Soil Survey Report No. 7

Semi-detailed Soil Survey of the Lluidas Vale Area, St. Catherine-St. Ann, Jamaica (1:25,000)

(August 1990)

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PREFACE

This report is the seventh in a series of Soil Survey and Land Evaluation publications carried out by the Soil Survey Unit of the Ministry of Agriculture. These surveys started in July 1983 under the auspices of the Jamaica Soil Survey Project, a bi-lateral undertaking between the Governments of Jamaica and The Netherlands; the project was finalized in December 1989 after which the Soil Survey Unit continued the island-wide soil survey programme.

The ultimate aims and objectives of the surveys are to improve the role of the agricultural sector as part of the overall economy of Jamaica by optimizing land use through re-inventory of the soils of the island according to modern, international standards. This will provide full characterization and evaluation of the soils and permit correlation with soils of other tropical and subtropical regions, as well as exchange and comparison of agricultural production and research statistics.

In this report the data and information obtained have been entered and applied in the Rural Physical Planning Division's Physical Land Evaluation System (JAMPLES), which is an integral part of the Jamaica Geographic Information System (JAMGIS).

This publication is a result of a team effort by the Rural Physical Planning Division's Soil Survey Staff under the direction of Mr. V.A. Campbell and Mr. G.R. Hennemann (up to December 1989).

Aerial photo interpretation was carried out by Mr. G.R. Hennemann and Mrs. P.A.M. van Gent. The major part of the field work was done by Mr. L.L.T. Dawkins, Ms. G.J. Ford and P.A.M. van Gent in 1988/1989. Earlier, field work (1986) was carried out by various members of the Soil Survey Unit, whose names are indicated in the profile descriptions of Appendix IV. Soil chemical and physical analyses were carried out by the Division's Soil Laboratory, headed by Ms. S. Austin. Climatic analyses and land evaluation tables were prepared by P.A.M. van Gent and G.J. Ford, with assistance of Mr. N.H. Batjes from the Land Evaluation Section. Soil correlation was carried out in discussion with G.R. Hennemann of the Soil Correlation Section and N.H. Batjes. Cartography was done by Mr. V.A. Ricketts. Report and maps were prepared by P.A.M. van Gent.

V.A. Campbell - Acting Director
Rural Physical Planning Division
Kingston, August 1990.

SUMMARY

The Lluidas Vale survey area comprises about 11,000 ha in the north-western and central-southern part of the parishes of St. Catherine and St. Ann respectively. The area is covered by topographical map sheets 84A and 84C. The soil map for the area is attached as Enclosure I. The mapping units are delineated on the basis of physiography, lithology and soils, defined according to USDA Soil Taxonomy at Series level.

The survey area lies in the Intermediate and Wet Moisture Availability Zone. Yearly R75/PET values, in which R75 is rainfall reached or exceeded in 75% of the years and PET is potential evapo-transpiration, range from 0.76 to 1.15, which reflect favourable rainfall conditions for a wide range of climatically adapted crops in most years. Rainfall in 80% of the years varies from 857-1807 mm per year at the driest locations to 1313-2453 mm per year at the wettest locations. The dependable growing period lasts from May to December in the major part of the area. Mean temperatures range from 24-26°C at the lowest elevations (about 250 m above msl) to 17-20°C at the highest elevations (about 900 m above msl).

The major landforms in the area are the Hills and Foothills (80% of the survey area), the Inland Basins (15%) and the River Plains (2%). The Hills and Foothills are hilly to steeply dissected, located in the northern, central and south-eastern parts of the survey area. Lithologically they are mainly related to limestone deposits. The Inland Basins consist of almost flat to rolling Old Alluvial Deposits, also referred to as lacustrine deposits. The River Plains consist of Recent Alluvial Deposits with almost flat to undulating topography. The Old and Recent Alluvial deposits occur in two basins: the Lluidas Vale basin in the south-west and the St. Thomas in the Vale, or Linstead basin in the central-east of the survey area. Rural residential areas occupy about 3% of the surveyed area.

Arable land comprises mainly the soils of the Lluidas Vale basin and the Linstead basin. The soils over Old Alluvium generally are moderately well to poorly drained and acid, which makes them suitable only for natural forest and unimproved pasture at low management levels. At high management and input levels, these soils are only marginally to moderately suitable for most crops, due to persisting fertility problems (low nutrient availability, high exchangeable aluminium contents) and/or physical problems (poor

drainage, poor workability). The area is considered suitable for sugar cane and improved pasture. The soils over Recent Alluvium are marginally suitable for most crops at low management levels, due to stoniness-gravelliness, and hard consistence when the soils are dry. However, with increasing management level, the soils become moderately to highly suitable for most crops.

The very shallow soils of the Hills and Foothills are marginally to non suitable at all management levels. Since these soils mainly occur on (very) steep slopes, erosion is a serious problem. They should be kept under natural forest. At low management levels, a limited number of annual crops can be grown on the less steep slopes of shallow and moderately deep soils. But on steeper slopes, cultivation (except from forest) of the soils is not recommended at any management level. The deep soils of the moderately steep slopes are moderately suitable for most crops at higher management and input levels. Stoniness and low moisture and nutrient retention capacity remain a problem. At low management levels, soil fertility is the major problem, which makes the soils marginally suitable for most annual crops and moderately suitable for tree crops.

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1. INTRODUCTION

In the period 1958-1970, the soils of Jamaica were mapped at scale 1:12,500 by the Regional Research Centre of the University of the West-Indies (formerly the Imperial College of Tropical Agriculture) in Trinidad. These surveys resulted in the publication of the "Soil and Land Use Surveys", also known as the "Green Books" (RRC 1958-1970). They cover 13 of the 14 parishes of the island (scale 1:50,000).

