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# CLASSIFICATION AND INTERPRETATION OF SELECTED SOIL DATA

FROM A TROPICAL REGION OF BOLIVIA

by

Noemi E. de Sabillon

A report submitted in partial fulfillment of the requirements for the degree

of

MASTER OF SCIENCE

in

Soil Science and Biometeorology

(Genesis and Classification)

Plan B

Approved:

UTAH STATE UNIVERSITY Logan, Utah

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I am thankful to the University of Honduras for its sponsorship. I would like to dedicate this report to my families: Enamorado-Alcantara, Sabillon Coto, especially to my husband, German, and my children: Taira, Nohemy, German Jose, and Haskel Noe, who have given support and encouragement at the time when I have needed them most.

Naoemi E. de Sabillon

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#### INTRODUCTION

"Half of the uncultivated land of the world, or some 80 million hectars (ha), lies in the humid tropics, where the climatic environment offers a high potential for crop production. ... If only 2 percent of this area were put into cultivation with good management practices, enough food could be produced to feed the present population of Latin America" (Committee on Tropical Soils, National Academy of Sciences, 1972).

The main use of the soils is the capability to support land plants; plants that supply most of the animal and human needs, therefore we must be interested in getting the best we can out of the soils we have.

To achieve such important goals, it is necessary to have a good understanding of the soil characteristics, their relationships, and how we could fit them into a classification system that will allow us to extrapolate information and give the adequate use and management practices useful for a praticular need. The purpose of this report is to provide some experience in the soil classification and interpretation procedures. This project was undertaken because there was available a reasonable data set for soils of a portion of Bolivia (Cochrane, 1968). No additional field or laboratory experiments were carried out for this project.

### OBJECTIVES

The objectives of this report, using the available pedon descriptions and analytical data are:

- To classify the 17 selected soils, based on the kind of diagnostic horizon(s) present in each of them.
- 2. To evaluate each soil, giving its actual use and its capability for other uses according to its own limitations and suitability of response to special management practices.
- To estimate engineering soil properties and soil limitation ratings that affect their engineering and recreational use.

#### DESCRIPTION OF THE AREA

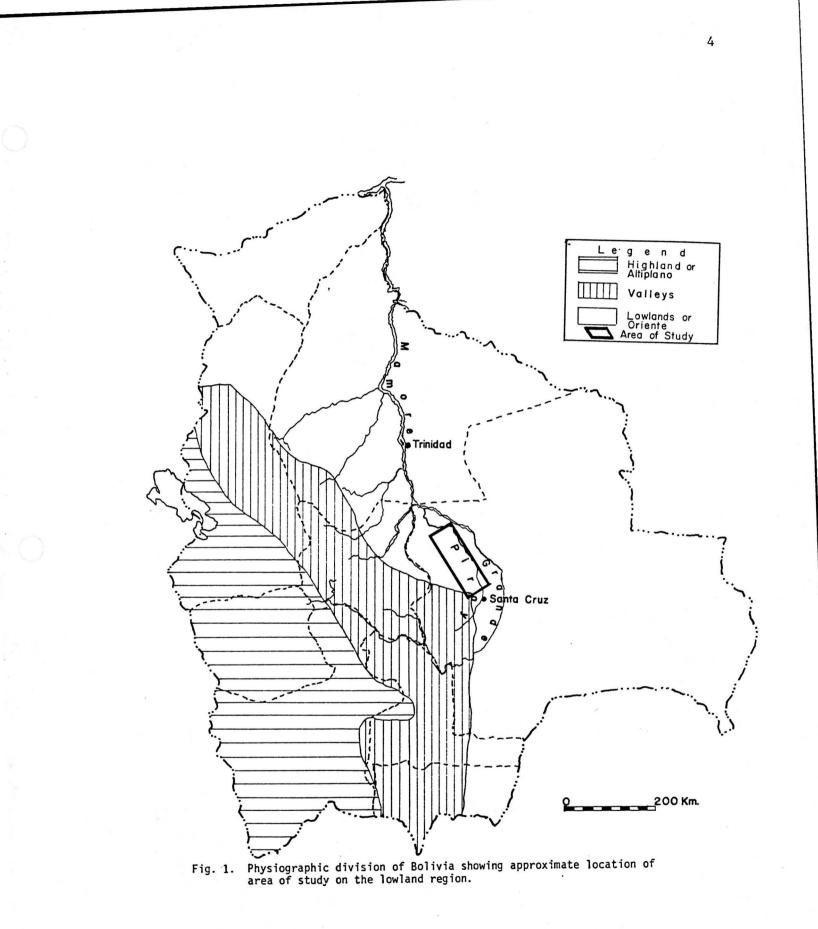
Bolivia has been physiographically divided into three regions: (Fig. 1).

- The highland or altiplano (in western Bolivia, the Andes with cordilleras bordering a massive platea--more than 3,600 m altitude).
- The valleys (in central Bolivia, a deeply dissected mountainous region--from 600 m to 3,600 m altitude).
- 3. The lowlands or oriente (eastern Bolivia, vast lowlands and peneplains, the largest region, 3/5 of the country, about 669,000 km<sup>2</sup>--less than 600 m altitude). (World Atlas of Agriculture, 1970; Leonard, 1952) (Fig. 1).

The lowland region consists of dense tropical forest of the Amazon Basin, vast natural pasture lands, open forest, and savanna in the south. In the central part, around Santa Cruz, the conditions are very good for the cultivation of sugar cane, rice, oil plants, and citrus fruits.

"The whole region is very flat, within a radius of 400 miles there is no hill, no stones, and no gravel to be seen. Eighty-five percent of the land has been formed in mixing alluvial sandstone sediments. This land is still in the process of formation by the action of the rivers that are building up new layers of sedimentary deposits that they keep carrying from the mountains." (Murillo, 1975).

These sediments are deep, moderately well- to well-drained soils and nearly level to gently undulating slopes, most of them are



brownish colored, structureless, very friable, sandy loam to loamy sand textures, and are classified as Entisols.

#### Location

Bolivia is situated between  $57^{\circ}29'40"$  and  $69^{\circ}33'36"$  longitude west and between  $09^{\circ}34'50"$  and  $25^{\circ}13'00"$  latitude south in the east and  $10^{\circ}56'40"$  and  $25^{\circ}00'05"$  latitude south in the west. It is bounded on the north and east by Brazil, to the south by Argentina and Paraguay, to the southwest by Chile, and to the northwest by Peru (Osborne, 1964).

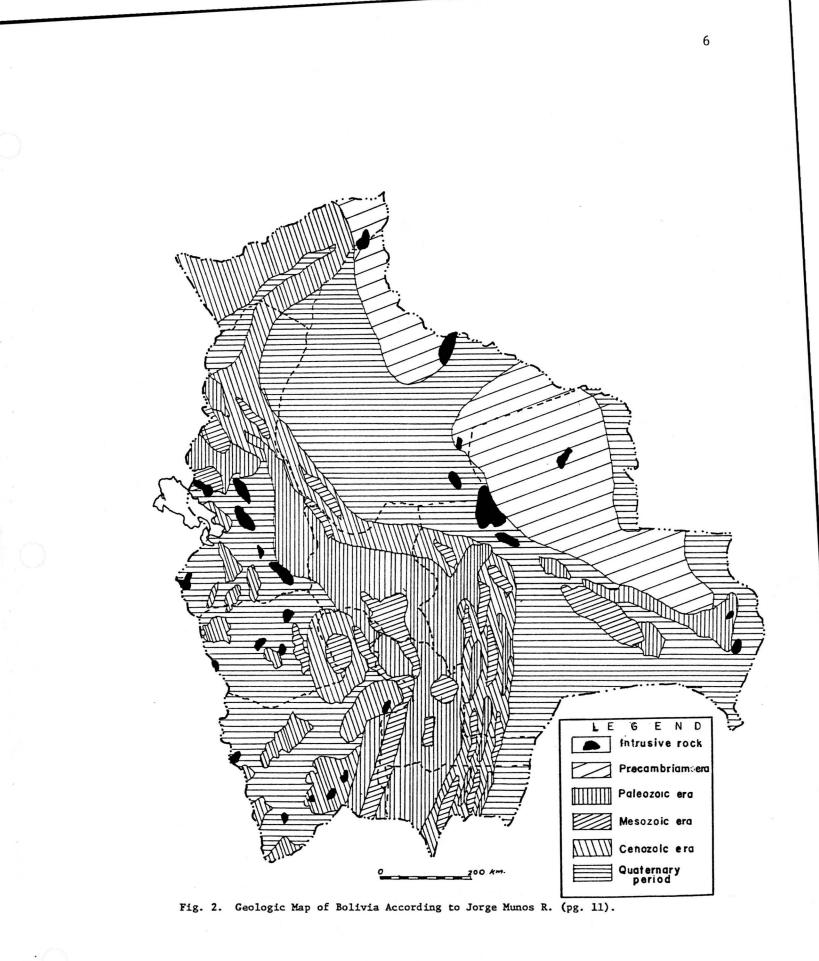
The region of study, Piray River System, lies within the lowland region northwest of the department of Santa Cruz. The Piray River is a contributor of the Rio Grande, named Mamore in the department of Beni and is one of the largest rivers of Bolivia.

#### Physiography and Geology

In Bolivia we find diversity in the kinds of rocks that have been formed in different periods of the geologic time, since the Precambiam time to the recent epoch (Holocene) (Fig. 2).

In the altiplano region (east and central mountains) most of the land is from the Paleozoic era, Ordovician period. In the north, northeast of the country, departments of Pando, Beni, and Santa Cruz, the predominant rocks (granite, a coarse-grained igneous rock, and gneiss, a foliated metamorphic rock) are formed since the precambrian time, the most stable and massive section of the earth's crust, that advances forward to the west under the tertiaries and quaternaries alluvium that cover the west lowlands of Beni (Munoz, 1977).

The area of study, Piray River system, is part of the great



alluvial plain named "Planicie of Chaco - Beni." This area, during the last period called "The Wisconsin", was flooded leaving different kinds of sedimentary deposits (Murillo, 1975).

#### Climate

The climate is determined by the altitude rather than by the latitude or distance south from the equator. Temperature, rainfall, and productivity are altered by this important factor.

<u>Rainfall</u>. Precipitation is greatest in the northern parts, decreasing gradually toward the south. The average rainfall is from 1,200 to 1,300 mm. The rainy season is from October to April; more than 75 percent of the rainfall occurs during this time. December to March there is an adequate and well distributed amount of rainfall for most cultivated crops (Osborne, 1964).

<u>Temperature</u> Warm to hot through the year. Annual mean temperature is  $23.7^{\circ}$ C. Winter (May to July) is  $19^{\circ}$  to  $20^{\circ}$ C and summer (September to March) temperatures are from  $24^{\circ}$ C to  $28^{\circ}$ C. November and December are the warmest months (up to  $40^{\circ}$ C.).

<u>Wind</u>. The winds are strong during May to August, some cold winds, usually accompanied by rainfall come from the north. Most of the winds come from the south, especially during summer and they are accompanied with clouds of sand, dust, and rainfall causing a drop of temperature of  $15^{\circ}$ C up to  $20^{\circ}$ C in a short period of time (hours). They are called "Surazos" and last from 3 days up to a week.

<u>Vegetation</u>. The native vegetation is seasonal forest and deciduous seasonal forest. Cleared areas are used for sugar cane, corn, and pastures.

Soils. Soils have formed in mixed alluvial sandstone sediments deposited by the Piray River. They are deep soils, moderate well to well drained, brown sandy loams with moderate subangular blocky structure to structureless soils.

#### USE AND MANAGEMENT OF SOILS

The soils of the Piray River area have a wet stream bottom dominant range site. Its present land use is mostly pastures and grasslands with tufted grasses. The crop suggestion has been improved pastures and grasslands due to the risk of wind erosion and flood hazards.

These soils are moderately too weakly leached and the levels of the major plant nutrients appear to be low. The water table is usually found within 1 m, showing mottles and "Mn" concretions. Most of the soils are well drained with moderate to high permeability.

#### Capability Groups of Soils

There are three levels of soil management: Land Capability Class, Capability Subclass (Soil Conservation Service, 1961), and Capability Unit (Donahue et al., 1977).

Land Capability Class. There are eight classes (I to VIII), classified depending on crop production limitation factors, such as the slope gradient, soil and water depth. Classes I to IV can be used for cultivation, classes V to VIII can be cultivated without special management practices.

Land Capability Subclass. The subclasses are designated by lower case letters that follow the Roman numeral of the soil class. These lower case letters are used to explain the reason for the limitations of intensive crop production.

The soil capability subclasses are expressed as follows: e - Erosion hazard w - Wetness

s - Shallow, droughty, or stony

c - Climate, too cold or too dry.

Land Capability Unit. The land capability units are subdivisions of the subclasses. There are nine divisions, and this means that the soils belonging to a determined soil unit are similar in vegetation suitability and can be treated with similar crop management practices to obtain a desired productivity. For example, IIIw-4 means Soil class III, subclass w (wetness limitation) and capability unit 4 (coarse texture or excessive gravel).

The nine capability units are defined as follows:

- 0 Sand and gravel in the substratum
- 1 Erosion hazard
- 2 Wetness caused by poor drainage or flooding
- 3 Slow or very slow permeability of the subsoil or substratum

4 - Coarse textured or excessive gravel

5 - Fine or very fine texture

6 - Salts or alkali

7 - Cobblestones, stones, or rocks

- 8 Nearly impervious bedrock or a hardpan
- 9 Low fertility or toxicity

# METHODS AND PROCEDURES

### Field Methods

Eighty-eight soil profiles were examined by T. T. Cochrane, AICTA Ag SC (British Advisors in Tropical Agriculture to the Ministry of Agriculture of Bolivia). The descriptions were recorded in accordance with the criteria specified in the "Soil Survey Manual" of the United States Department of Agriculture. The soil color was determined by the comparison of the wet soil color to Munsel color charts. These data provided the basis for this paper.

