.0	1.1%
W	Water	3.5	0.1%
Totals for Area of Interest		**5,560.1**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas

shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

San Juan Area, Puerto Rico

AaB—Aceitunas clay, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: bywn
Elevation: 20 to 400 feet
Mean annual precipitation: 55 to 66 inches
Mean annual air temperature: 75 to 79 degrees F
Frost-free period: 365 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Aceitunas and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Aceitunas

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Fine texture alluvium

Typical profile

H1 - 0 to 8 inches: clay
H2 - 8 to 60 inches: clay

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.14 to 1.42 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Hydric soil rating: No

AaC—Aceitunas clay, 5 to 12 percent slopes

Map Unit Setting

National map unit symbol: bywp

Elevation: 20 to 400 feet
Mean annual precipitation: 55 to 66 inches
Mean annual air temperature: 75 to 79 degrees F
Frost-free period: 365 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Aceitunas and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Aceitunas

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Fine texture alluvium

Typical profile

H1 - 0 to 8 inches: clay
H2 - 8 to 60 inches: clay

Properties and qualities

Slope: 5 to 12 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.14 to 1.42 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Hydric soil rating: No

AbD—Aibonito clay, 12 to 20 percent slopes

Map Unit Setting

National map unit symbol: bywq
Elevation: 900 to 1,700 feet
Mean annual precipitation: 90 to 100 inches
Mean annual air temperature: 72 to 77 degrees F
Frost-free period: 365 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Aibonito and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Aibonito

Setting

Landform: Ridges, mountain slopes
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountaintop, mountainflank
Down-slope shape: Concave, convex
Across-slope shape: Linear
Parent material: Weathered material

Typical profile

H1 - 0 to 7 inches: clay
H2 - 7 to 43 inches: clay
H3 - 43 to 99 inches: clay

Properties and qualities

Slope: 12 to 20 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.07 to 1.42 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 10.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Hydric soil rating: No

CaF—Caguabo clay loam, 40 to 60 percent slopes

Map Unit Setting

National map unit symbol: 2wx4p
Elevation: 100 to 1,970 feet
Mean annual precipitation: 31 to 86 inches
Mean annual air temperature: 69 to 89 degrees F
Frost-free period: 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Caguabo and similar soils: 74 percent
Minor components: 26 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Caguabo

Setting

Landform: Mountain slopes, hillslopes
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountaintop, mountainflank, interfluve, head slope, side slope, crest
Down-slope shape: Concave, convex, linear
Across-slope shape: Linear, convex
Parent material: Residuum weathered from volcanic rock

Typical profile

Ap - 0 to 4 inches: clay loam
Bw - 4 to 10 inches: very paragravelly clay loam
Cr - 10 to 16 inches: bedrock
R - 16 to 80 inches: bedrock

Properties and qualities

Slope: 40 to 60 percent
Depth to restrictive feature: 10 to 19 inches to paralithic bedrock; 16 to 20 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.14 to 1.42 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 0.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Consumo

Percent of map unit: 5 percent
Landform: Hills on mountains, hillslopes on mountains
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountaintop, mountainflank, interfluve, side slope
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Naranjito

Percent of map unit: 5 percent
Landform: Ridges, mountain slopes
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountaintop, mountainflank
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Mucara

Percent of map unit: 5 percent
Landform: Mountain slopes, hillslopes
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountaintop, mountainflank, head slope, side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Hydric soil rating: No

Morado

Percent of map unit: 5 percent
Landform: Mountain slopes, hillslopes
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountainflank, interfluve, head slope, nose slope, side slope
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Sabana

Percent of map unit: 5 percent
Landform: Mountain slopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank
Down-slope shape: Concave, convex
Across-slope shape: Linear
Hydric soil rating: No

Rock outcrop

Percent of map unit: 1 percent
Landform: Mountain slopes, hillslopes
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountainflank, head slope, nose slope, side slope
Down-slope shape: Convex, linear
Across-slope shape: Concave, convex
Hydric soil rating: No

CbF—Caguabo-Rock outcrop complex, 20 to 60 percent slopes

Map Unit Setting

National map unit symbol: 2wx4r
Elevation: 100 to 1,970 feet
Mean annual precipitation: 31 to 86 inches
Mean annual air temperature: 69 to 89 degrees F
Frost-free period: 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Caguabo and similar soils: 55 percent
Rock outcrop: 35 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Caguabo

Setting

Landform: Mountain slopes, hillslopes
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountaintop, mountainflank, interfluve, head slope, side slope, crest
Down-slope shape: Concave, convex, linear
Across-slope shape: Linear, convex
Parent material: Residuum weathered from volcanic rock

Typical profile

Ap - 0 to 4 inches: clay loam
Bw - 4 to 10 inches: gravelly clay loam
Cr - 10 to 16 inches: bedrock
R - 16 to 80 inches: bedrock

Properties and qualities

Slope: 20 to 60 percent
Depth to restrictive feature: 10 to 19 inches to paralithic bedrock; 16 to 20 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.14 to 1.42 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 0.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Hydric soil rating: No

Description of Rock Outcrop

Setting

Landform: Mountain slopes, hillslopes
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountainflank, head slope, nose slope, side slope
Down-slope shape: Convex, linear
Across-slope shape: Concave, convex
Parent material: Volcanic rock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Minor Components

Mucara

Percent of map unit: 10 percent
Landform: Mountain slopes, hillslopes
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountaintop, mountainflank, head slope, side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Hydric soil rating: No

Ce—Candelero loam

Map Unit Setting

National map unit symbol: byx0
Elevation: 10 to 20 feet
Mean annual precipitation: 85 to 90 inches
Mean annual air temperature: 75 to 81 degrees F
Frost-free period: 365 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Candelero and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Candelero

Setting

Landform: Terraces
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sediments