# Field Morphology

The studied soils are moderate to well drained and derived from sandy, quartz rich, wind-blown alluvium from the Piray River system parent materials. These soils occur in the lowland tropical region of Bolivia and on a flat to very gently undulating topography.

## Pedon Descriptions

Pedon 400.

T .....

Location:	Latitude 8056700, Longitude 487000
Soil Suite:	Rio Piray
Vegetation:	"Pampa", including native tufted grasses such as
	Sporobolis spp.
Present Land Use:	Extensive grazing

		12
Horizon	Depth (cm	) Description
A1 1	0-3	Dark brown (10YR 3/3) sandy loams, very
		friable; structureless, single grained;
		abundant roots; distinct smooth boundary.
A1 2	3-15	Dark brown (10YR 4/3) loamy sands; very
		friable; structureless, single grained;
	а. 1	many roots; indistinct smooth boundary.
A2	15-45	Strong brown (7.5YR 5/6) sands; very
		friable; structureless, single grained,
10		many roots; indistinct smooth boundary.
A3	45-70	Strong brown (7.5YR 5/6) coarse sandy
		loams, with profuse, medium sized, faint,
		light brownish gray (10YR 6/2) mottles;
	1	very friable; structureless, single
		grained; many roots; indistinct smooth
		boundary.
B1	70-95	Grayish brown (10YR 5/2) weakly gleyed,
		coarse sandy loam with profuse, medium
		sized, distinct to prominent, dark reddish
	×	brown (5YR 3/4) mottles; very friable;
		structureless, single grained; inhibition
		to roots due to water table at about 75
		cm; indistinct smooth boundary.
-	95-?	Reddish gray (5YR 4/2) weakly gleyed,
		coarse sandy clay loam with profuse,
		coarse sized, prominent, yellowish red
		(5YR 4/6) mottles; friable; structureless,
		, con accureress,

B1

•

B2

single grained; inhibition to roots due to water table.

Pedon 401.

Location:	Latitude 8066000, Longitude 467500
Soil Suite:	Rio Piray
Vegetation	"Pampa" with native tufted grasses such
	Sporobolis spp.

Present Land Use: Extensive grazing.

Horizon	Donth (	
	Depth (cm)	Description
A1 1	0-3	Dark brown (10YR 3/3) sandy loam; very
,		friable; weakly developed, medium granular
		structure breaking to single grains;
A12	5-30	abundant roots; distinct smooth boundary.
	5-30	Dark brown to brown (10YR 4/3) sandy loam,
		very friable; structureless, single
		grained; many roots; indistinct smooth
		boundary.
A2	30-55	Brown (10YR 5/3) sandy loam with abundant,
		medium sized, distinct, strong brown
		(7.5YR 5/6) mottles; a few small "Mn"
		concretions; very friable; structureless,
		single grained, many roots; indistinct
B2	55-90	smooth boundary.
Βζ		Brown (10YR 5/3) sandy loam, weakly gleyed
		with abundant dark brown to brown (10YR
		4/4) medium sized, faint mottles, a few
	÷	"Mn" concretions lup to 2.5 cm in

13

as

diameter; very friable; structureless, single grained; few roots; indistinct smooth boundary.

Brown (10YR 5/3) sandy loam, weakly gleyed with a few "Mn" concretions; very friable; structureless, single grained; inhibition to roots due to excessive moisture-water table at at about 90 cm.

sand; very friable; structureless, single

#### Pedon 402

90-?

Location:	Latitude 8115200, Longitude 481400
Soil Suite:	Rio Piray
Vegetation:	An ex-maize field. Land cleared from original
	semi-evergreen seasonal forest about 7 years
	previously.

Present Land Use: Maize cultivation.

Horizon	Depth (cm)	Description
A11p	0-8	Very dark grayish brown (10YR 3/2)
		loamy sand; loose; very weakly developed,
		medium sized, crumb structure, breaking to
		single grains; many roots, distinct smooth
		boundary.
A12	8-30	Dark brown (10YR 3/3) loamy sand, very
		friable; structureless, single grained;
		many roots; indistinct smooth boundary.
A2	30-60	Dark yellowish brown (10YR 3/4) loamy

С

grained; many roots; indistinct smooth boundary.

60-140 Reddish brown (5YR 4/3) loamy sand, very friable; structureless, single grained; many roots; diffuse smooth boundary.
140-? Brown (7.5YR 5/4) loamy sand with a few reddish brown spots; very friable; structureless; single grained; few roots.

Pedon 403.

Location:	Latitude 8115200, Longitude 477000	
Soil Suito.	Rio Piray	)
Vegetation:	Grasslands Land	

vegetation:Grasslands. Land has probably been cleared from<br/>original forest vegetation for over 10 years.Present Land Use:Some sugar cane and food crops.

		ind rood erops.
Horizon	Depth (cm)	Description
A1p	0-8	Very dark grayish brown (10YR 3/2) loamy
		sand, loose; structureless, single
		grained; many roots; distinct smooth
		boundary.
A12	8-25	Dark brown (10YR 3/3) sandy loam, very
		friable; structureless, single grained,
12		many roots; diffuse smooth boundary.
A2	25-60	Dark brown to brown (7.5YR 4/4) loamy
		sand, very friable; structureless, single
		grained; many roots; diffuse smooth

boundary.

15

B2

С

B2

С

60-110

110-?

Donth (am)

Brown (7.5YR 5/4) sandy loam with many medium faint, dark reddish brown (5YR 3/4) mottles occasionally showing signs of "Mn" precipitation in their centers; very friable; structureless, single grained; many roots; indistinct smooth boundary. Yellowish red (5YR 5/6) sandy loam with abundant, medium, distinct, dark reddish brown mottles and some "Mn" concretions; very friable; structureless, single grained; few roots. The horizon may indicate the upper limit of the water table.

Pedon 404.

Iloui son

Location:	Latitude 8106000,	Longitude	477200	
Soil Suite:	Rio Piray			
Vegetation:	Grassland			
Present Land Use:	Pastures			

Horizon	Deptn (cm)	Description
A1 1	0- 5	Very dark grayish brown (10YR 3/2) loamy
		sand, loose; structureless, single
		grained; many roots; distinct smooth
		boundary.
A1 2	5-30	Dark brown to brown (7.5YR 4/4) sandy
		loam; very friable; structureless, single
		grained; many roots; indistinct smooth

Deconintion

boundary.

30-60

60-120

120-?

Strong brown (7.5YR 5/8) loamy sand with some fine sized, faint mottles (7.5YR 5/6); very friable; structureless, single grained; many roots; indistinct smooth boundary.

Strong brown (7.5YR 5/6 loamy sand with profuse fine sized; faint mottles (7.5YR 5/8), and some redder stains along ald roots traces; friable; structureless, single grained; many roots; diffuse smooth boundary.

Reddish yellow (7.5YR 6/6) loamy sands abundant, medium sized, distinct, dark reddish brown (5YR 3/3) mottles; friable; structureless, single grained; some inhibition to root development due to the water table that was found at 120 cm.

Pedon 405.

Location:

Soil Suite:

Latitude 8097800, Longitude 477800 Rio Piray

Vegetation: Grassland

Present Land Use: Grazing.

Horizon Depth (cm)

0-3

Description

A11

Very dark grayish brown (10YR 3/2) sandy loam; very friable; very weakly developed medium crumb structure breaking down to

17

B2

С

A3

single grains; many roots; indistinct smooth boundary.

Dark brown (10YR 3/3) sandy loam; friable;

structureless, single grained; many roots;

diffuse smooth boundary.

A12

3-30

30-60

60-100

100-160

160-?

B1

Dark brown to brown (7.5YR 4/2) sandy loam with some traces of "rusty" coloration along some root traces; friable; structureless, single grained; many roots; indistinct smooth boundary.

Pale brown (10YR 6/3) loamy sand, with abundant medium sized, faint to distinct strong brown (7.5YR 5/8) mottles; sand; very friable; structureless, single grained; few roots; diffuse smooth boundary.

Pink (7.5YR 7/4) sands with abundant, coarse sized, distinct strong brown (7.5YR 5/8) mottles; very friable; structureless, single grained; few roots; indistinct smooth boundary.

Reddish brown (5YR 5/4) sandy loam with many coarse, distinct pink (7.5 YR 7/4) mottles; friable; structureless, single grained; few roots.

B2

B3

С

## Pedon 406.

Loction:	L	atitude 8087700, Longitude 475400			
Soil Suite:		Rio Piray			
Vegetation:	Gi	rasslands			
Present Land		tensive Grazing			
Horizon	Depth (cm)				
A1 1	0- 5	Description			
	c J	Very dark grayish brown (10YR 3/2)			
		loamy sand; loose; very weakly developed,			
		medium, crumb structure breaking down to			
		single grains; many roots; distinct smooth			
		boundary.			
A12	5-35	Dark brown (7.5YR 3/2); sand; very			
		friable; structureless, single grained;			
-	,	many roots; indistinct smooth boundary.			
A3 3	35-60	Yellowish brown (7.5YR 5/6) loamy sand			
		with profuse, fine sized, faint to			
		distinct, yellowish brown (7.5YR 5/4)			
		mottles; very friable; structureless,			
		single grained; many roots; indistinct			
		smooth boundary.			
B2 60	-80	Light brown (7.5YR 6/4) loamy sand with			
		many medium, distinct, yellowish red			
		(7.5YR 5/6) mottles; very friable;			
		structureless, single grained; few roots;			
		indistinct smooth boundary.			
80-					

Light brown (7.5YR 6/4) loamy sand with abundant, yellowish red (5YR 5/6) mottles;

B2

С

80-?

very friable; structureless, single grained; some root inhibition due to water table which was noted at approximately 90 cm.

## Pedon 407.

С

Location:	Latitude 8076500, Longitude 456300
Soil Suite:	Rio Piray
Vegetation:	Grasslands - some "Grama negra"
Present Land Use:	Pastures.
Horizon Depth (c	m) Description
A1 0-10	Dark brown (7.5YR 3/2) sandy loam; very
	friable; structureless, single grained;
A3 10-40	many roots; indistinct, smooth boundary.
A3 10-40	Dark brown to brown (7.5YR 4/4) sandy loam,
	with a faint trace of reddish brown (5YR
	4/4) mottle and a little reddish brown
	staining along root traces; friable;
	structureless, single grained, many roots;
-	diffuse smooth boundary.
B2 40-75	Dark brown to brown (7.5YR 4/4) sandy clay
	with a few, medium sized, faint reddish
	brown (5YR 4/4) mottles, friable;
	structureless, single grained; many roots;
•	diffuse smooth boundary.
C 75-?	Light brown (7.5YR 6/4) weakly gleyed
	loamy sand with many, medium sized,
	distinct reddish yellow (5 YR 6/8) mottled

with some "Mn" concretion in formation; very friable; structureless, single grained; few roots - some inhibition to penetration due to high water table found at 105 cm.

### Pedon 408.

Depth (cm)

0-7

7-28

28-55

Location:	Latitude Pozzaca
Soil Suite:	Latitude 8077800, Longitude 460000 Rio Piray
Vegetation:	Grassland, with many native tufted grasses,
Die	including Sporobilis spp.
Lesent Land II	Pasture.

Horizon

A11

A12

B2

Description

Very dark grayish brown (10YR 3/2) sandy loam with a faint trace of a "rusty" coloration along the root traces; friable; structureless, single grained; abundant roots; distinct smooth boundary. Dark brown (7.5YR 3/2) sandy loam with a distinct "rusty" coloration along some of the root traces; friable; very weakly developed, medium, blocky structure breaking down to single grains; many roots; diffuse smooth boundary. Dark brown to brown (7.5YR 4/2) sandy loam; very friable; structureless, single grained; many roots; indistinct smooth boundary.

55-?

С

Light brown (7.5YR 6/4) loamy sand with abundant medium sized, distinct strong brown (7.5YR 5/6) mottles and a strong brown colour along the root traces; very friable; structureless, single grained; few roots.

Pedon 409.

Location:	Latitude 8083700, Longitude 473400
Soil Suite:	Rio Piray
Vegetation:	Cultivated pasture, including "Grama Negra" and
	"Bermuda" grasses
Present Land Use:	Cultivated pastures.

Horizon	Depth (cm)	Description
A1p	0-10	Very dark grayish brown (10YR 3/2) sandy
		loam; friable; very weakly developed
		medium, granular structure breaking to
		single grains; abundant roots; distinct
		smooth boundary.
A1 2	10-40	Dark brown (7.5YR 3/2) sandy loam friable;
		very weakly developed, fine blocky
		structure breaking to single grains; many
		roots; indistinct smooth boundary.
B2	40-70	Brown (7.5YR 5/4) sandy clay loam with
		many fine to medium sized, faint,
		yellowish red (5YR 5/8) mottles and some
		soft "Mn" concretions; friable; very
		weakly developed, medium, blocky structure

breaking to single grains; many roots; indistinct smooth boundary.

Brown (7.5YR 5/2) sandy loam, very weakly gleyed with abundant, medium sized, distinct, yellowish red (5YR 4/8) mottles; friable; structureless, single grained; some inhibition to root development due to a high water table which was seen at a depth of 120 cm.

### Pedon 410.

Location:

С

Soil Suite:

Vegetation

Present Land Use:

Horizon Depth (cm)

0-12

12-30

A1p

Description

Rio Piray

Pastures

Latitude 8085800, Longitude 481700

Pasture, (Yaragua) ex sugar cane

Dark brown (7.5YR 3/2) fine sandy loam; friable; very weakly developed; fine blocky structure with some moderately developed, medium, granular structure breaking to single grains; many roots; indistinct smooth boundary.