Typical profile

H1 - 0 to 6 inches: loam
H2 - 6 to 35 inches: sandy clay loam
H3 - 35 to 60 inches: sandy clay

Properties and qualities

Slope: 2 to 12 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.57 in/hr)
Depth to water table: About 12 to 18 inches

Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 9.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C/D
Hydric soil rating: No

Minor Components

Cayagua

Percent of map unit: 15 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope, base slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: Yes

CuF—Consumo clay, 40 to 60 percent slopes

Map Unit Setting

National map unit symbol: 2thqk
Elevation: 100 to 2,460 feet
Mean annual precipitation: 54 to 96 inches
Mean annual air temperature: 65 to 90 degrees F
Frost-free period: 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Consumo and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Consumo

Setting

Landform: Hills on mountains, hillslopes on mountains
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountaintop, mountainflank, interfluve, side slope
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Parent material: Residuum weathered from volcanic rock

Typical profile

Ap - 0 to 6 inches: clay
Bt - 6 to 14 inches: clay
BC - 14 to 20 inches: clay

C - 20 to 60 inches: silty clay loam

Properties and qualities

Slope: 40 to 60 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.14 to 1.42 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Anones

Percent of map unit: 5 percent
Landform: Hills on mountains, hillslopes on mountains
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountaintop, mountainflank, interfluve, side slope
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Humatas

Percent of map unit: 5 percent
Landform: Mountain slopes, hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank, side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Hydric soil rating: No

Es—Estacion silty clay loam

Map Unit Setting

National map unit symbol: byxk
Elevation: 10 to 100 feet
Mean annual precipitation: 60 to 80 inches
Mean annual air temperature: 75 to 79 degrees F
Frost-free period: 365 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Estacion and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Estacion

Setting

Landform: Terraces, flood plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Rise, talf
Down-slope shape: Convex, linear
Across-slope shape: Linear
Parent material: Moderately fine textured sediments over gravel of mixed origin

Typical profile

H1 - 0 to 8 inches: silty clay loam
H2 - 8 to 20 inches: gravelly clay loam
H3 - 20 to 50 inches: very gravelly sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: B
Hydric soil rating: No

HtE—Humatas clay, 20 to 40 percent slopes

Map Unit Setting

National map unit symbol: 2tgwq
Elevation: 100 to 2,460 feet
Mean annual precipitation: 54 to 96 inches
Mean annual air temperature: 65 to 90 degrees F
Frost-free period: 365 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Humatas and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Humatas

Setting

Landform: Mountain slopes, hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank, side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Parent material: Clayey residuum weathered from volcanic rock

Typical profile

A - 0 to 4 inches: clay
Bt1 - 4 to 12 inches: clay
Bt2 - 12 to 19 inches: clay
BC - 19 to 38 inches: clay
C - 38 to 80 inches: clay

Properties and qualities

Slope: 20 to 40 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low (0.01 to 0.14 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 9.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Alonso

Percent of map unit: 5 percent
Landform: Ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountaintop, mountainflank
Down-slope shape: Convex
Across-slope shape: Linear, convex
Hydric soil rating: No

Daguey

Percent of map unit: 5 percent
Landform: Ridges
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountaintop, mountainflank
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Consumo

Percent of map unit: 5 percent

Landform: Mountain slopes, hills, hillslopes
Landform position (three-dimensional): Mountaintop, mountainflank, interfluve, side slope
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Other vegetative classification: Unnamed (G270XZ000PR)
Hydric soil rating: No

HtF—Humatas clay, 40 to 60 percent slopes

Map Unit Setting

National map unit symbol: 2tgwr
Elevation: 100 to 2,460 feet
Mean annual precipitation: 54 to 96 inches
Mean annual air temperature: 65 to 90 degrees F
Frost-free period: 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Humatas and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Humatas

Setting

Landform: Mountain slopes, hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank, side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Parent material: Clayey residuum weathered from volcanic rock

Typical profile

A - 0 to 4 inches: clay
BC - 19 to 38 inches: clay
C - 38 to 80 inches: clay

Properties and qualities

Slope: 40 to 60 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low (0.01 to 0.14 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Consumo

Percent of map unit: 10 percent
Landform: Hills on mountains, hillslopes on mountains
Landform position (three-dimensional): Mountaintop, mountainflank, interfluve, side slope
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Other vegetative classification: Unnamed (G270XZ000PR)
Hydric soil rating: No

Alonso

Percent of map unit: 5 percent
Landform: Ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountaintop, mountainflank
Down-slope shape: Convex
Across-slope shape: Linear, convex
Hydric soil rating: No

LaC2—Lares clay, 5 to 12 percent slopes, eroded

Map Unit Setting

National map unit symbol: byxy
Elevation: 200 to 400 feet
Mean annual precipitation: 43 to 73 inches
Mean annual air temperature: 65 to 89 degrees F
Frost-free period: 365 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Lares and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Lares

Setting

Landform: Terraces
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Clayey marine sediments

Typical profile

H1 - 0 to 36 inches: clay
H2 - 36 to 60 inches: clay

Properties and qualities

Slope: 5 to 12 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low (0.01 to 0.14 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Hydric soil rating: No

LoF2—Lirios silty clay loam, 20 to 60 percent slopes, eroded

Map Unit Setting

National map unit symbol: byy1
Elevation: 300 to 650 feet
Mean annual precipitation: 80 to 90 inches
Mean annual air temperature: 77 to 81 degrees F
Frost-free period: 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Lirios and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Lirios

Setting

Landform: Ridges, mountain slopes
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountaintop, mountainflank
Down-slope shape: Concave, convex
Across-slope shape: Concave, linear, convex
Parent material: Weathered material

Typical profile

H1 - 0 to 4 inches: silty clay loam
H2 - 4 to 34 inches: clay
H3 - 34 to 60 inches: silty clay loam

Properties and qualities

Slope: 20 to 60 percent

Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low (0.01 to 0.14 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 10.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Hydric soil rating: No