Dark brown to brown (7.5YR 4/4) fine sandy loam; friable; structureless, single grained; many roots; diffuse, irregular boundary.

A12

23

70-?

30-60

60-?

Strong brown (7.5YR 5/6) loamy sand with just a trace of brown (7.5YR 5/4) mottling; very friable; structureless, single grained; many roots; diffuse, smooth boundary.

Light brown (7.5YR 6/4) loamy sand with abundant medium sized, faint to distinct reddish yellow (7.5YR 6/6) mottles; friable; structureless, single grained; few roots.

### Pedon 411.

Location: Latitude 8074600, Longitude 480600 Soil Suite: Rio Piray Vegetation: Grasslands, including native tufted grasses, such as Sporobolis spp. Present Land Use: Pastures

Horizon	Depth (cm)	Description
A1 1	0- 4	Dark brown to brown (10YR 4/3) loamy sand;
		very friable; some very weakly developed,
		medium, crumb structure, but largely
		structureless and single grained; many
A12		roots; distinct smooth boundary.
RIZ	4-30	Dark brown (7.5YR 3/2) loamy sand; very
		friable; structureless, single grained;
		many roots; indistinct smooth boundary.

B2

С

				25
	AC	30-60		Brown (7.5YR 5/4) loamy sand; very
				friable; structureless, single grained,
				few roots; diffuse smooth boundary.
	С	60-?		Strong brown (7.5YR 5/6) sand; friable;
	Pedon	412.		structureless, single grained; few roots.
	Location:		Latit	ude 8062000, Longitude 484100
	Soil Suite:		Rio P	iray
	Vegetation:		Culti	vated Yaragua pasture
	Present Land	d Use:	Pastu	rage
	Horizon	Depth (cr	<u>n)</u>	Description
	A1p	0-20		Dark brown (7.5YR 3/2) sandy loam; very
				friable; very weakly developed, fine,
				blocky structure breaking to single
				grains; many roots; indistinct smooth
				boundary.
	A3	20-50		Brown (7.5YR 5/4) sandy loam with many
				fine sized, faint to distinct, yellowish
				red (5YR 4/8) mottles; friable; very
				weakly developed, medium, blocky structure
			•	breaking to single grains; many roots;
				indistinct smooth boundary.
	B2	50-90		Brown (7.5YR 5/4) sandy loam with abundant
				reddish brown (5YR 4/4) fine sized
8				distinct mottles, and a small amount of
				<pre>small soft "Mn" concretions; friable;</pre>
				structureless, single grained; indistinct
				smooth boundary.

С

Pale brown (10YR 6/3) weakly gleyed, loamy sand with abundant, medium, distinct reddish brown (5YR 4/4) mottles, and some soft, small "Mn" concretions; friable; structureless, single grained; few roots due to some inhibition caused by the high water table found at 90 cm.

sandy clay "lenses" specially in the lower

Pedon 413.

90-?

Location:	Latit	ude 8027800, Longitude 491300
Soil Suite:	Rio P	iray
Vegetation:	"Pamp	a". Native tufted grasses
Present Land Use:	Grass	land
Horizon Depth	(cm)	Description
A1 1 0-5	5	Reddish brown (5YR 4/4) sandy loam;
	:	friable; weakly developed, fine subangular
		blocky structure breaking to single
		grains; many roots; indistinct smooth
		boundary.
A2 5-1	.5	Yellowish red (5YR 4/6) sandy clay loam
		friable to firm; very weakly developed,
		medium, blocky structure breaking to
		single grains; many roots; indistinct
		smooth boundary.
B2 15-5	5	Yellowish red (5YR 4/8) sandy clay loam
		with many medium sized, distinct, red
		(7.5YR 4/6) mottles and some occasional

part of the horizon, very dark gray in color (5YR 3/1); "Mn" concretions up to 1.5 cm in diameter common; firm; weakly developed, mediuim, blocky structure, breaking into single grains; an occasional medium sized rounded stone; many roots; indistinct smooth boundary.

Red (5YR 4/6) sandy loam with many medium sized light brown mottles; friable; structureless, single grained; few roots; diffuse smooth boundary.

Yellowish red (5YR 4/6) to red (2.5YR 4/8) loamy sand, with just a trace of mottling; very friable; structureless, single grained; some fine sized rounded gravel sized particles; few roots.

Pedon 414.

Location: Soil Suite:

Vegetation:

Horizon

Latitude 8031000, Longitude 488000 Rio Piray

Pampa. Native tufted grasses including Sporobolis spp.

Present Land Use:

Extensive grasslands

Horizon	Depth (cm)	Description
A1	0- 5	Dark brown to brown (7.5YR 4/4) sandy
		loam; very friable; very weakly developed,
		fine, subangular blocky structure breaking

B3

С

55-75

75-?

to single grains; many roots; indistinct smooth boundary.

Dark brown to brown (7.5YR 4/4) sandy loam; friable; structureless, single grained; many roots; indistinct smooth boundary.

Reddish brown (5YR 4/4) sandy loam; friable; structureless, single grained; many roots; diffuse smooth boundary. Reddish yellow (7.5YR 6/6) loamy sand with abundant medium sized, faint mottles and occasional small (0.5 cm diameter) "Mn" concretions; friable; structureless, single grained; few roots; indistinct smooth boundary.

Light reddish brown (5YR 6/4) slightly gleyed; loamy sand with abundant, medium

sized, faint, reddish brown (5YR 5/4) mottles; friable; structureless, single grained; few roots; the water table was found at a depth of 145 cm.

Location: Latitude 4816000, Longitude 8032500 Soil Suite: Rio Piray Vegetation: Pampa. Native tufted grasses common, but some "Grama Negra" Present Land Use: Grassland.

A3

B2 25-70

5-25

70-100

100-?

**B**3

С

Pedon 415.

Horizon	Depth (cm)	Description
A1 1	0- 5	Reddish brown (5YR 4/4) loamy sand; very
		friable; very weakly developed, medium,
		blocky structure - almost structureless,
		single grained; abundant roots; indistinct
		smooth boundary.
A1 2	5-20	Yellowish red (5YR 4/6) sandy loam; very
		friable; structureless, single grained;
		many roots; diffuse smooth boundary.
A3	20-40	Yellowish red (5YR 5/6) loamy sand; very
		friable; structureless, single grained;
		many roots, diffuse smooth boundary.
B1	40-75	Yellowish red (5YR 6/6) loamy sand; very
	3	friable; structureless, single grain; many
	2. <sup>1</sup>	roots, indistinct smooth boundary.
B2	75-105	Red (5YR 5/6) sandy loam with many medium
		sized, faint reddish yellow (5YR 6/6)
		spots; some traces of carbon present;
		very friable; structureless, single
		grained; many roots; indistinct smooth
		boundary.
С	105-?	Yellowish red (5YR 4/6) loamy sand,
		friable; weakly developed, fine blocky
		structure breaking into single grains; few
		roots.

## Pedon 416.

B3

С

Loction:		Latituda Paranaa
Soil Su	ite:	Latitude 8030000, Longitude 479000
Vegetat:	а • Полици и на	Rio Piray
		Food garden - Maize
	Land Use:	Maize and food crop cultivation.
Horizon	Depth (cm	
A1p	0-15	Dark reddish brown (5YR 3/4) sandy loam;
		very friable; structureless, single
		grained; abundant roots; distinct smooth
40		boundary.
A2	15-35	Reddish brown (5YR 5/4) sandy loam; very
		friable; structureless, single grained;
B2		many roots; diffuse smooth boundary.
DC	35-90	Reddish brown (5YR 4/4) sandy clay loam;
		very friable; structureless, single
		grained; many roots; diffuse smooth
22		boundary.
B3	90-140	Reddish brown (5YR 4/4) sandy loam; very
		friable; structureless, single grained;
		many roots; an occasional small piece of
		"carbon" seen; diffuse smooth boundary.
	140-?	Reddish yellow (5YR 6/8) sandy loam with
		just a trace of yellowish red mottling;
*		very friable; structureless, single
		grained; few roots.

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# Laboratory Methods

There is no specific information about the methods followed in doing the physical and chemical analysis of these pedons. The methods used for the chemical analysis were basically similar to those described by Mossin in "A Laboratory Manual of Chemical and Physical Methods for Soils and Plant Analysis." This manual is not available at the library of Utah State University. The details of the methods of analysis are not known.

			11-04
-		•	- 1
	ah		

ANALYTICAL DATA PROFILE Nº 400

			(a	a)			
SAMPLE DEPTH		Exch		ata m. 1 (105	e. % c °C)	oven di	гу
in cm.	pН	Ca	Mg	к	Na	CEC	% BS
0 - 3	6.4	1.6	0.4	0.2	0.2	2.8	78
5 -15	6.2	0.6	0.1	0.2	0.1	1.7	53
20 - 30	6.1	0.1	0.1	0.1	0.1	1.1	42
50 - 60	6.1	0.2	0.2	0.1	0.1	1.4	34
75 - 85	6.1	1.5	0.4	0.2	0.2	3.1	75
125 -140	6.2	4.7	1.3	0.5	0.4	7.6	90

TEXTURE

(b)							
% CLAY	% SILT	% SAND					
15.2	3.0	81.8					
13.0	3.0	84.0					
2.4	3.0	94.6					
15.2	5.1	79.7					
19.5	7.3	73.2					
24.1	7.2	68.7					

(h)

Table 2.				(a)			
SAMPLE DEPTH		Exch		ata m. 1 (105	e. % c	oven di	гу
in cm.	Нq	Ca	Mg	к	Na	CEC	% BS
0 - 5	6.5	2.2	0.5	0.4	0.2	3.2	95
10 -20	6.2	1.1	0.2	0.2	0.1	2.4	67
35 -45	6.5	0.7	0.2	0.1	0.1	1.6	74
60 -75	6.5	0.3	0.2	0.1	0.2	2.0	40
100-110	6.5	0.6	0.1	0.1	0.2	1.7	60
	4						

Table 2. ANALYTICAL DATA PROFILE Nº 401

TEXTURE

(b)							
% SILT	% SAND						
5.1	77.6						
3.0	79.7						
5.1	79.6						
3.0	81.8						
3.0	81.8						
	5.1 3.0 5.1 3.0						

(b)

	(a)						
SAMPLE DEPTH		Exch		ata m. 1 (105	e. % c °C)	oven di	гу
in cm.	рĦ	Ca	Mg	к	Na	CEC	% BS
0 - 5	7.7	16.6	5.3	0.7	0.3	9.9	
10 -25	7.4	2.6	0.8	0.2	0.1	3.7	98
35 -50	7.5	1.9	0.6	0.2	0.1	2.8	97
70 -85	7.3	1.6	0.6	0.2	0.1	2.7	93
105-120	6.6	1.1	0.2	0.2	0.1	2.2	71
155-170	7.2	1.1	0.2	0.2	0.08	1.5	97

Table 3. ANALYTICAL DATA PROFILE Nº 402

TEXTURE

	(b)	-
% CLAY	% SILT	% SAND
9.9	4.3	85.8
11.7	4.7	83.6
13.8	2.5	83.7
13.8	2.5	83.7
13.8	2.5	83.7
11.3	2.9	85.8

	(a)							
	SAMPLE DEPTH		Exch		ata m. 1 (105	e. % c	oven di	сy
	in cm.	рH	Ca	Mg	к	Na	CEC	% BS
	0 - 5	7.7	14.2	1.1	0.6	0.2	8.0	-
	10 - 20	7.6	4.2	1.8	0.1	0.3	5.0	
	30 - 45	7.5	1.7	0.3	0.3	0.2	2.5	98
	70 - 85	7.3	1.8	0.4	0.2	0.1	2.4	99
þ	20 -145	7.4	1.8	0.4	0.4	0.1	3.1	.89
þ	60 -170	7.4	1.7	0.6	0.3	0.1	3.1	89
L			×	×				

Table 4. ANALYTICAL DATA PROFILE Nº 403

Ć

TEXTURE

(D)							
% CLAY	% SILT	% SAND					
11.3	5.1	83.6					
13.4	2.9	83.7					
11.3	5.1	83.6					
13.9	3.6	82.4					
13.9	3.6	82.4					
13.9	3.6	82.4					

(Ъ)

			(;;	a)			
SAMPLE DEPTH		Exch		ata m. <u>1 (105</u>	e. % c °C)	oven di	гу
in cm.	рH	Ca	Mg	к	Na	CEC	% BS
0 - 5	6.7	1.5	0.7	0.2	0.1	3.0	81
10 -25	5.2	0.6	0.2	0.2	0.1	2.4	44
35 -50	5.5	0.5	0.1	0.04	0.04	2.1	42
70 -85	5.8	0.1	0.1	0.04	0.04	1.7	23
100-115	5.9	0.4	0.1	0.1	0.1	1.6	42
130-140	6.3	0.2	0.3	0.1	0.1	1.4	56
			8				

Table 5. ANALYTICAL DATA PROFILE Nº 404

TEXTURE

(b)							
% CLAY	% SILT	% SAND					
13.9	1.5	84.6					
16.0	1.5	82.5					
13.9	1.5	84.6					
11.8	1.5	86.7					
11.8	1.5	86.7					
9.6	1.5	88.9					
1							

Table 6.	ANALYTICAL	DATA	PROFILE	Nº 405	
lable v.			a second a second second second		-

1ab1e •••			(.	a)			
SAMPLE DEPTH		Exch	ange D soi	ata m. 1 (105		oven di	гу
in cm.	рН	Ca	Mg	к	Na	CEC	% BS
0 - 3	6.5	2.1	0.4	0.3	0.1	4.0	72
3 -20	5.7	0.9	0.1	0.1	0.1	3.0	67
35 -50	5.6	0.3	0.1	0.1	0.1	2.5	19
70 -85	5.7	0.2	0.1	0.04	0.1	2.0	18
120-135	6.3	0.4	0.1	0.04	0.1	1.5	35
160-170	6.8	0.9	0.6	0.1	0.1	3.3	52

## TEXTURE

	(b)						
8	CLAY	% SILT	% SAND				
	13.9	3.6	82.5				
	15.0	4.3	80.7				
	15.0	4.3	80.7				
	10.7	2.1	87.2				
	6.4	2.1	91.4				
	12.8	4.3	82.9				

(b)

m 1	-	-
Tab	10	1.

## ANALYTICAL DATA PROFILE Nº 406

(a)						
	Exch				oven di	гу
рH	Ca	Mg	к	Na	CEC	% BS
6.6	2.2	0.8	0.3	0.1	4.2	81
5.7	0.9	0.1	0.2	0.1	2.4	54
5.8	0.3	0.1	0.1	0.04	1.9	35
6.0	0.1	0.2	0.04	0.1	1.9	35
6.5	0.5	0.2	0.2	0.1	1.2	71
	6.6 5.7 5.8 6.0	pH Ca 6.6 2.2 5.7 0.9 5.8 0.3 6.0 0.1	Exchange E           pH         Ca         Mg           6.6         2.2         0.8           5.7         0.9         0.1           5.8         0.3         0.1           6.0         0.1         0.2	Exchange Data m. soil (105           pH         Ca         Mg         K           6.6         2.2         0.8         0.3           5.7         0.9         0.1         0.2           5.8         0.3         0.1         0.1           6.0         0.1         0.2         0.04	Exchange Data m.e. % consoli (105°C)           pH         Ca         Mg         K         Na           6.6         2.2         0.8         0.3         0.1           5.7         0.9         0.1         0.2         0.1           5.8         0.3         0.1         0.1         0.04           6.0         0.1         0.2         0.04         0.1	Exchange Data m.e. % oven dr           pH         Ca         Mg         K         Na         CEC           6.6         2.2         0.8         0.3         0.1         4.2           5.7         0.9         0.1         0.2         0.1         2.4           5.8         0.3         0.1         0.04         1.9           6.0         0.1         0.2         0.04         0.1         1.9

## TEXTURE

	(b)	
% CLAY	% SILT	% SAND
10.7	4.3	85.0
12.9	2.1	85.0
12.9	2.1	85.0
10.7	2.1	87.2
10.7	2.1	87.2

(b)

			(4	a)			
SAMPLE DEPTH		Exch	ange D soi	ata m. 1 (105		oven di	сy
in cm.	pН	Ca	Mg	к	Na	CEC	% BS
0 - 5	6.2	1.6	0.7	0.2	0.1	4.1	61
15 -35	5.5	0.9	0.4	0.1	0.1	3.6	41
45 -55	5.3	0.7	0.3	0.1	0.1	5.8	19
100 -110	5.2	0.1	0.1	0.03	0.1	1.6	15

Table 8. ANALYTICAL DATA PROFILE Nº 407

TEXTURE

% CLAY	% SILT	% SAND
12.8	6.4	80.8
17.1	4.3	78.6
22.2	5.6	72.2
11.5	1.4	87.1

**(**b)

	(a)						
SAMPLE DEPTH		Exch		ata m. 1 (105		oven di	гу
in cm.	pН	Ca	Mg	ĸ	Na	CEC	% BS
0 - 5	6.1	2.4	0.7	0.1	0.1	4.6	69
10 -20	5.5	1.8	0.5	0.1	0.1	4.1	60
35 -45	5.6	0.9	0.2	0.1	0.2	4.0	33
65 -80	5.5	0.8	0.2	0.03	0.1	2.7	41
100-115	5.7	0.5	0.3	0.1	0.1	1.9	54
150-160	6.6	0.6	0.1	0.03	0.1	1.0	47

Table 9. ANALYTICAL DATA PROFILE Nº 408

TEXTURE

·····	(b)						
% CLAY	% SILT	% SAND					
13.2	5.6	81.2					
13.2	5.6	81.2					
15.6	3.6	80.8					
11.3	5.8	82.9					
11.3	1.5	78.2					
9.2	1.5	89.3					

			(;	a)			
SAMPLE DEPTH		Exch	ange D soi	ata m. 1 (105		oven di	ГУ
in cm.	рH	Ca	Mg	к	Na	CEC	% BS
0 - 5	6.3	4.8	1.4	0.6	0.2	7.3	88
10 -25	6.3	4.4	0.7	0.3	0.1 .	5.5	100
45 -60	6.1	3.5	0.7	0.3	0.2	5.4	83
75 -85	6.2	2.4	0.7	0.3	0.2	5.5	66
100-110	6.1	1.6	0.6	0.2	0.2	3.2	84
120-130	6.3	1.4	0.4	0.2	0.2	2.5	86
		8					

Table 10. ANALYTICAL DATA PROFILE Nº 409

TEXTURE

(b)						
% CLAY	% SILT	% SAND				
17.7	7.9	74.4				
18.9	7.9	73.2				
26.8	7.5	65.7				
20.3	5.4	74.3				
16.1	3.2	80.7				
13.9	1.1	85.0				

(h)

			(a	a)			(a)				
SAMPLE DEPTH		Exch		ata m. 1 (105	e. % c	oven di	гу				
in cm.	рН	Ca	Mg	к	Na	CEC	% BS				
0 - 6	6.8	3.1	0.8	0.3	0.1	4.4	98				
15 - 25	6.8	1.9	0.5	0.2	0.1	3.8	64				
35 - 45	5.9	0.9	0.8	0.2	0.1	2.8	70				
70 - 85	5.9	0.8	0.1	0.1	0.1	3.3	45				
100-115	6.1	2.0	0.4	0.2	0.1	2.8	96				
140-150	6.0	2.2	0.6	0.2	0.1	3.1	93				

Table 11. ANALYTICAL DATA PROFILE Nº 410

TEXTURE

		(6)	
	% CLAY	% SILT	% SAND
		•	
	11.8	7.5	80.7
	16.1	3.2	80.7
	13.9	3.2	82.9
	13.9	3.2	82.9
	13.9	3.2	82.9
	14.6	4.7	80.7
L			

(b)

	(a)						
SAMPLE DEPTH		Exch		ata m. <u>1 (105</u>	e. % c °C)	oven di	гу
in cm.	рH	Ca	Mg	к	Na	CEC	% BS
0 - 4	6.1	1.6	0.7	0.2	0.1	2.7	95
8 - 20	6.1	1.6	0.3	0.1	0.1	2.1	96
25 - 50	6.0	0.8	0.2	0.1	0.04	2.0	56
75. – 90	5.7	0.8	0.1	0.04	0.1	1.5	71
130-140	5.8	0.4	0.2	0.02	0.04	1.0	64
		: • :					

Table 12. ANALYTICAL DATA PROFILE Nº 411

TEXTURE

	(b)	•
% CLAY	% SILT	% SAND
12.4	2.6	85.0
10.3	2.6	87.1
10.2	2.6	87.2
10.3	2.6	87.2
8.1	2.6	89.3

(2)

	(a)								
		APLE PTH		Exch		ata m. 1 (105	e. % c °C)	oven di	гy
	in	cm.	Нq	Ca	Mg	к	Na	CEC	% BS
	0	- 5	5.5	1.9	0.4	0.2	0.1	3.9	69
	8	-20	5.5	1.3	0.4	0.1	0.1	3.6	51
	25	-40	5.5	0.4	0.2	0.1	0.1	2.4	36
	60	-75	6.6	0.5	0.3	0.2	0.2	2.3	45
-	L10-	-120	6.8	0.8	0.3	0.1	0.1	1.4	87
			ж. Т						
L								11.	

Table 13. ANALYTICAL DATA PROFILE Nº 412

TEXTURE

	(D)	
% CLAY	% SILT	% SAND
17.1	4.3	78.6
17.1	8.6	74.3
15.0	8.6	76.4
15.0	8.6	76.4
11.3	5.8	82.9

(b)

			(;	a)			
SAMPLE DEPTH		Exch	ange D	ata m. 1 (105		oven di	гу
in cm.	рH	Ca	Mg	к	Na	CEC	% BS
0 - 3	6.6	3.4	1.3	0.7	0.1	5.5	99
6 -12	6.1	3.2	1.3	0.4	0.1	5.6	90
20 -30	6.4	4.6	1.0	0.6	0.2	7.6	87
40 -50	6.6	3.2	1.3	0.4	0.2	5.8	90
55 -65	6.9	2.8	0.9	0.3	0.2	4.2	99
80 -95	6.8	1.9	0.7	0.2	0.2	3.1	87
115-130	6.7	2.1	0.7	0.2	0.1	3.2	98

Table 14. ANALYTICAL DATA PROFILE Nº 413

TEXTURE

		(Ъ)	
	% CLAY	% SILT	% SAND
	17.8	5.8	76.4
	24.2	5.8	70.0
	26.3	7.9	65.8
	24.2	3.6	72.2
	16.1	4.3	79.7
	13.9	2.1	84.0
L	13.9	2.1	84.0

(h)

_	(a)								
		MPLE PTH		Exch		ata m. 1 (105	e. % c	oven di	гу
		cm.	рН	Ca	Mg	к	Na	CEC	% BS
	0	- 4	6.0	1.1	0.8	0.04	0.1	2.7	77
	8	-20	6.4	0.7	0.4	0.2	0.1	2.1	69
	30	-45	5.9	0.4	0.4	0.1	0.1	1.7	61
	75	-90	5.9	0.2	0.3	0.1	0.1	1.1	56
1	10	-125	6.2	0.4	0.1	0.1	0.1	1.5	42
1	45	-155	5.9	0.7	0.4	0.1	0.1	1.5	89
L									

Table 15. ANALYTICAL DATA PROFILE Nº 414

TEXTURE

·	(b)	
% CLAY	% SILT	% SAND
16.1	2.1	81.8
16.1	4.3	79.7
16.1	4.3	79.7
13.9	2.1	84.0
13.9	2.1	85.0
11.8	2.1	86.1

(b)

(a)							
SAMPLE DEPTH		Exch		ata m. 1 (105		oven di	гу
in cm.	pН	Ca	Mg	к	Na	CEC	% BS
0 - 5	6.2	1.6	.0.6	0.3	0.1	3.0	84
8 -18	5.8	1.3	0.4	0.2	0.1	3.0	65
25 -35	5.8	0.8	0.5	0.1	0.1	2.1	65
45 -60	5.8	0.7	0.5	0.1	0.1	1.8	71
80 -95	6.1	2.5	0.5	0.2	0.2	4.6	75
115-130	6.5	3.5	1.1	0.3	0.1	5.8	87
170-180	6.7	5.9	1.4	0.3	0.4	8.2	97

Table 16. ANALYTICAL DATA PROFILE Nº 415

TEXTURE

	×	(b)	
	% CLAY	% SILT	% SAND
	12.6	3.4	84.0
	16.9	3.4	79.7
	14.8	1.2	84.0
	12.6	1.3	86.1
	16.9	1.3	81.8
•	19.0	7.7	73.3
I	25.5	9.8	64.7

*(*1 )

			(a)									
SAMPLE DEPTH		Exch	ange D soi	ata m. 1 (105		oven di	гу					
in cm.	рH	oH Ca Mg K Na CEC %										
3 - 11	6.2	2.2	0.3	0.3	0.1	3.9	76					
20 -30	6.0	1.0	0.4	0.1	0.1	2.3	74					
40 -50	5.7	0.7	0.4	0.3	0.1	3.0	47					
70 -85	5.4	1.4	0.3	0.2	0.1	3.7	70					
100-115	5.4	0.7	0.3	0.2	0.04	4.4	34					
160-170	5.8	0.9	0.2	0.1	0.1	2.1	63					
			2									

TEXTURE

	(b)	
% CLAY	% SILT	% SAND
14.8	3.4	81.8
16.9	3.4	79.7
21.2	7.7	71.1
21.2	7.7	71.1
19.0	3.4	77.6
14.8	1.7	83.5

#### RESULTS AND DISCUSSION

Tables 18 and 19 show the results of the soil classification and the capability groups of the soils.

#### Pedon 400

This pedon is classified as fine loamy, mixed, hypethermic Aquic Udipsamments. The color of this pedon goes from dark brown to reddisn grey. Its texture, from sandy loam to coarse sandy loam, with a particle size distribution of 19.6 percent of clay, 73.87 percent of sand, and 6.53 percent of silt. It is structureless, very friable, with roots until about 75 cm, some mottles and a drainage somewhat imperfect due to the presence of the water table at that depth.

The range of pH values is from 6.1 to 6.4, decreasing with depth. There is no problem of salinity (EC from 0.004 to 0.018 mmhos  $\times 10^{-3}$ ).

Cation Exchange Capacity (CEC) values are very low through the profile. The values range from 1.7 to 3.2 me/100 g decreasing with depth. Base saturation of the samples ranges from 40 to 95 percent, and the exchangeable complex is dominated by calcium.

This soil occurs on a gently undulating topography. It has an udic moisture regime, and a hypethermic temperature regime.