MxD—Mucara clay, 12 to 20 percent slopes

Map Unit Setting

National map unit symbol: 2thqw
Elevation: 160 to 2,000 feet
Mean annual precipitation: 49 to 95 inches
Mean annual air temperature: 71 to 77 degrees F
Frost-free period: 365 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Mucara and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mucara

Setting

Landform: Mountain slopes, hillslopes
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountaintop, mountainflank, head slope, side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Parent material: Residuum weathered from volcanic rock

Typical profile

Ap - 0 to 6 inches: clay
Bw - 6 to 13 inches: clay loam
BC - 13 to 19 inches: clay loam
C - 19 to 27 inches: clay loam
Cr - 27 to 80 inches: bedrock

Properties and qualities

Slope: 12 to 20 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately low (0.01 to 0.14 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Juncos

Percent of map unit: 10 percent
Landform: Hillslopes
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Naranjito

Percent of map unit: 10 percent
Landform: Mountain slopes, hillslopes
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountaintop, mountainflank, head slope, side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Hydric soil rating: No

MxE—Mucara clay, 20 to 40 percent slopes

Map Unit Setting

National map unit symbol: 2thqv
Elevation: 160 to 2,000 feet
Mean annual precipitation: 49 to 95 inches
Mean annual air temperature: 71 to 77 degrees F
Frost-free period: 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Mucara and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mucara

Setting

Landform: Mountain slopes, hillslopes
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountaintop, mountainflank, head slope, side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Parent material: Residuum weathered from volcanic rock

Typical profile

Ap - 0 to 6 inches: clay
Bw - 6 to 13 inches: clay loam
BC - 13 to 19 inches: clay loam
C - 19 to 27 inches: clay loam
Cr - 27 to 80 inches: bedrock

Properties and qualities

Slope: 20 to 40 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low (0.01 to 0.14 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Humatas

Percent of map unit: 5 percent
Landform: Mountain slopes, hillslopes
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountaintop, mountainflank, head slope, side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Hydric soil rating: No

Caguabo

Percent of map unit: 5 percent
Landform: Mountain slopes, hillslopes
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountaintop, mountainflank, head slope, side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Hydric soil rating: No

Morado

Percent of map unit: 5 percent
Landform: Mountain slopes, hillslopes
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountaintop, mountainflank, head slope, side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Hydric soil rating: No

Naranjito

Percent of map unit: 5 percent
Landform: Ridges, mountain slopes
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountaintop, mountainflank
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

MxF—Mucara clay, 40 to 60 percent slopes

Map Unit Setting

National map unit symbol: 2thqt
Elevation: 100 to 2,460 feet
Mean annual precipitation: 49 to 95 inches
Mean annual air temperature: 71 to 77 degrees F
Frost-free period: 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Mucara and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mucara

Setting

Landform: Mountain slopes, hillslopes
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountaintop, mountainflank, head slope, side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Parent material: Residuum weathered from volcanic rock

Typical profile

Ap - 0 to 6 inches: clay
Bw - 6 to 13 inches: clay loam
BC - 13 to 19 inches: clay loam
C - 19 to 27 inches: clay loam

Cr - 27 to 80 inches: bedrock

Properties and qualities

Slope: 40 to 60 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low (0.01 to 0.14 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Caguabo

Percent of map unit: 10 percent
Landform: Mountain slopes, hillslopes
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountaintop, mountainflank, head slope, side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Hydric soil rating: No

Naranjito

Percent of map unit: 5 percent
Landform: Ridges, mountain slopes
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountaintop, mountainflank
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Rock outcrop

Percent of map unit: 5 percent
Hydric soil rating: No

Morado

Percent of map unit: 5 percent
Landform: Mountain slopes, hillslopes
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountaintop, mountainflank, head slope, side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Hydric soil rating: No

NaE—Naranjito silty clay loam, 20 to 40 percent slopes

Map Unit Setting

National map unit symbol: 2tgww
Elevation: 100 to 2,460 feet
Mean annual precipitation: 54 to 96 inches
Mean annual air temperature: 65 to 90 degrees F
Frost-free period: 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Naranjito and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Naranjito

Setting

Landform: Ridges, mountain slopes
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountaintop, mountainflank
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Parent material: Residuum weathered from volcanic rock

Typical profile

Ap - 0 to 7 inches: silty clay loam
Bt - 7 to 20 inches: clay
BC - 20 to 30 inches: clay
C - 30 to 38 inches: clay loam
R - 38 to 48 inches: weathered bedrock

Properties and qualities

Slope: 20 to 40 percent
Depth to restrictive feature: 31 to 41 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.07 to 1.42 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 6.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Mucara

Percent of map unit: 5 percent
Landform: Mountain slopes, hillslopes
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountaintop, mountainflank, head slope, side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Hydric soil rating: No

Humatas

Percent of map unit: 5 percent
Landform: Mountain slopes, hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank, side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Hydric soil rating: No

Caguabo

Percent of map unit: 5 percent
Landform: Mountains, hills
Landform position (two-dimensional): Summit, shoulder, backslope, footslope
Landform position (three-dimensional): Mountaintop, mountainflank, interfluve, head slope, side slope, base slope, crest
Down-slope shape: Concave, convex, linear
Across-slope shape: Linear, convex
Hydric soil rating: No

NaF—Naranjito silty clay loam, 40 to 60 percent slopes

Map Unit Setting

National map unit symbol: 2tgwy
Elevation: 100 to 2,460 feet
Mean annual precipitation: 54 to 96 inches
Mean annual air temperature: 65 to 90 degrees F
Frost-free period: 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Naranjito and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Naranjito

Setting

Landform: Ridges, mountain slopes

Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountaintop, mountainflank
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Parent material: Residuum weathered from volcanic rock