#### Pedons 402, 411

These pedons are classified as sandy, mixed, hypethermic, Typic Ustipsamments. They are loamy sand textured soils, with a clay content of 9.5 to 13.8 percent, sand content of 83.7 to 87.9 percent, and 2.5 to 2.6 percent of silt. They are largely structureless, very

	Soil class	ification	
Pedon No.	Family	Subgroup	Order
400	Fine loamy, mixed, hypethermic	Aquic Udipsamments	Entisol
401	Sandy, mixed, hypethermic	Aquic Ustifluvents	Entisol
402	Sandy, mixed hypethermic	Typic Ustipsamments	Entisol
403	Sandy, mixed, hypethermic	Typic Ustifluvents	Entisol
404	Sandy, mixed, hypethermic	Aquic Ustipsamments	Entisol
405	Sandy, mixed, hypethermic	Aquic Ustifluvents	Entisol
406	Sandy, mixed, hypethermic	Aquic Ustisamments	Entisol
407	Sandy, mixed, hypethermic	Aquic Ustifluvents	Entisol
408	Sandy, mixed hypethermic	Aquic Ustifluvents	Entisol
409	Fine loamy, mixed, hypethermic	Fluventic Haplustolls	Molliso
410	Sandy, mixed, hypethermic	Aquic Ustipsamments	Entisol
411	Sandy, mixed, hypethermic	Typic Ustipsamments	Entisol
412	Sandy mixed, hypethermic	Aeric Fluvaquents	Entisol
413	Fine loamy, mixed, hypethermic	Typic Ustifluvents	Entisol
414	Sandy, mixed, hypethermic	Typic Ustifluvents	Entisol
415	Sandy, mixed, hypethermic	Typic Ustifluvents	Entisol
416	Fine loamy, mixed, hypethermic	Typic Ustifluvents	Entisol

Table 18. Soil classification of the 17 pedons\*

\*Soil Survey Staff, 1975

Pedon	No.	Capability unit
400		IIIw-2
401		IIIw-2
402		IIe-4
403		IIe-2
404		IIw-4
405		IIW-2
406		IIw-4
407		IIIw-2
408		IIw-2
409		IIw-2
410		IIw-4
411		IIe-4
412		IIIw-2
413		IIIe-2
414		IIe-2
415		IIe-2
416		IIe-2

Table 19. Capability groups of the soils\*

\*Soil Conservation Service, USDA Agr. Handbook 210, 1961. Reprinted 1973. friable. The pH values range from 5.7 to 7.7 decreasing with depth.

CEC range is from 1 to 9.9 me/100 g. Base saturation values range from 64 to 98 percent. The cation exchange complex is dominated by calcium.

Electrical conductivity is very low, showing no salinity problems.

The water table was not seen in the examined horizons. These soils occur on nearly level to gently undulating slopes, and are well drained. They have an ustic moisture regime, and hypethermic temperature regime.

#### Pedons 404, 406, 410

These pedons are classified as sandy, mixed, hypethermic, Aquic Ustipsamments and have sandy loam textures. Particle size distribution shows the clay content ranges from 11.4 to 13.9 percent with high sand content, 82.9 to 86.4 percent, and a very low silt content, 1.5 to 3.2 percent. Their structure is weakly developed, fine to medium crumb to blocky, breaking to single grains. They are very friable with a high water table (about 30 cm depth) showing faint to reddish yellow mottles. The pH values range from 5.2 to 6.8 decreasing with depth.

CEC values are very low, from 1.2 to 4.4 me/100 g. Base saturation in the top 10 cm is high (81-98%) deeper it changes abruptly, with values that range from 23 to 64 percent. These soils are moderately to well drained and occur on nearly level slopes.

#### Pedons 413, 416

These pedons are classified as fine-loamy, mixed, hypethermic, Typic Ustifluvents. These soils are light colored, reddish brown to yellowish red. Pedon 413 is too light in color and too thin to be a mollic epipedon. The base saturation is too high (87-98% to be an umbric epipedon.

Pedon 416 does not have such a high base saturation, but it is structureless, therefore the epipedon is ochric. Their particle size distribution shows high sand and clay values, being not coarse enough to be classified as Psamments.

For both soils CEC values range from 2.1 to 7.6 me/100 g. They do not show salinity problems, and have pH values from 5.4 to 6.8. They occur on a nearly level to gently undulating topography, and their drainage is from moderate to well. They have an ustic and hypethermic moisture and temperature regime, respectively.

#### Pedons 403, 414, 415

These pedons are classified as sandy, mixed, hypethermic, Typic Ustifluvents. These soils are deep and brown-reddish colored, mostly structureless, very friable, loamy sand textures, sand percent ranges from 82.5 to 83.9 percent, clay values from 13 to 14.8 percent, and silt values from 1.27 to 4.10 percent.

The water table is present at about 100 cm, mottles and "Mn" concretions are shown at that depth. The pH values range from 5.8 to 7.7 decreasing with depth. CEC values range from 1.8 to 8.2 me/100 g and calcium is the dominant cation. They apparently do not have salinity problems. They occur on nearly flat to gently undulating topography and they are moderate to well drained, with an ustic moisture regime and hypethermic regime.

#### Pedons 401, 405, 407, 408

These pedons are classified as sandy, mixed, hypethermic, Aquic Ustifluvents. These soils are mostly the same as those described above; with the difference that the soils have a high water table, about 30 cm, showing strong brown to reddish brown mottles and "Mn" concretions at that depth.

#### Pedon 409

This pedon is classified as fine-loamy, mixed, hypethermic, Fluventic Haplustolls. This soil is moderately deep, has high base saturation (66-100%), dark colored, with very weakly developed medium granular structure, breaking to single grains, sandy loam to sandy clay loam texture, 21 percent clay, 73.6 percent sand, and 5.4 percent silt. It is very friable, with abundant roots, assuming it has enough organic matter content to be a mollic epipedon. The pH values range from 6.1 to 6.3, EC is very low, less than 0.054 mmhos x  $10^{-3}$ .

From the analytical data this soil appears to be only very weakly leached, with CEC values from 2.5 to 7.3 me/100 g. Calcium is the dominant cation in the exchange complex.

This soil occurs on a nearly flat slope and is moderately well drained. It has ustic and hypethermic moisture and temperature regimes, respectively.

The water table is at 40 cm, showing yellowish red mottles and some "Mn" concretions.

#### Pedon 412

This soil is classified as sandy, mixed, hypethermic, Aeric Fluvaquents. This soil is deep and occurs on a level slope. Particle size distribution show high sand content (74.3-82.9%) 11.3 to 17.1 percent of clay, and about 7.7 percent of silt. Its structure is from very weakly developed, fine blocky to structureless. It is very friable and has a pH value that is the same for the first 40 cm, 5.5, and then increases with depth up to 6.8. This soil does not have salinity problems.

This soil appears to be moderately weathered, the analytical data would indicate that this soil is only weakly leached. CEC values range from 1.4 to 3.9 me/100 g. Calcium is the dominant cation in the exchangeable complex. To a depth of 20 cm, this soil begins to show reddish brown mottles, the water table is found at 90 cm.

#### ENGINEERING CLASSIFICATION OF THE SOILS

Two classifiction systems were used: UNIFIED system, based on the particle size distribution, plasticity index, liquid limit, and organic matter content. There are 15 classes (GW, GP, GM, GC, SW, SP, SM, SC, ML, CL, OL, MH, CH, OH, and PT), and we might have a combination of them. Example: SM-SC. This system is used by the Soil Conservation Service Engineers, the Department of Defense and others (American Society for Testing and Materials, 1974). The other system is AASHTO (American Association of State Highway [and Transportation] Officials, 1970). It classifies the soil according to those properties that affect use in highway construction and maintenance. There are 7 classes, from A-1 to A-7. Also, here, we might have a combination of those. Example: A-2-4. This system has been adopted by the American Association of State Highway Officials.

#### ENGINEERING INTERPRETATIONS

After estimating the engineering properties for each pedon, interpretations were made, rating the soils based on how favorable their properties are for their rated use. Tables 20 to 36 are an adaptation of Standard Soils Conservation Service Form 5.

The soil limitation ratings are:

- Slight; soil properties favorable for their rated use. Limitations, easy to overcome or modify.
- Moderate; soil properties somewhat unfavorable for the rated use. Limitations more difficult to overcome or modify.
- Severe; soil properties unfavorable for the rated use.

Limitations too difficult to overcome or modify.

The soil suitability degrees are: good, fair, and poor. Their meanings are similar to those for the soil limitation ratings.

#### SUMMARY AND CONCLUSIONS

To write this report, I obtained the profile descriptions (field morphology) and the analytical tables of the soils from the report made by T. T. Cochrane, a British adviser in Tropical Agriculture in 1968. With these data and information acquired by a review of the literature, the classification was made on the 17 selected soils at the family level (Table 18) according to Soil Taxonomy (Soil Survey Staff, 1975). The following interpretations were then made:

- Table 19, fit the soils into a capability group, according to their characteristics.
- Tables 20-36, show the engineering classification and interpretations for each of the studied pedons.

If more information about Bolivia had been available, the written part of this report could have been more precise and complete. These soils are sandy, wet soils of a tropical region, with a good potential for cultilvation with moderate management practices. Table 20, Soil properties and interpretations for pedon 400

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SOIL PROPERTIES AND INTERPRETATIONS

Pedon Nº 400 Soi	l Classification Fir	e loamy, hypethern	nic Aquic Udipsamm	ents				
	,	ESTIMATED EN	GINEERING PROP	ERTIES				
20- 30 Sand (2.4% cla	USDA TEXTURE Loamy sand (13-15% clav) av) Loam-coarse sandy clay 1	GP	IFTED AASIIO FRAC SC A-2,A-4 0 or GW A-1 0 I-SC A-2,A-4 0	1 PERCE THAN ) 4 100 100 100	15-20 80-85	200 LT 15-20 20 0 -5 N	-25 5-10	15,- 25
			· · · · · · · · · · · · · · · · · · ·		1			
DEPTH (CM) (CM) (CM) (CM/CM) (CM/CM) (CM/CM) (CM/CM) (CM/CM)	(pH) (PCT) 6.1-6.5 0.1-0.2	SALINITY FROST ACTION NA NA	POTENTIAL	BLE 1	R TA- HYD. DEPTII M) GRP 45 B	WIND EROSION GROUP 3	· · · · · · · · · · · · · · · · · · ·	
20-30 0.03 50-140 0.11	6.1 $0.1-0.46.1$ $0.4$	NA NA NA NA	low					
	TIONS OF SOIL LIM	ITATION RATINGS	& DOMINANT SOI	L FEAT	URES AFFEC	TING USE	FOR	
SEPTIC TANK ABSORTION FIELDS	SEWAGE LAGOONS	TRENCH TYPE SANITARY LANDFILI	AREA TYP S SANITARY LAND	E	COVER AREA SANITARY L	TYPE	SHALLOW	EXCAVATIONS
	Severe; depth to wa-				Fair			seasonal
table	ter table, permeabi-	seasonal water ta	- seasonal wate	r ta-			water tab	ole.
	lity	ble	ble			e e		
DWELLINGS	DWELLINGS	LOCAL ROADS		S	UTABILITY A		RCE OF	
WITHOUT BASENENTS	WITH BASEMENTS	AND STREETS	ROADFILL		SAND AND GI	RAVEL	TOPSO	ц
Severe; seasonal wa-	Severe; seasonal water	Slight	Good		Good	ж.	Poor; text	ture
ter table	tablé					2		
						2		• •
	RECREATION USE LIM	ITATION FOR					DLIFE HAB	
CAMP AREAS	PICNIC AREAS	PLAYGROUNDS	PATH AND TR	ALLS	Open Land 1	backhool	wetland	Rangeland_
Moderate; texture	Moderate; texture	Moderate; textur	e Moderate; te	xture	NR	41 -	NR	
		1. y			с			

Table 21. Soil properties and interpretations for pedon 401

SOIL PROPERTIES AND INTERPRETATIONS

Pedor	N° 401 Soi	l Classific	ation San	dv, mixed	, hvpeth	nermic	Aquic Us	tifluv	vents							
			4	ESTIMA	TED E	NGINE	EERING	PROPE	RTIES							
DEPTH (СМ) 0 -45	Sandy loam (1		TURE			NIFIED SM-SC SM-SC	) AASIIO A-2 A-2	FRACT	PERCENTUAN 4 100	NT OF CY 10 100		200	LIMIT 20-25	INDEX	PERMEAB (CM/) 2.5 - 5	HR)
60-110	Sandy loam (1	5.2% clav)				SM-SC	A-2	0	100	100	52-54	81.8	20-25	5-10	5 -15	
											;					
			<u></u>	T	1							1				
DEPTH (CM)	AVAILABLE WATER CAPACIT (CM/CM) 0,11	(Hg)	EXCH. SODIUM (PCT)	SALINITY	POTENT FROST ACTION		IRINK - SU POTENT:		WATEI BLE I	r та- Deptii 4) 55	HYD. GRP	WIND EROSIO GROUP	N			
0 - 45 60 - 110	$\frac{0.11}{0.11}$	6.1-6.5	0.1-0.2	NA NA	NA NA		Low			55	<u>.</u> B	3				
00 110						14						,				
l			•			·										
	INTERPRETAT	TIONS OF SO	IL LIM	ITATION	RATING	SGI	OMINANT	SOIL	FEAT	URES	AFFEC	TING	JSE FC	8		
ABSORT	TON FIELDS	SEWAGE LAG	OONS	TRENCH SANITARY		LLS	ARE! SANITARY	LANDF	ILLS	SAN	R AREA ITARY L	TYPE ANDFILL	s	SHALLOW	EXCAVAT	TONS
1	e; depth to wa-	Severe; dep	th to wa-	Severe;	depth (	to	Moderat	e			Fair		Se	vere; s	seasonal	wa-
ter t	able	ter table		water t	able								te	r table	2	
				×											-	
	WELLINGS	DWELLING		LOCAL		-			SI		TLITY	the second second	SOURCE			
WITHO	OUT BASENENTS	WITH BASEME	NTS	AND ST	REETS		ROADI	TLL_		SAN	D_AND_G	RAVEL		TOPSO	ĮI,	
Severe	; depth to wa-	Severe; dep	th to wa-	Sl	ight		Good			2 A	Good		2	Good	1	•
ter ta	able	ter table														
				• • •												·
	÷															
		RECREATION		ITATION	1.03						OTENTIA				ITAT Rangel:	and
CAMP	AREAS	PICNIC ARE	AS	PLAYG	RCUNDS_		PATH ANI	) <u>TPA</u>	<u>11.5</u>	Open	land	Mood Lan	d we	Land	Kangela	and
Modera	ate; wetness	Moderate; w	etness	Moderat	e; wetn	ess	Moderate;	wetne	ess		NR			N	ર	
				1.4												
												250				- 1
											•					