Typical profile

Ap - 0 to 5 inches: silty clay loam
Bt - 5 to 12 inches: clay
BC - 12 to 24 inches: clay
C - 24 to 38 inches: clay loam
R - 38 to 48 inches: weathered bedrock

Properties and qualities

Slope: 40 to 60 percent
Depth to restrictive feature: 31 to 41 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.07 to 1.42 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 6.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Humatas

Percent of map unit: 5 percent
Landform: Mountain slopes, hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank, side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Hydric soil rating: No

Caguabo

Percent of map unit: 5 percent
Landform: Mountains, hills
Landform position (two-dimensional): Summit, shoulder, backslope, footslope
Landform position (three-dimensional): Mountaintop, mountainflank, interfluve, head slope, side slope, base slope, crest
Down-slope shape: Concave, convex, linear
Across-slope shape: Linear, convex
Hydric soil rating: No

Mucara

Percent of map unit: 5 percent
Landform: Hillslopes, mountain slopes
Landform position (two-dimensional): Summit, shoulder, backslope

Landform position (three-dimensional): Mountaintop, mountainflank, head slope, side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Hydric soil rating: No

PeF—Pellejas clay loam, 40 to 60 percent slopes

Map Unit Setting

National map unit symbol: 2yq9g
Elevation: 300 to 2,460 feet
Mean annual precipitation: 70 to 90 inches
Mean annual air temperature: 75 to 79 degrees F
Frost-free period: 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Pellejas and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pellejas

Setting

Landform: Mountain slopes, ridges
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountaintop, mountainflank
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear
Parent material: Sandy and loamy residuum weathered from granodiorite and/or diorite

Typical profile

Ap - 0 to 6 inches: clay loam
Bw - 6 to 11 inches: sandy clay loam
BC - 11 to 16 inches: sandy loam
C - 16 to 80 inches: loamy sand

Properties and qualities

Slope: 40 to 60 percent
Depth to restrictive feature: 10 to 13 inches to abrupt textural change
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.14 to 1.42 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 1.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Lirios

Percent of map unit: 10 percent
Landform: Ridges, mountain slopes
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountaintop, mountainflank
Down-slope shape: Concave, convex
Across-slope shape: Concave, linear, convex
Hydric soil rating: No

Ingenio

Percent of map unit: 5 percent
Landform: Hillslopes, mountains
Landform position (two-dimensional): Backslope, footslope, toeslope
Landform position (three-dimensional): Side slope, base slope
Down-slope shape: Convex, linear
Across-slope shape: Linear
Hydric soil rating: No

Pandura

Percent of map unit: 5 percent
Landform: Mountain slopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank
Down-slope shape: Concave, convex
Across-slope shape: Convex, linear
Hydric soil rating: No

RoC2—Rio Arriba clay, 5 to 12 percent slopes, eroded

Map Unit Setting

National map unit symbol: byyw
Elevation: 100 to 300 feet
Mean annual precipitation: 60 to 70 inches
Mean annual air temperature: 75 to 81 degrees F
Frost-free period: 365 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Rio arriba and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rio Arriba

Setting

Landform: Alluvial fans, terraces

Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Fine textured sediments

Typical profile

H1 - 0 to 8 inches: clay
H2 - 8 to 60 inches: clay

Properties and qualities

Slope: 5 to 12 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.14 to 1.42 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 10.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Hydric soil rating: No

Um—Urban land-Mucara complex, 12 to 40 percent slopes

Map Unit Setting

National map unit symbol: 2yg3d
Elevation: 100 to 1,970 feet
Mean annual precipitation: 31 to 86 inches
Mean annual air temperature: 69 to 89 degrees F
Frost-free period: 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 50 percent
Mucara and similar soils: 40 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Description of Mucara

Setting

Landform: Mountain slopes, hillslopes
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountaintop, mountainflank, head slope, side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Parent material: Residuum weathered from volcanic rock

Typical profile

Ap - 0 to 6 inches: clay
Bw - 6 to 13 inches: clay loam
BC - 13 to 19 inches: clay loam
C - 19 to 27 inches: clay loam
Cr - 27 to 80 inches: bedrock

Properties and qualities

Slope: 12 to 40 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low (0.01 to 0.14 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Caguabo

Percent of map unit: 10 percent
Landform: Mountain slopes, hillslopes
Landform position (two-dimensional): Summit, shoulder, backslope, footslope
Landform position (three-dimensional): Mountaintop, mountainflank, interfluve, head slope, side slope, base slope, crest
Down-slope shape: Concave, convex, linear
Across-slope shape: Linear, convex
Hydric soil rating: No

W—Water

Map Unit Composition

Water: 100 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

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Soil Map—San Juan Area, Puerto Rico
(Naranjito Area)

66° 16' 52" W
66° 12' 24" W
18° 19' 14" N
18° 16' 53" N
787500
788200
788900
789600
790300
791000
791700
792400
793100
793800
794500
795200
2027800
2027100
2026400
2025700
2025000
2024300
2023600

CuF MxF HtF NaF W MxF LaC2 Es CuF MxE CaF NaE MxE NaE NaF HtF CaF AaC W AaC AaC MxE CaF MxF AaC AaC NaE AaC AaC AaB NaF CbF NaE CaF NaF CbF NaF NaE CbF NaE NaE MxF HtE NaF MxF CaF NaF CbF CbF MxE NaE NaF AaC MxE MxD NaE AaC NaE CaF MxF NaF HtF NaF W MxF CaF CaF CaF NaF PeF AbD PeF LoF2 Ce Ce CuF CuF HtE NaF PeF RoC2 Um

Carr 825
Desvio Naranjito
Desrio Naranjito
Camino Los Pelras
Carr 811
Carretera 152
Carr 167

Map Scale: 1:21,200 if printed on B landscape (17" x 11") sheet.

N

Meters
0 300 600 1200 1800

Feet
0 1000 2000 4000 6000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Juan Area, Puerto Rico
Survey Area Data: Version 17, Sep 13, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jan 23, 2022—Mar 1, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
AaB	Aceitunas clay, 2 to 5 percent slopes	5.7	0.1%
AaC	Aceitunas clay, 5 to 12 percent slopes	36.7	0.7%
AbD	Aibonito clay, 12 to 20 percent slopes	5.4	0.1%
CaF	Caguabo clay loam, 40 to 60 percent slopes	421.7	7.6%
CbF	Caguabo-Rock outcrop complex, 20 to 60 percent slopes	19.6	0.4%
Ce	Candelero loam	0.9	0.0%
CuF	Consumo clay, 40 to 60 percent slopes	15.8	0.3%
Es	Estacion silty clay loam	18.8	0.3%
HtE	Humatas clay, 20 to 40 percent slopes	36.0	0.6%
HtF	Humatas clay, 40 to 60 percent slopes	107.9	1.9%
LaC2	Lares clay, 5 to 12 percent slopes, eroded	0.0	0.0%
LoF2	Lirios silty clay loam, 20 to 60 percent slopes, eroded	0.3	0.0%
MxD	Mucara clay, 12 to 20 percent slopes	7.4	0.1%
MxE	Mucara clay, 20 to 40 percent slopes	131.3	2.4%
MxF	Mucara clay, 40 to 60 percent slopes	2,744.7	49.4%
NaE	Naranjito silty clay loam, 20 to 40 percent slopes	350.4	6.3%
NaF	Naranjito silty clay loam, 40 to 60 percent slopes	1,298.6	23.4%
PeF	Pellejas clay loam, 40 to 60 percent slopes	278.8	5.0%
RoC2	Rio Arriba clay, 5 to 12 percent slopes, eroded	14.4	0.3%
Um	Urban land-Mucara complex, 12 to 40 percent slopes	62.0	1.1%
W	Water	3.5	0.1%
Totals for Area of Interest		**5,560.1**	**100.0%**

ATTACHMENT 3

APPENDIX A

ET COVER DESIGN ELEMENTS FOR THE TOA ALTA LANDFILL INTERMEDIATE COVER REQUIREMENTS

Contents

ET Cover Design Elements for the Toa Alta Landfill Intermediate Cover Requirements

Background

The Municipality of Toa Alta owns different properties that constitute the Landfill that has been in operation since the 1960s. This operation commenced before the creation of the Puerto Rico Environmental Policy Act, Act Number 9, on June 18, 1970, and was later substituted by Act Number 416 on September 22, 2004, as amended. This Landfill has provided services for solid waste disposal to different surrounding municipalities in the past. The total area of the Landfill properties is divided into the original Landfill areas and the Southeast cell, which construction was completed around the year 2007.

The Landfill is preparing for its pre-closure and closure activities due to the USEPA and DNER negotiations. Presently, the most essential actions being actively discussed and required as part of the closure plan are related to stormwater management, leachate management, waste daily cover, and maintenance of soil cover, among others. The only action to be implemented with this RFP is the intermediate cover in the specific areas identified in Appendix A

Project Details and Scope

The specific actions required for this project scope are the development of an organized schedule and the execution plan for the placement of the intermediate cover in the areas with the identified technical details included in Appendix A at a rate of one acre per month and the creation of stormwater down-chutes, which its specific location will be determined on-site. The material to be placed for intermediate cover soils must be limited to Silty Clay Loam, Silty Clay, and Clay Loam, and mixtures of such (USDA Textural Soil Classifications) as defined in the referenced Field Guide to Soil Texture Classes (USDA). Soil must be tested to determine its ability to support long-term vegetation growth. Cover soil may contain up to 15% gravel (> 2.00 mm [0.0787 in], retained on the No. 10 sieve), using ASTM C136 standard. Mulch content may be up to 15% and must be thoroughly combined homogeneously with other soil constituents before placement and compaction. Mulch shall consist of wood and other woody vegetation. Mulch chips shall be less than or equal to 5 inches in length, with 95 percent passing a 2-inch screen. Mulch shall not contain chipped manufactured boards or chemically treated wood such as particleboard, railroad ties, or similarly treated wood.

During intermediate cover soil placement, the soil moisture content should be below the soil's optimum moisture content to facilitate a lower-density fill. Soil should be placed in a single, loose lift (e.g., 14 inches thick, compacted to 12 inches for an intermediate cover) to avoid over-compaction. In compacting the cover soil, the standard Proctor density (ASTM D698-12(2021) Standard) specified for the intermediate cover should be greater than or equal to 80% and less than or equal to 90% of the standard Proctor density for that soil type.

Proposed Schedule

This proposed schedule will establish the general process until the final selection of the Contractor that will be qualified.

Drawings

Allowable Intermediate Cover Soil Characteristics

For existing areas of the Toa Alta Landfill with an existing daily cover layer of 6-inches (152-mm), and an intermediate cover layer of 12-inches (305-mm), an additional 27-inches (695-mm) of soil will be needed for the ET cover (after compaction). With an average compaction of 85%, this would require 32-inches of soil (820-mm) of soil, pre-compaction. The daily cover serves as the base layer, while intermediate cover may be incorporated into the final, ET cover (if application of additional ET cover elements proceeds expeditiously).

Intermediate cover soils must be limited to Silty Clay Loam, Silty Clay, and Clay Loam, and mixtures of such (USDA Textural Soil Classifications) as defined in the referenced *Field Guide to Soil Texture Classes (USDA)*.[1] Soil must be tested to determine its ability to support long-term vegetation growth. Cover soil may contain up to 15% gravel (> 2.00 mm [0.0787 in], retained on the No. 10 sieve). Mulch content may be up to 15% and must be thoroughly combined homogeneously with other soil constituents prior to placement and compaction. Mulch shall consist of wood and other woody vegetation. Mulch chips shall be less than or equal to 5 inches in length with 95 percent passing a 2-inch screen. Mulch shall not contain chipped manufactured boards or chemically treated wood such as particleboard, railroad ties, or similar treated wood.