Table 22. Soil properties and interpretations for pedon 402

SOIL PROPERTIES AND INTERPRETATIONS

Pedon 3° 402 Soi	l Classification Sa	any mixed hypet										
						RTIES						
DEPTH (CM) 0-25 Loamy sand (9, 35-120 Loamy sand (1)	USDA TEXTURE 9-11.7% clay) 3.8% clay)	l	NIFIE SM SM	AASHO A-2-4 A-2	(PCT)	PERCEN THAN 4 100 100	T OF C1 P 10 100 100	4()	AL LESS SIEVE 200 0 10-15 5 15-20	NP	PLAS- TICITY INDEX	PERMEABILIT
							i					
DEPTH AVAILABLE WATER CAPACIT	SOIL         EXCH.           Y         REACTION         SODIUM           (pH)         (PCT)           7.4-7.8         0.3	SALINITY FROST ACTION NA NA		HRINK - SU POTENT	IAL	WATER BLE 1	DEPTH	HYD. GRP	WIND EROSIO GROUP			
35-120 0.11	6.6-7.5 0.1	NA NA	•	Low								
	TIONS OF SOLL LIM	ITATION RATING	ss a	DOMINANT	SOIL	FEAT				ISE FO	OR	
SEPTIC TANK ABSORTION FIELDS	SEWAGE LAGOONS	TRENCH TYPE SANITARY LANDFI	LLS	ARE. SANITARY	LANDE	ILLS	COVER SANI	AREA	TYPE ANDFILL	s	SHALLOW	EXCAVATIONS
Moderate; depth to	Moderate; permeabili-	Moderate; textu	ire	S1:	lght			Fa	ir		Severe;	texture
water table	ty										,	
DWELLINGS	DWELLINGS	LOCAL ROADS				SI	ITABI	LITY	AS A	SOURCE		
WITHOUT BASENENTS Slight	WITH BASEMENTS Slight	AND STREETS Slight		ROAD	ood		SAND	<u>AND G</u> Good		P	TOPSC oor; te	-
												4
	RECREATION USE LIN	ITTATION FOR							I. AS			
CAMP AREAS	PICNIC AREAS	PLAYGROUNDS		PATH AN	) TPAL	U.S	Openl	and	Kood Lan	d we	tland	Rangeland
Moderate; texure	Moderate; texture	Moderate; textu	ire	Moderat	e; text	ture		NR			N	R
•												

.

## Table 23. Soil properties and interpretations for pedon 403

SOIL PROPERTIES AND INTERPRETATIONS

Pedo	on №° 403 Soi	l Classific:	ation sa	andy, mixe	d, hyp		nic Typic			s						
				ESTIMA	TED E	ENGINE	EERING	PROPE	RTIES							
DEPTH (CM)	-	USDA TEX	TURE		U	INIFIED	AASHO	FRACT	PERCEN THAN 4	T OF C1 F 10	MATERI PASSING 40	AL LESS SIEVE	LIQUID	PLAS- TICITY INDEX	PERMEAB (CM/	(HR)
0-45	Loamy sand - Sa O Sandy loam (13.		13.4% clay	2)		SM SM	A-2, A-4	()	100	100	84	16	NP		$\frac{5 - 15}{5! - 15}$	
					×											
	AVAILABLE	SOIL	EXCH.	1	POTENT	TAT			WATER			WIND				
DEPTH (CM)	WATER CAPACIT		SODIUM (PCT)	SALINITY	FROST	r   .	RINK - SV POTENTI		BLE I	DEPTH	HYD. GRP	EROSIO	N			
0 - 4 70-17	5 0.11 0 0.11	7.5-7.7	0.2-0.3	NA NA	NA		Low			110	Α	2				
									1.							
	INTERPRETA	TIONS OF SO	TL LIM	ITATION	RATING	S & I	OMINANT	SOII	FEAT	URES	AFFE	CTING L	JSE F	OR		
ABSO	SEPTIC TANK RTION FIELDS	SEWAGE LAG		TRENCH SANITARY	LANDFI	LLS	AREA SANITARY	A TYPE LANDF	ILLS	COVEI	R AREA	A TYPE CANDFILL	s		EXCAVAT	TONS
Seve	re; depth to wa-	Severe; per	meability	Severe;				Moderate; permeabili-				.r	Мо	derate;	seasona	1 wa-
ter	table			seasonal water ta-			ty							r table		
				ble			,						· .			
	DWELLINGS	DWELLING		LOCAL		-			Si		ILITY		SOURCE	TOPSO		
WITH	HOUT BASENENTS	WITH BASEME	NTS	AND ST	REETS		ROADI	FILL_		SAN!	AND (	RAVEL.			11.	
	Slight	Moderate; se	asonal	Slig	ht .		Go	bod		- 19	Good		P	oor; te	xture	
- 5		water table	,	v.		- 2							18			
						:										
		RECREATION	USE LIN	TTATION	FO3	ł.					TENTI			FE HAP		
CAM	P AREAS	PICNIC ARE			RCUNDS		PATH ANI	D TPA	11.5	Open	land	Moodlan	d we	tland	Rangel	and
Mode	rate; texture	Moderate; te	xture	Moderate	; textu	ire	Moderate;	; text	ure		NR			N	R	in the

Table 24. Soil properties and interpretations for pedon 404

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SOIL PROPERTIES AND INTERPRETATIONS

Pedon N°404 Soi	l Classifica	ition s	andy, mixe	ed, hypet	hermi	ic Aquic	Ustip	samment	8						
			ESTIMA	TED EN	GINE	ERING	PROPE	ERTIES					-		
DEPTH ((M) 0-50 Loamy sand-san 70-140 Loamy sand (9.	USDA TEX dy loam (14 - 6-11.8% clay)	TURE 16% clay)			IFIED SM SM	AASHO A-2,A-4 A-2		PERCEN THAN 4 100 100	T OF CM 10 100 100	MATERI. PASSING 40 82-85 87	AL LESS SIEVE 200 15-18 13	LIQUID LIMIT NP NP	PLAS- TICITY INDEX 	PERMEA (CM <u>5 -</u> .5 -	(HR)
										<u>-</u>					
DEPTH (CM) (CM) (CM/CM) (CM/CM) (CM/CM)	(pH)	EXCH. SODIUM (PCT) 0.04-0.1	SALINITY	POTENTIA FROST ACTION NA	<sup>AL</sup> SH	RINK - SW POTENTI Low		WATER BLE I	DEPTH	HYD. GRP	WIND EROSIQ GROUP	N			6
70-140 0.08	5.6-6.5	0.04-0.1	NA NA	NA		Low			50						
					•				····						
INTEDDETA	TIONS OF SOT	T ITM	ITATION	PATINCS		ONTRANT	SOTI	EFAT	UDEC	ATTEC	TINC	19 8 121	) F		
SEPTIC TANK ABSORTION FIELDS	SEWAGE LAGO		TRENCH			AREA SANITARY	TYPE			R AREA ITARY L			SHALLOW	EXCAVA	TIONS
Severe; depth to wa-	Severe; dept	h to wa-	Severer	e; depth	to	Modera	te		2	Fair			Severe;	texture	, és
ter table	ter table, p	permeabili	seasona	l water t	a-										
	ty		ble								÷	,			
DWELLINGS	DWELLINGS		LOCAL		-	DOADI		SI		TI ITY D AND G	<b>A.I.</b>	SOURCE			
WITHOUT BASENENTS	WITH BASEMEN	NTS	AND ST	REETS		ROADI			SAN	D AND G	RAVEI.				
Moderate; depth to	Severe; dept	th to wa-	Sli	ght		Goo	d			Good	l	P	oor; te	ture	. :
water table	ter table													-	
						-									
	RECREATION		TATION	FOR		PATH ANI		TIS		OTENTIA Land	L <u>AS</u> Voorilan	WILPIT	tland	Range	land
CAMP AREAS	PICNIC AREA	AS	PLAYG	RCUNDS		FAIH ANI	1.124		lopen.	100	soon Lan	a _ * s	<u>, , , , , , , , , , , , , , , , , , , </u>		
Moderate; texture,	Moderate; te	exture,	Moderate	; texture	,	Moderate	; tex	ture,		NR			N	2	
wetness	wetness		wetness			wetness									
	2										•	1			

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Table 25. Soil properties and interpretations for pedon 405

SOIL PROPERTIES AND INTERPRETATIONS

Pedon N° 405 Soi	l Classification sa	andy, mixed, hyper	thermi	ic Aquic (	Jstifl	uvents						
		ESTIMATED EN	NGINE	EERING	PROPE	ERTIES						
DEPTH (CM) 0-50 Sandy loam (14- 70-85 Loamy sand (10) 120-135 Sand (6.4% clay	.7% clay)		NIFIEL SM SM SP,SM	A-2-4 A-2-4	FRACT (PCT) () () () ()	PERCENTHAN 4 100 100 100	NT OF 10 10 100 100 100	MATERI ASSING 40 81-83 87 92		LIWI.	TINDEX	(CM/HR)
DEPTH         AVAILABLE           (CM)         WATER CAPACIT           0-50         0.11           70-85         0.11           120-135         0.08	SOIL         EXCH.           REACTION         SODIUM           (pH)         (PCT)           5.6-6.5         0.1           5.7         0.1           6.3         0.1	SALINITY FROST ACTION NA NA NA NA NA NA	1 31	IRINK - SV POTENT: Low Low Low		BLE I	DEPTH	HYD. GRP B	WIND EROSIO GROUP 3	N		
INTERPRETA SEPTIC TANK ABSORTION FIELDS	TIONS OF SOIL LIM SEWAGE LAGOONS	ITATION RATING TRENCH TYPE SANITARY LANDFII		DOMINANT ARE SANITARY	A TYPE		URES COVER SANI	AFFE AREA TARY L	CTING U TYPE ANDFILL	ISE F		V EXCAVATIONS
Severe; depth to wa- ter table	Severe; depth to wa- ter table, permeabili ty	Severe; depth t - seasonal water ble		Modera lity	te; p	ermeabi	Poor	r; text	ture	1	Severe;	texture
DWELLINGS	DWELLINGS	LOCAL ROADS	-			S		LITY		SOURC	E OF	
WITHOUT BASENENTS Moderate; depth to water table	WITH BASEMENTS Severe; depth to wa- ter table	AND STREETS		<u>ROADI</u> Go	od		SAND	Good	*****	P	oor; te:	xture
	RECREATION USE LIN	TTATION FOR					PO	TENTI	L AS			
CAMP AREAS	PICNIC AREAS	PLAYGRCUNDS		PATH ANI	TPA	TLS	Open1	and	Moodlan	d w	etland	Rangeland
Moderate; wetness	Moderate; wetness	Moderate; wetne	ss	Moderate	; wetr	ness		NR		2	· NI	R
			-									

Table 26. Soil properties and interpretations for pedon 406

SOLL PROPERTIES AND INTERPRETATIONS

Pedon N° 406 Soi	l Classification sar	dy, mixed, hype	thermic	Aquic Us	stisam	nents_						
		ESTIMATED	ENGINE	ERING	PROPE	ERTIES						
DEPTH (CM) 0-115 Loamy_sand (11	USDA TEXTURE -13% clay)		UNTFIED	D AASHO (PČT) 4			10	4()	AL LESS SIEVE 200 7 13-15	LIMIT	PLAS- TICITY INDEX	PERMEABILITY (CM/HR) 5 - 15
DEPTH (CM) U-115 (CM) (CM) (CM/CM) U-115 (CM/CM)	Y SOIL EXCH. REACTION SODIUM (pH) (PCT) 5.7-6.6 0.1	SALINITY FROS ACTIO NA NA	T SIL	RINK - SU POTENT: Low		WATEF BLE I (C)	DEPTH	IYD. GRP B	WIND EROSIO GROUP 2	N		
INTERPRETA SEPTIC TANK ABSORTION FIELDS Severe; depth to wa- ter table	TIONS OF SOIL LIM SEWAGE LAGOONS Severe; depth to wa- ter table, permeabili-	ITATION RATIN TRENCH TYPE SANITARY LANDF Severe; depth seasonal water	to 1	OMINANT ARE/ SANITARY Moderate seasonal	A TYPE LANDF ; dept	TLLS h to	URES COVER SANIT	AFPEC AREA FARY L Fair	TYPE	.s S	SHALLOW	EXCAVATIONS depth to water table,
DWELLINGS	ty DWELLINGS	ble, permeabil					ITTABTI	TTV	AS A	, t	OF	
WITHOUT BASENENTS Severe; depth to wa÷	WITH BASEMENTS	AND_STREETS		ROADI			SAND	AND G			TOPSÇ oor; te	
ter table	ter table					^						•
and a local sector of the sect		TATION FOR							L AS			
CAMP AREAS Severe; wetness	PICNIC AREAS	PLAYGRCUNDS Severe; wetnes		PATH ANI Severe; v			<u>Open L</u>	NR	Noodlan		<u>tland</u> NR	Rangeland

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Table 27. Soil properties and interpretations for pedon 407

Pedon N°407 Soi	l Classification s	SOIL PROPERTIE										
	1 01233111020101 5				PROPE				*****		1.57	
DEPTH (CM) 0-35 Sandy loam (13 45-55 Sandy clay (22			UNIFIEI SM SC	D AASHO A-2-4 A-7	FRACT S CM (PCT) 0	PERCENT THAN 4 100 100	NT OF 1 CM P 10 100 100	MATERI ASSING 40 80 72	AL LESS SIEVE 200 20 20 20	LIQUID LIMIT 20-25 20-25	PLAS- TICITY INDEX 5-10 5-10	PERMEABILIT (CM/HR) 5 - 15 2.5- 5
DEPTH (CM) 0-35 AVAILABLE WATER CAPACIT (CM/CM) 0.11	SOIL         EXCH.           REACTION         SODIUM           (pH)         (PCT)           5.5-6.2         0.1	SALINITY FROS ACTIO		IRINK - S POTENT Low		WATE BLE (C)	DEPTH	HYD. CRP B	WIND EROSIO GROUP	N	· · ·	
45-55 0.08	5.3 0.1	NA NA		Low								
	<u> </u>	Ll	·			1						
INTERPRETA SEPTIC TANK ABSORTION FIELDS		TRENCH TYPE SANITARY LANDF	GS & I	ARE.	A TYPE		COVER	ARFA	TYPE			
ABSORTION FIELDS	SEWAGE LAGOONS	SANITARY LANDF	·	SANITARY	LANDF	LLS	SANI	TARY L.	ANDFILL	, <u>S</u>	SHALLOW	EXCAVATIONS
Severe; depth to wa-	Severe; depth to wa-	Severe; depth	to	Moderate	; perma	eabili		Fair		S	evere;	depth to
ter table	ter table, permeabili	seasonal water	ta-	ty		÷.,	3.			S	easonal	water table
	ty	ble								i.		
DWELLINGS	DWELLINGS	LOCAL ROADS	-			SI		LITY		SOURCE		
WITHOUT BASENENTS	WITH BASEMENTS	AND STREETS		ROAD	FILL		SAND	AND G	RAVEI.		TOPSO	utt
Severe; seasonal wa-	Severe; depth to wa-	Slight		Go	od			Good			Good	t i chia
ter table	ter table											
	RECREATION USE IT	ITISTION FOR					PO	TENTIA	. AS	WILDLI	FE HAB	ITAT
CAMP AREAS	PICNIC AREAS	PLAYGROUNDS		PATH AN	)TPAI	LS	Open 1	and	loodlan	d we	tland	Rangeland
Moderate; wetness	Moderate; wetness	Moderate; wetr	ness	Moderate	; wetno	ess		NR			N	IR
		· · ·					w.		•			

SOIL PROPERTIES AND INTERPRETATIONS

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Table 28. Soil properties and interpretations for pedon 408

SOLL PROPERTIES AND INTERPRETATIONS

Pedor	n №° 408 Soi	1 Classific	ation s	sandy, mix	ked, hvr	petherm	ic Aqui	c Ustin	fluvent	.s					
				ESTIMA	TED E	ENGINE	ERING	PROPE	RTIES						
DEPTH (СМ) 0-115	Sandy loam (1)	USDA TEX [-15% clay]	TURE			INIFIED SM	AASHO A-2-4	FRACT SCM (PCT)	PERCEN THAN 4 100	VT OF CM 10 100	MATERI PASSING 40 78-8	AL LESS SIEVE 200 3 17-22	LIMIT	INDEX	$\frac{(CM/HR)}{5 - 15}$
												-			
DEPTH (CM) 0-115	AVAILABLE WATER CAPACIT (CM/CM) 0.11	SOIL REACTION (pH) 5.5-6-1	EXCH. SODIUM (PCT) 0.1	SALINITY NA	POTENT FROST ACTION		RINK - S POTENT Low		WATE BLE I	DEPTH	HYD. GRP B	WIND EROSIQ GROUP	N		
		5.5 0-1					10*								
	INTERPRETA	TIONS OF SO	IL LIM	ITATION	RATING	S & D	OMINANT	SOIL	. FEAT	URES	AFFEC	TING	JSE FO	R	
ABSORT	EPTIC TANK TION FIELDS	SEWAGE LAG	OONS	TRENCH SANITARY	LANDFI	ILLS	ARE SANITARY	A TYPE LANDF	ILLS	SAN	R AREA ITARY L	ANDFILL	s	SHALLOW	EXCAVATIONS
Sever ter t	e; depth to wa-	Severe; dep					Moderate ty	; perm	eabili		Fa	ir			lepth to water table
Ler L	adie	ty	permeabi	ble	L WALEI	La	Ly			a de la compañía de l					
	WELLINGS	DWELLING	-	LOCAL		_			SI		ILITY		SOURCE		
WITHO	OUT BASENENTS	WITH BASEME	NTS	AND ST	REETS		ROAD	FILL		SAN	AND G	RAVEL		TOPSO	)II
Moder	ate; depth to	Severe; dept	th to wa-	Sligh	nt		Goo	d			Good			Good	ı .
water	table	ter table									Ŧ				
		RECREATION	USE LTN	ITTATION	FOR					P	TENTA	1 19	UTIDIT		TT AT
CAMP		PICNIC ARE			RCUNDS	100	PATH AN	D TPA	ILS	Open	land	doodlan	d we	tland	Rangeland
Modera	te; wetness	Moderate; we	etness	Moderate	; wetne	SS	Moderate	; wetr	iess	- 2016	NR			NF	R

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Table 29. Soil properties and interpretations for pedon 409

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SOIL PROPERTIES AND INTERPRETATIONS

Pedon N° 409 Soi	l Classification f:	ine loamy, mixed	d, hype	thermic.	Fluver	ntic Ha	plust	olls			
		ESTIMATED			PROPE	RTIES					
DEPTH (CM) 0-25 Sandy loam (187 45-60 Sandy clay loam 75-130 Sandy loam (14-	n (27% clay)		UNIFIE SM-SC SC SM-SC	AASHO A-2 A-2-6 A-2	0	PERCEN THAN 4 100 100 100	10 100 100 100	4() 74 66 75-8	26	IQUID TICI LIMIT 25-30 30-35 10-1 20-30 5-10	PERMEABILIT           X         (CM/HR)           5         -           5         1.5
DEPTH         AVAILABLE           UATER         CAPACIT           (CM)         (CM/CM)           0-25         0.11           45=60         0.17           75-130         0.11	SOIL         EXCH.           Y         REACTION         SODIUM           (pH)         (PCT)           6.3         0.1           6.1         0.2	SALINITY FROS ACTIC NA NA NA NA NA NA	ST ST	IRINK - SV POTENTI Low Low Low	AL	WATEF BLE I	қ та- рертн		UIND EROSION GROUP 3		
INTERPRETAT SEPTIC TANK ABSORTION FIELDS	FIONS OF SOIL LIM SEWAGE LAGOONS	ITATION RATIN TRENCH TYPE SANITARY LANDF	TILLS	AREA SANITARY	LANDF	FEAT	URES COVE SAN	R AREA ITARY I	TYPE ANDFILLS	SHALLO	DW EXCAVATIONS
Moderate; depth to water table	Moderate; depth to water table	Moderate; permo	eabili-	51	ight			Fair	c		e; depth to 1 water table
DWELLINGS	DWELLINGS	LOCAL ROADS				SI	ITTAB	TLITY	AS A SI	OURCE OF	
WITHOUT BASENENTS	WITH BASEMENTS	AND_STREETS		ROADI			SAN	D AND C	RAVEL		SQIL
Slight	Moderate; depth to water table	Slight		Good				Good		G	boo
	RECREATION USE LIN	ITATION FOR					P	OTENTIA		ILDITER !!	
CAMP AREAS	PICNIC AREAS	PLAYGROUNDS	·	PATH ANI	TPA	ILS	Open	land	Wood Land	wetland	Rangeland
Slight	Slight Slight			Sligh	t			NR			NŖ
									•		

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Table 30. Soil properties and interpretations for pedon 410

SOLL PROPERTIES AND INTERPRETATIONS

Pedor	N° 410 Sol	1 Classific.	ation sa	andy, mixe	d, hypether	mic, Aqui	c Ustip	samment	s_						
				ESTIMA	TED ENGI	NEERING	PROP	ERTIES							
DEPTH (CM) 0-25 35-150	Fine sandy loam Loamy sand (14%	USDA TEX 1 ( 12-16% cla 2 clay)	TURE y)	•	UNIFI SM SM	A-4	- ()	PERCE THAN 4 100 100	NT OF 3 CM 10 100 100	40	AL LESS SIEVE 200 3 17-20 17	LIMIT	INDEX	(0	ABILITY M/HR) -2.5 - 15
										;					
DEPTH (CM) 0-25 35-150	AVAILABLE WATER CAPACIT (CM/CM) 0.17 0.11	SOIL REACTION (pH) 6.0	EXCH. SODIUM (PCT) 0.1 0.1	SALINITY NA	POTENTIAL FROST ACTION NA	SHRINK - POTE	SWELL		I R ТА- DEPTH M) 50	HYD. GRP B	WIND EROSIO GROUP 3				
	INTERPRETA EPTIC TANK TION FIELDS	TIONS OF SO SEWAGE LAG		TRENCH	RATINGS G TYPE LANDFILLS	DOMINA AI SANITA	EA TYP	E	URES COVE	AFFE R AREA	CTING U TYPE ANDFILL	SE P	OR SHALLOW	EXCAV	ATIONS
Severe	e; depth to wa-	Severe; dep			depth to	Modera				Fair		S	evere;	depth	to
ter ta	able	ter table		seasonal	water tabl	e						S	easonal	water	table
								6				r		1	
	WELLINGS DUT BASENENTS	DWELLING WITH BASEME		LOCAL AND ST		RO	DFILL	S		D AND (		SOURCE	TOPSO	TT	
	ate; depth to	Severe; dept			ght		ood			Good			Goo	-	
water	table	ter table													
."														ŝ.	•
		RECREATION		TTATION	FOR						L AS				
CAMP	AREAS	PICNIC ARE	AS	PLAYG	RCUNDS	PATH	ND TP	ATLS	Open	land	Mood Lan	- we	tland	duġ	elani_
Modera	ate; wetness	Moderate; w	etness	Moderat	e; wetness	Modera	e; wet	ness		NF	1994 1		N	Ŗ	

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Table 31. Soil properties and interpretations for pedon 411

SOIL PROPERTIES AND INTERPRETATIONS

Pedon	N° 411 Soi	l Classific:	ation sa	ndy, mixe	d, hype	thermi	c, Typic	Ustip	samment	s					
				ESTIMA	TED I	ENCINE	ERING	PROPE	RTIES		×.				
DEPTH	1	USDA TEX	TURE		UNIFIE			FRACT S CM (PCT)	4	10	4()	AL LESS SIEVE 200	LIMIT	INDEX	PERMEABILIT (CM/HR)
0-90	Loamy sand (10 Sand (8.1% cla					SM SP-SM	A-2 A-3	0	<u>100</u> 100	100	85-9	0 10-15	NP NP		5 - 15 15 - 20
100			Landa - 1944 - 1444 - 1444 - 1444 - 1444 - 1444 - 1444 - 1444 - 1444 - 1444 - 1444 - 1444 - 1444 - 1444 - 1444												
DEPTH (CM)	WATER CAPACITY REACTION SODIUM (CM/CM) (pH) (PCT)			SALINITY	POTENT FROST	r   <sup>3</sup>	SHRINK - SWELL POTENTIAL (CM			DEPTH	HYD. GRP	WIND EROSIO GROUP	N		
0-90 130-140	0.11	0.11 6.1 0.1 NA 0.08 5.8 0.04 NA		NA NA		Low Low			140	A	2_				
1-0-140						-									
		TIONS OF SO	IL LIM	I ITATION TRENCH	RATING	ns & D	OMINANT	SOIL	FEAT	URES	AFFE	CTING I	JSE F	OR	
ABSORT	PTIC TANK ION FIELDS	SEWAGE LAG	OONS	SANITARY	LANDFI	ILLS	AREA SANITARY	LANDF	TLLS	SANI	TARY L	TYPE	s	SHALLOW	EXCAVATIONS
S1	ight	Severe; per	meability	Moderate	; textu	ire	Slight				Fair		S	evere;	texture
												2	1		
D	WELLINGS	DWELLING		LOCAL	ROADS	_			SI		LITY	A.1	SOURCI		
WITHO	UT BASENENTS	WITH BASEME	NTS	AND ST	REETS		ROADI	FILL		SAND	AND C	RAVEL.		TOPS	)IL
s	light	Slight		Sli	ght		Goo	bd			Good			Poor;	texture
	<u> </u>							÷				2 *			
		2													
		RECREATION	USE LI	ITATION	FOR							L AS			
CAMP	AREAS	PICNIC ARE	AS	PLAYG	BCUNDS		PATH ANI	) TPA	ILS	Open1	and	Roodlan	d we	etland	Rangeland
Moder	ate; texture	Moderate; te:	xture	Moderate	; textu	ire	Moderate	; text	ture		NR			NR	
		1947 1										×			