During intermediate cover soil placement, the soil moisture content should be below the soil's optimum moisture content to facilitates a lower density fill. Soil should be placed in a single, loose lift (*e.g.,* 14 inches thick, compacted to 12 inches for an intermediate cover) to avoid over-compaction. In compacting the cover soil, the standard Proctor density specified for the intermediate cover should be greater than or equal to 80% and less than or equal to 90% of the standard Proctor density for that soil type.

Engineering Caveats

We strongly emphasize the critical importance of conducting a thorough review and analysis of geotechnical engineering aspects before finalizing soil specifications for the landfill intermediate cover and final closure caps. The stability of waste and cover slopes is a key factor in ensuring the long-term success of the landfill facility closure.

The broad intermediate cover soil specifications given here specifically address the suitability for incorporation into an evapotranspirative landfill cap. From these specifications, a set of narrower, site-specific soil (and allowable amendment, if any) specifications must be prepared and recommended by the project geotechnical engineer after a thorough geotechnical engineering review by them.

Details on Evapotranspiration & Intermediate Cover Specifications

The following elements are excerpts from *Design, Implementation, and Approval of Evapotranspiration Covers in Puerto Rico* and other documents as applicable to the application of Intermediate Cover as

[1] https://www.vdh.virginia.gov/content/uploads/sites/20/2016/05/Appendix-F.pdf provides a suitable and simple guidance for USDA soil typing.

both an interim protective layer and as the initial layer of an evapotranspiration landfill cover at the Toa Alta Landfill.

Intermediate Cover – A solid waste landfill cover, more durable than Daily Cover, designed, installed, and maintained in accordance with Good Engineering Practices, and consisting of at least twelve (12) inches of compacted soil (or other alternative cover material approved in writing by DNER prior to use), placed over the existing Daily Cover, with appropriate stormwater erosion controls (*e.g.,* vegetated cover, temporary chutes, channels, berms, and/or swales), graded and compacted to minimize ponding. Acceptable intermediate and alternative intermediate cover must: minimize saturated hydraulic conductivity; have sufficient shear strength to resist sliding on the slope; and have tensile capacity large enough to prevent cracking during local subsidence. In place intermediate cover soil must provide a saturated hydraulic conductivity no greater than $1.0x10^{-4}$ cm/s (*e.g.,* USDA Sandy Clay Loam; crushed, well-graded limestone with percentage fines greater than 14%) so as to reduce precipitation infiltration that results in leachate generation and release.

Evapotranspiration Cover (ET Cover) – A cover system that stores precipitation in a designed soil layer for removal by evaporation and transpiration. An ET Cover may be referred to using one of the following terms: phytocap, water balance cover, store and release cover, sponge and pump cover, or vegetated soil landfill cover.

Table 1. Characteristics of the Five Ecozones of Puerto Rico.

Ecozone and Approximate Area	Elevation	Annual Precipitation	Primary Forest Types
North Shore 80 miles by 2–6 miles	Near sea level	1500–1750 mm 59-69 in	Moist coastal forest Moist limestone forest
Northern Foothills 110 miles by 4 miles	100–1000 ft	1016–1651 mm 40–65 in	Moist coastal forest Moist limestone forest
Mountains 60% of island	Up 4390 ft	1524–2286 mm 60–90 in	Tropical moist forest Moist coastal forest Moist limestone forest
Southern Foothills 110 miles by 4–10 miles	100–1000 ft	1500–1750 mm 59-69 in	Lower cordillera forest Dry coastal forest Moist coastal forest
South Shore 75 miles by 8–12 miles	Near sea level	800–1000 mm 31-39 in	Dry limestone forest Dry coastal forest

Toa Alta Landfill

Table 3. Performance Goals (Sr) and Feasibility of ET Covers in Puerto Rico by Ecozone.

Ecozone	Performance Goal, Sr, (Required Water Storage)[1] (mm/yr)	USDA Soil Classification Available in Ecozone[2]	Avg. Unit Water Storage (cm^3/cm^3)	ET Cover Feasibility
North Shore	173	Loam Silty Clay Loam Silty Clay Clay Loam Sandy Clay Loam	0.2289	Very feasible
Northern Foothills	387	Loam Silty Clay Loam Silty Clay Clay Loam Sandy Clay Loam	0.2289	Feasible

Table 5. Average Percolation Rates of an Acceptable ET Cover (Any Soil) and Clay Cover.

Climate Ecozone	Site (City)	P (mm/yr)	PET (mm/yr)	Avg. Percolation (mm/yr)		Prototype ET Cover Soil Thickness (mm)	Factor of Safety[1]
				Clay Cover	ET Cover		
North Shore	Toa Baja	1725.4	1651	196	133	900	1.5
	Vega Baja	1586.2	1667				
Northern Foothills	Florida	1542.1	1632	203	133	1000	1.5
	Fajardo	1585.0	1615				

Table 23. Performance of Different Soil Types Used as Cover Designs.

Climate Ecozone	Site Name	Preliminary Soil Cover Design Thickness (mm)[1]	Percolation Though ET Cover (mm/yr)				
			Loam Soil	Silty Clay Loam	Silty Clay	Clay Loam	Sandy Clay Loam
North Shore	Toa Baja	900	133	125	122	121	133
	Vega Baja						
Northern Foothills	Florida	900	142	133	129	129	142
	Fajardo						
Mountains	Juncos	900	236	228	224	229	235
	Barranquitas						
Southern Foothills	Guayama	900	260	252	250	250	260
	Hormigueros						
South Shore	Lajas	900	44	41	17	17	*
	Santa Isabel						

[1] The modeling compared the effect of soil types on ET Covers of equal thickness.

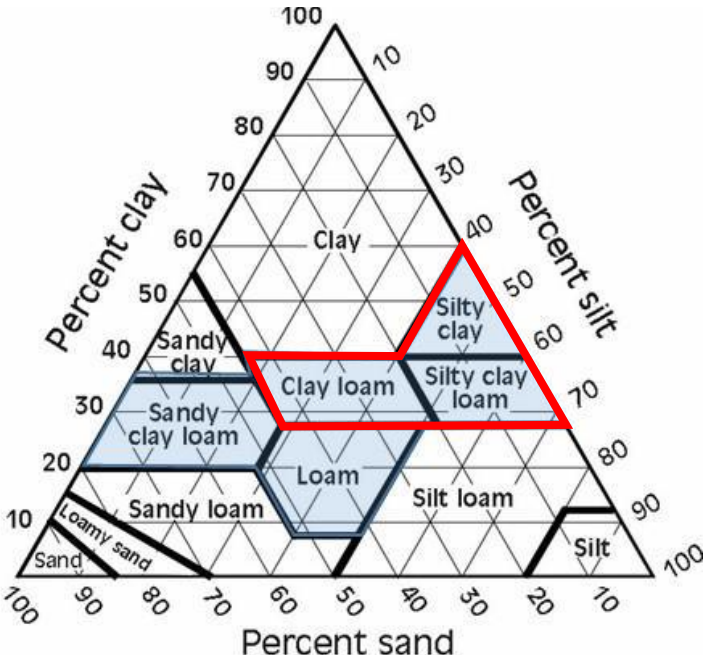
* Simulation did not converge (percolation was too low).

Prototype ET Cover Design and Preliminary Site Characterization for Puerto Rico

These steps are presented below and described throughout the rest of this section.

1. Identify acceptable soil types (Section 3.1)
    a. This step has been completed as part of this guidance and is included as part of the prototype ET Cover design.
    b. Acceptable soil types for ET Covers in Puerto Rico: Loam, Silty Clay Loam, Silty Clay, Clay Loam, and Sandy Clay Loam.
2. Determine recommended soil cover thickness (Section 3.2)
    a. This step has been completed as part of this guidance and is included as part of the prototype ET Cover design.
    b. Normally, this step would be done after the preliminary site characterization has been completed (e.g., borrow source analysis, vegetation evaluation). For this guidance, preliminary design computations have been completed to determine the required water storage of the soil (Sr), the available water storage, and required soil thickness. Water balance modeling has also been completed as part of this guidance to determine performance equivalency to a prescribed clay cover.
3. Complete borrow source analyses (Section 3.3)
    a. Volume of soils available.

   b. Uniformity of soils.
   c. Particle size and soil type.
   d. Water content.
   e. Soil screening for vegetative properties [*e.g.,* hydrogen ion concentration (pH), calcium carbonate ($CaCO_3$)].
   f. Soil evaluation to support appropriate vegetation (helps determine whether amendments are needed to support vegetation).
4. Evaluate local vegetation and develop the revegetation plan (Section 3.4)
   a. Plant species.
   b. Phenology (how species are affected by seasonal variations in climate).
   c. Planting locations.
   d. Schedule for planting.
   e. Additional activities as needed.
   f. Additional water balance modeling, if needed (*e.g.,* if conditions differ from those used in developing the prototype ET Cover in this guidance's scenarios).
   g. Geometric design.
   h. Surface water and leachate management strategies.
   i. Landfill gas management.
   j. Erosion control strategies.
   k. Specification preparation.
5. Finalize the ET Cover design (specifics not discussed in this guidance)
6. Obtain regulatory approval. Basic regulatory references regarding equivalency and permit modifications are provided in Section 1.4, specifics are not discussed in this guidance.



The only soil types (*i.e.,* textures) that are acceptable for ET Covers in Puerto Rico are: Loam, Silty Clay Loam, Silty Clay, Clay Loam, and Sandy Clay Loam (shaded blue in Figure).

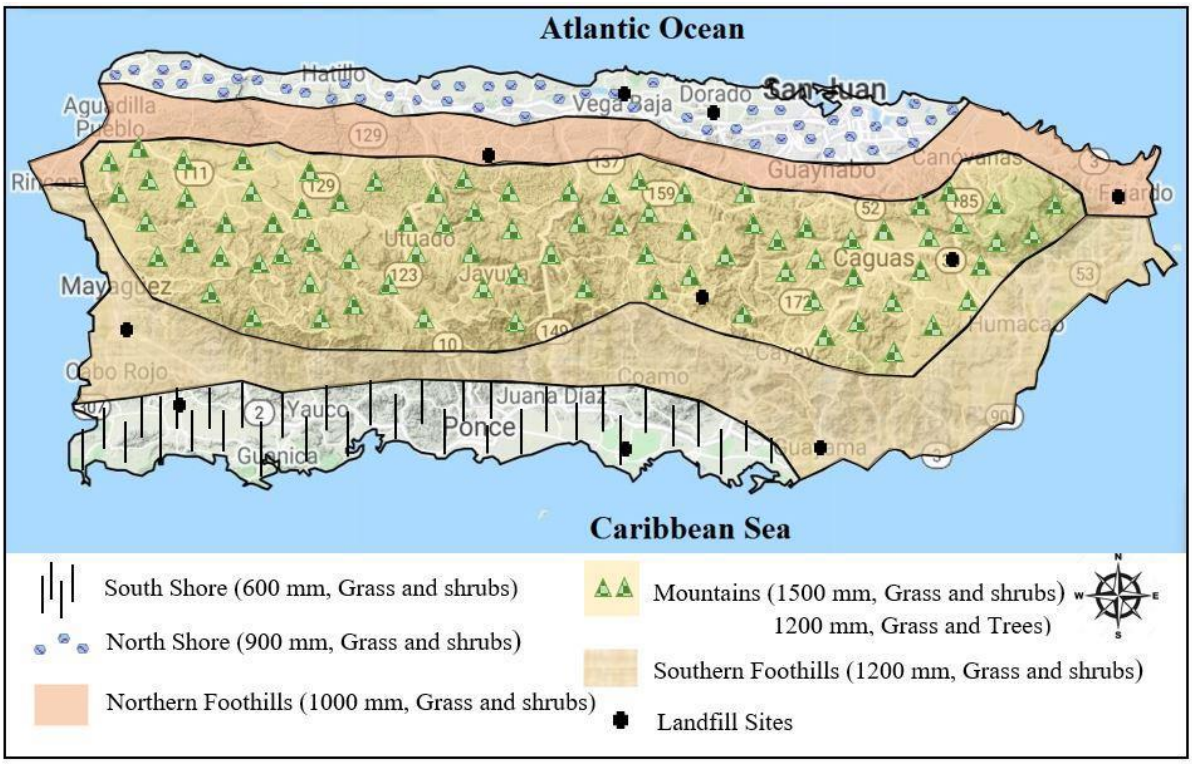
The only soil types (i.e., textures) that are suitable for ET Covers in Puerto Rico's Northern Foothills (*e.g.,* Toa Alta) are: Silty Clay Loam, Silty Clay, and Clay Loam (outlined in red in Figure).