Table 32. Soil properties and interpretations for pedon 412

SOLL PROPERTIES AND INTERPRETATIONS

Pedon	N° 412 Soi	l Classific	ation sa	andy, mixe	d. hyp	etherm	ic. Aeric	Fluva	quents						
	1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -		•	ESTIMA			EERING ,								
	Sandy loam ( 1 Sandy loam ( 1		TURE			UNIFIE SM-SC SM-SC	A-2	FRACT S CM (PCT)	PERCEN TIIAN 4 100 100	10 100 100	4() 74-8 76	AL LESS SIEVE 200 0 20-26 24	LIMI	INDEX	PERMEABILITY (CM/HR) 2.5 - 15 5 - 15
(CM) 0-20	AVAILABLE WATER CAPACIT (CM/CM) 0.11	(pH)	EXCH. SODIUM (PCT)	SALINITY	POTEN FROS ACTIO NA	T N	HRINK - SU POTENT		WATEI BLE I	DEPTH	HYD. CRP	WIND EROSIO GROUP	N		
25-75	0.11	5.5-6.6	0.1-0.2	NA	NA		Low		-						
	TIC TANK ON FIELDS depth to wa-	TIONS OF SO SEWAGE LAG Severe; dept ter table	OONS	ITATION TRENCH SANITARY Severe; seasonal	depth	to	ARE. SANITARY	A TYPE		COVE	R AREA	TING I TYPE ANDFILL	<u>s</u>	SHALLOW	EXCAVATIONS
	ELLINGS T BASENENTS	DWELLING WITH BASEME		LOCAL AND ST			ROAD	FILL	SI		TLITY D AND C		SOURC	COP TOPSO	ŢŢ
Slight		Moderate; d water table	epth to	Moderate nage cla	; soil	drai-	\$1:	lght			Good			Go	od
		RECREATION		TATION							OTENTIA		_	FF HAB	
	AREAS	<u>PICNIC</u> ARE Moderate; we		PLAYG Moderate	; wetn		<u>PATH</u> ANI Moderate;			<u>Open</u>	landNR	<u>Kood Lan</u>	<u>d W</u>	N	<u>Rangeland</u>

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Table 33. Soil properties and interpretations for pedon 413

SOLL PROPERTIES AND INTERPRETATIONS

Modera	te; wetness	Moderate; we	tness	Moderate	; wetness	Modera	e; wetn	ess		NR	÷	1.62	NR
CAMP	AREAS	PICNIC ARE	AS	PLAYG	RCUNDS	PATH	ND TPA	US	Openi	and	isoodland	wetland	Rangela
		RECREATION	USE LI	TATION	FOR				PO	ידרייסדו	AT AS UT		BITAT
ter ta	DIE	ter table											
	; depth to wa-	Severe; dept	h to wa-	Sligh	t		Good			Good		G	ood
	UT BASENENTS	WITH BASEME		AND ST		RO	DFILL			AND (		TOPS	SQTI.
ומ	WELLINGS	DWELLING	s	LOCAL	ROADS			5	UTTART	TITY	AS A SO	URCE OF	
ter ta	ble	ter table		seasonal	water tab	le						seasonal	water tab
Severe	; depth to wa-	Severe; dept	h to wa-	Severe;	depth to	Moderat				Fair	•	Severe;	depth to
ABSORT	PTIC TANK ION FIELDS	SEWAGE LAG		TRENCH	TYPE LANDFILLS	SANITA	REA TYPE		COVER	ARE. TARY	A TYPE LANDFILLS		W EXCAVATI
	INTERPRETA	TIONS OF SO	IL LIM	ITATION	RATINGS	DONINA	T SOII	FEAT	URES	AFFE	CTING US	E FOR	
0-170	0.11	6.8	0.1	NA	NA	Low							
0-3	0.11 0.17	6.6	8:1	NA	NA	Low			50	Α	3		
DEPTH (CM)	AVAILABLE WATER CAPACIT (CM/CM)	Y REACTION	EXCH. SODIUM (PCT)	SALINITY	POTENTIAL FROST ACTION	SHRINK - POTE	SWELL		DEPTH	HYD. GRP	WIND EROSION GROUP		
						A=			, ,				-
-65	Sandy clay loa	m (24-26% cla	y)			C A-2-6	0	100	100	65-7	75 25-35 30 35 15-20 1	0-35 10-15	
DEPTH (CM) -3	Sandy loam (17	USDA TEX	TURE		UNIF SM-	TED AASH	) (PCT)	<u>THAN</u> 4 100	3 <u>CY</u> P 10 100	40 76	IAL LESS <u>SIEVE</u> 200 L 24 20	IMIT INDEN	PERMEABI
T				ESTINA	TED ENG	I		100 A		MATER	TAL TESS -	PLAS	
				E C T T M A									

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Table 34. Soil properties and interpretations for pedon 414

SOIL PROPERTIES AND INTERPRETATIONS

Pedon N° 414 Soi	l Classification s		rmic Typic Ustifluve	nts	
	۱۹۹۹ - ۲۰۰۰ میلید کار	ESTIMATED ENGI			
DEPTH (CM) 0-45 Sandy loam (16 75-125 Loamy sand (13		UNIT SM- SM	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		QUID PLAS- TICITY PERMEABILIT IMIT INDEX (CN/HR) 0-25 5-10 5 - 15 NP 1.5- 15
		t a ann aite an ann an an ann an tarainn An ann an ann ann ann ann ann ann ann an			
DEPTH         AVAILABLE           0CM)         UATER         CAPACIT           0CM/CM)         (CM/CM)         0.11           75-125         0.11         0.11	SOIL EXCH. REACTION SODIUM (pH) (PCT) 5.9-6.4 0.1 5.9-6.2 0.1	SALINITY SALINITY ACTION NA NA NA	POTENTIAL Low	TER TA- E DEPTII HYD. WIND EROSION (CM) CRP GROUP 145 A 3	
		· · · ·			
	TIONS OF SOIL LIM	ITATION RATINGS	DOMINANT SOIL FE	ATURES AFFECTING US	E FOR
SEPTIC TANK ABSORTION FIELDS	SEWAGE LAGOONS	TRENCH TYPE SANITARY LANDFILLS	AREA TYPE SANITARY LANDFILLS	COVER AREA TYPE SANITARY LANDFILLS	SHALLOW EXCAVATIONS
Moderate; flooding	Moderate; depth to	Severe; permeabili	- Moderate	Fair	Moderate; depth to
	water table	ty			seasonal water table
DWELLINGS	DWELLINCS	LOCAL ROADS	-		URCE OF
WITHOUT BASENENTS	WITH BASEMENTS	AND STREETS	ROADFILL	SAND AND GRAVEL	TOPSOIL
Slight	Moderate; depth to	Slight	Good	Good	Good
	water table				
	RECREATION USE LIN	TTATION 103		POTENTIAL AS WI	LDLIPE HABITAT
CAMP AREAS	PICNIC AREAS	PLAYGROUNDS	PATH AND TRAILS	Openland Woodland	wetland Rangeland
Moderate; flooding	Moderate; flooding	Moderate; flooding	Slight	NR	NR
		A			
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Table 35. Soil properties and interpretations for pedon 415

SOIL PROPERTIES AND INTERPRETATIONS

### Pedon 2° 415 Soil Classification sandy, mixed, hypethermic, Typic Ustifluvents

			50) -	ESTIMA	TED	ENGIN	EERING		RTIES						
DEPTH (CM) 0-130	Loamy sand- s	USDA TEX andy loam (13-	TURE -19% clay)			UNIFIEI SM	D AASHO A-2	FRACT	PERCE THAN 4 100	NT OF 3 CM 10 100	4()	IAL LESS <u>SIEVE</u> 200 0 10-30	LIMIT	PLAS- TICITY INDEX	PERMEABILITY (CM/HR) 5 - 15
				·····											
											1	_	<u> </u>		
DEPTH (CM) 0-130	AVAILABLE NATER CAPACIT (CM/CM) 0.11	SOIL REACTION (pH) 5,8-6,2	EXCH. SODIUM (PCT) 0.1	SALINITY NA	POTEN FROS ACTION	T	HRINK - SI POTENT Low			Г R ТА- DEPTH M) 105	HYD. GRP A	WIND EROSIO GROUP 2	N		
	n an ann a' ffraga far san air tar dar san air						~								
I									_ <u> </u>						
SF		TIONS OF SO	IL LIM	ITATION TRENCH	RATIN	GS & I	DOMINANT	SOIL	FEAT	URES	AFPE	CTING TYPE	USE PO	DR	
ABSORT	PTIC TANK ION FIELDS	SEWAGE LAG	OONS	TRENCH SANITARY	LANDF	ILLS	ARE. SANITARY	LANDE	ILLS	SAN	ITARY	A TYPE LANDFILL	. <u>s</u>	SHALLO	EXCAVATIONS
Severe	; depth to wa	Severe; dept	n to wa-	Severe;	depth	to	Moderat	e		* *****	Fair		Se	evere;	texture
ter tal	ble	ter table		seasona	l water	ta-							2.00		
				ble											
	WELLINGS	DWELLING		LOCAL					S				SOURCE		
WITHO	UT BASENENTS	WITH BASEME	NTS	AND ST	REETS		ROAD	FILL		SAN	DAND	GRAVEL		TOPS	)[[
Sli	ght	Moderate; dep	pth to	Moderate	; flood	ling	Good	1			Good		1	Goo	ď.
		water table													
	2														
	· ·														
0.00		RECREATION		TTATION	FOR		D			1	OTENTT:			FE HAI	Rangeland
CAMP	AREAS	PICNIC ARE	AS	PLAYG	RCHIDS		PATH AN	<u>) TPA</u>	11.5	Open	i and	Kood Lan			
Moderat	e; texture	Moderate; to	exture	Moderat	e; text	ture	Moderate	textı	ure		NR			N	R
					-										
											•	•			

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Table 36, Soil properties and interpretations for pedon 416

SOIL PROPERTIES AND INTERPRETATIONS

Pedon Nº 416 Soi	l Classification f	ine loamy, mixed,					wonte			
redon 3 410 501	t classification 1				PROPE					
DEPTH ((M) 3-30 Sandy Loam (1) 40-85 Sandy clay loa 100-170 Sandy loam (1)	am (21.2% clay)		NIFIED SM-SC SM-SC	AASIIO A-2 A-2-6	FRACT CM YPCT)	PERCEN THAN 4 100 100	T OF MATE CM PASS 10 2 100 80 100 70	RIAL LESS NG SIEVE 0 200 1.1 -85 15-20 20 -75 25-30 30 -85 15-25 20	D-25 5-10	PERMEABILITY (CN/HR) 2.5 - 5 1.5 - 5
DEPTH         AVAILABLE           UATER         CAPACIT           (CM)         (CM/CM)           3-30         0.11           40-85         0.17           100-170         0.11	SOIL EXCH. REACTION SODIUM (pH) (PCT) 6.0-6.2 0.1 5.4-5.7 0.1 5.4-5.8 0.1-0.2	SALINITY POTENT: SALINITY FROST ACTION NA NA NA NA NA NA	50	IRINK - SU POTENT Low Low Low		WATER BLE D	EPTH HYD.	WIND EROSION GROUP 3		
INTERPRETA SEPTIC TANK ABSORTION FIELDS Moderate; depth to war ter table	SEWAGE LAGOONS	ITATION RATINGS TRENCH TYPE SANITARY LANDFILLS Severe; depth to seasonal water tab			A TYPE LANDFI		COVER AF		SHALLOW Moderate;	EXCAVATIONS depth to water table
DWELLINGS WITHOUT BASENENTS Moderate; depth to water table	DWELLINGS WITH BASEMENTS Severe; depth to water table	LOCAL ROADS AND STREETS Moderate; flood	ing	ROAD		SI	ITABILITY SAND ANI Ga		CF OF TOPSO Goo	
		ITATION FOR PLAYGROUNDS		PATH AN	)TPA1	1.5		TAL AS WII		
Moderate; flooding	Moderate; flooding	Moderate; flood	ing	Sligh	t			NR	NR	

#### LITERATURE CITED

American Association of State Highway [and Transportation] Officials. 1970. Ed. 10, 2 vol., illus.

American Society for Testing Materials. 1974. Methods for classification of soils for engineering purposes. ASTM Stand. D 2487-69, in Annual Book for ASTM Standards, Part 19, 464.

Americas. 1970. World atlas of agriculture. Vol. 3.

- Cochrane, T. T. 1968. Profile descriptions and accompanying analytical data of soils of the Central Piedmont and the Santa Cruz regions of Tropical Bolivia, with a tentative classification of some of the major soils. British Advisers in Tropical Agriculture. Ministry of Agriculture, LaPaz, Bolivia.
- Donahue, Roy L., Raymond W. Miller, and John C. Shikluna. 1977. An introduction of soils and plant growth. Prentice-Hall, Inc., Englewood Cliffs, New Jersey 07632.
- Leonard, Olen E. 1952. Bolivia: Land, people, and institutions. The Scarecrow Press, Washington, D.C.

Munos, Jorge. 1977. Geografia de Bolivia, LaPaz, Bolivia.

- Murillo, Walter C. 1975. Recommendations for improvement in the use of nitrogen fertilizer on northeast soils of Santa Cruz, Bolivia. M.S. Report, Utah State University, Logan, UT.
- National Academy of Sciences, Washington, D. C. 1972. Committee on Tropical Soils Agricultural Board, National Research Council. 1972. Soils of the humid tropics.
- Osborne, Harold. 1964. Bolivia, a land divided. Oxford University Press, Ely House, London W.
- Soil Conservation Service, 1973. Land Capability Classification. Agricultural Handbook 210. USDA, GPO, Washington, D.C.
- Soil Survey Staff. 1975. Soil Taxonomy. U.S.D.A. Handbook 436, Soil Conservation Service, Washington, D.C.
- Soil Survey Staff. 1983. National Soils Handbook. USDA-SCS., Washington, D.C.