In summary, for performance equivalent to a compacted clay cover in the same Ecozone, the following minimum ET Cover thicknesses are recommended:

• North Shore – 900 mm (3 ft).

ET Cover Design Elements for the Toa Alta Landfill Intermediate Cover Requirements

• Northern Foothills – 1000 mm (3.25 ft).



For MSW landfills, subgrade is typically defined as a minimum 6-inch-thick foundation layer composed of earthen material (e.g., typically derived from intermediate or daily cover soils) that is situated between the disposed material and the ET Cover. For non-MSW landfills with homogeneous wastes (*e.g.,* ash monofills), subgrade may be defined as the top of the waste surface. Best practices for subgrade preparation include the following:

- Proof-roll the subgrade and make repairs as needed to achieve a stable surface.
- Grade the subgrade to achieve a surface consistent with the approved design contours for ET Cover construction.
- Roughen relatively steeper side slopes (e.g., > 5%) using appropriate equipment prior to placement of cover soil.
- Survey the prepared subgrade surface prior to ET Cover construction to establish a basis for the lines, grades, and total soil cover thickness to be achieved during construction.

In general, soils used for the water storage layer of the ET Cover should be suitable for establishing vegetation. The role of vegetation in an ET Cover is essentially to remove moisture through evapotranspiration. Therefore, soils proposed for the construction of an ET Cover should support long-term vegetation growth. In that context, soils should be tested for:

• Salt content
  - High concentrations (*e.g.,* greater than 2%) of ionic salts (sodium, potassium, calcium, etc.) can inhibit vegetation growth.
  - High gypsum content is an indicator that vegetative growth may be inhibited.

- Amendments with composted manure can increase salt content and may not be appropriate to use.

• pH

- Soil pH should be between 6.0 and 8.4 s.u.
- pH greater 8.0 (usually due to high sodium content) can cause soils to disperse, resulting in drainage problems that may inhibit vegetative growth.
- pH greater than 8.4 can inhibit vegetative growth.
- pH less than 6.0 can inhibit vegetative growth (suggestion: raise pH by adding lime, calcitic limestone, or dolomitic limestone to the soil).

• Nitrogen

- The recommended soil nitrogen content is 5–30 parts per million (ppm).
- Nitrogen readily leaches from soil and may require additional monitoring.
- Nitrogen is very important for initial growth and vegetative health, but native and many naturalized plants are often adapted to low-nitrogen conditions.
- Nitrate-nitrogen as low as 5 ppm in conjunction with 1.5-2.0% soil organic matter will be satisfactory for most major dryland native plants likely to be used on covers.

• Phosphorus

- The recommended soil phosphorus content is 30-70 ppm.
- Phosphorus has a moderate leaching potential from soil.

• Potassium

- The recommended soil potassium content is approximately 75-200 ppm.
- Potassium has a low leaching potential and generally stays in place until used by the vegetation.

• Electrical conductivity

- The electrical conductivity of soils should be less than 400 millisiemens per meter (mS/m). This conductivity is a good indicator of a soil capable of sustaining healthy vegetation, with higher values indicating higher salt content. Optimal electrical conductivity levels in the soil can range from 110 to 570 mS/m.

Key Considerations in Geotechnical Engineering Review

Slope Stability: The stability of waste and cover slopes significantly influences the effectiveness of landfill closures. Geotechnical analysis is crucial for identifying potential risks of slope failures and developing mitigation strategies.

Soil Specification: Selecting suitable soil specifications is vital for preventing erosion and maintaining structural integrity. Geotechnical engineering expertise is necessary to determine soil properties that align with the specific conditions of the landfill site.

Assessing the stability of waste and cover slopes is a challenging task, requiring proper shear strength parameters for waste and applicable analysis for civil design. The Geotechnical Engineer will run the appropriate models, considering the seismic zone assigned, seismic hazard curve data, ground motion data and values and from the USGS U.S. Seismic Hazard Maps for Puerto Rico and the Virgin Islands. In

addition, the analysis and results obtained from the site geotechnical assessment, including soil borings and surrounding areas geotechnical characteristics will promote definition of the ET Cover material specifications and installation procedures for a particular scenario.

For waste slope and closure cap stability, theoretical analysis and field studies are necessary. Local geotechnical engineers will establish safety factors (typically 1.5–2) for stable slope angles, considering variables such as shear strength, subsoil conditions, density, phi angle, effective cohesion, and more. Collaboration with flora experts will ensure that the specified soil supports healthy vegetation.

A detailed geotechnical investigation, analysis, and design at the site will result in a comprehensive design and specifications, incorporating input from you and other project stakeholders. Once completed, the detailed design and specifications can be provided to qualified contractors to ensure adherence and compliance with the design, specifications, and geotechnical engineering requirements.

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