Soil investigations during the late '70s and early '80s in the Western Region (RPPD 1981) indicated that the "Green Book" studies should be updated, especially the chemical and physical characterization of the soils. These additional data, plus more detailed morphometric soil descriptions were needed as well to classify the soils according to the classification system in Jamaica, which is based on USDA Soil Taxonomy (Soil Survey Staff 1975). The new data should also allow for better agricultural interpretation for rural planning.

For the purpose of updating the available soil data, the Jamaica Soil Survey Project, a bi-lateral undertaking of the Governments of Jamaica and the Netherlands, was started in 1983. During its first surveys priority was given to areas of major agricultural importance, e.g. the Coastal Plains of St. Catherine (SSU 1986b). More recently, the Upper Rio Cobre watershed in the parish of St. Catherine was re-surveyed. The soils of this parish were first described by Vernon (1958). The central part of this watershed, comprising the major part of the St. Thomas in the Vale basin, has been re-surveyed in 1986 and the results are documented in the "Semi-detailed Soil Survey of the Linstead-Bog Walk Area" (SSU 1987b, see also Appendix XI).

The Lluidas Vale basin and surrounding hills, located north-east of the Linstead-Bog Walk area, are the subject of this report. The area has been partially re-surveyed in 1986, but the major part of the field work has been done during autumn of 1988 and spring 1989.

The Lluidas Vale survey resulted in a further standardization of the methodology for soil surveys within the Soil Survey Unit of the Ministry of Agriculture in Jamaica. The report is written according to the format developed under tenure of the Jamaica Soil Survey Project (SSU 1989g).

The report consists of 5 chapters, 11 appendices and one enclosure, i.e. the soil map of the Lluidas Vale area (1:25,000). After the introduction (Chapter 1), a general description of the survey area is given in Chapter 2, including location and infrastructure, climate, geology, landforms, hydrology and land cover. Field work preparation and execution, laboratory analyses and map compilation are described in Chapter 3. The soils, soil formation, the soil mapping units, and the legend of the soil map are discussed in Chapter 4. The procedures for and results of land evaluation, as carried out with the Jamaica Physical Land Evaluation System JAMPLES (SSU 1986a) are discussed in Chapter 5; these data form the basis for subsequent rural physical planning. The technical glossary (Chapter 7) can be found immediately behind the main report and references (Chapter 6).

The Appendices include statistical analyses of the monthly and seasonal rainfall data (I), results of chemical rock analyses (II) and land use data (III) as part of the general description of the area. The appendices with soil profile descriptions and analytical data (IV), USDA Soil Taxonomy classification of the soils (V), comparison of former (i.e. the "Green Books") and present mapping units (VI) and a copy of the legend of the soil map (VII) accompany Chapter 4. Agro-ecological limitations of the major soils (VIII) and possible soil conservation practices (IX) are the appendices related to Chapter 5. Appendix X is a conversion table of SI-units to Imperial units v.v. The last appendix (XI) shows the location of the survey area as part of the Upper Rio Cobre Watershed Survey.

2. DESCRIPTION OF THE SURVEY AREA

2.1 GENERAL CHARACTERISTICS

The major part of the survey area is located in north-western part of the parish of St. Catherine, while the northern portion extends into the parish of St. Ann. It is covered by topographical map sheets Nos. 84A and 84C (scale 1:12,500) of the Survey Department. The northern and southern boundaries are at latitude 18°13'13"N and 18°16'37"N respectively and the eastern and western boundaries are at 77°10'22" and 77°05'11" west of Greenwich. The corresponding state plane coordinates are indicated in Figure 1. The total acreage of the survey area is approximately 11,040 ha.

The main centres in the survey area are Lluidas Vale and Worthy Park Estate, occupying most of the land in the Lluidas Vale basin, and Ewarton at the upper fringe of the St. Thomas in the Vale basin (or: Linstead basin). Ewarton is located along the main road from Spanish Town (56 km south-east) to Ocho Rios (37 km north). Lluidas Vale lies along the secondary road from Spanish Town via Point Hill to Moneague. Both routes run in north-southerly direction. A poorly asphalted road forms the east-west connection from Ewarton, through Lluidas Vale to Crofts Hill in Clarendon. Small villages in the area include Tydixon, Mount Rosser, Charlton, River Head, Top Hill and Polly Ground.

With the exception of the bauxite industry (ALCAN Jamaica Ltd.) south-east of Ewarton and the sugar cane factory of Worthy Park, there are no major industries in and surrounding the survey area. Ewarton provides employment as an administrative centre for the area. Large farms, like Worthy Park Estate, Ewarton Nurseries Ltd., some CIDCO (Coffee Industry Development Corporation) farms and a few poultry farms are important centres of agricultural activity, besides the majority of small farmers living in the villages.

Piped water is available in most villages, including those in the hills. The latter villages, however, have no electricity or telephone facilities. Post offices, police stations as well as markets are found in Lluidas Vale and Ewarton. Secondary schools are located in Ewarton. For health services (hospital) the population is dependant on Linstead.

Ewarton has a Jamaica Agricultural Society (JAS)-shop, where agricultural goods like fertilizers and pesticides are sold at subsidized prices. The major centre for agricultural extension is the Land Authority Office in Linstead. The Land Authority Office takes care of the free distribution of pesticides and planting material from the Ministry of Agriculture. The two extension areas are Ewarton (within the Linstead extension division) and Lluidas Vale (within the Watermount extension division).

Legend for Figure 1:

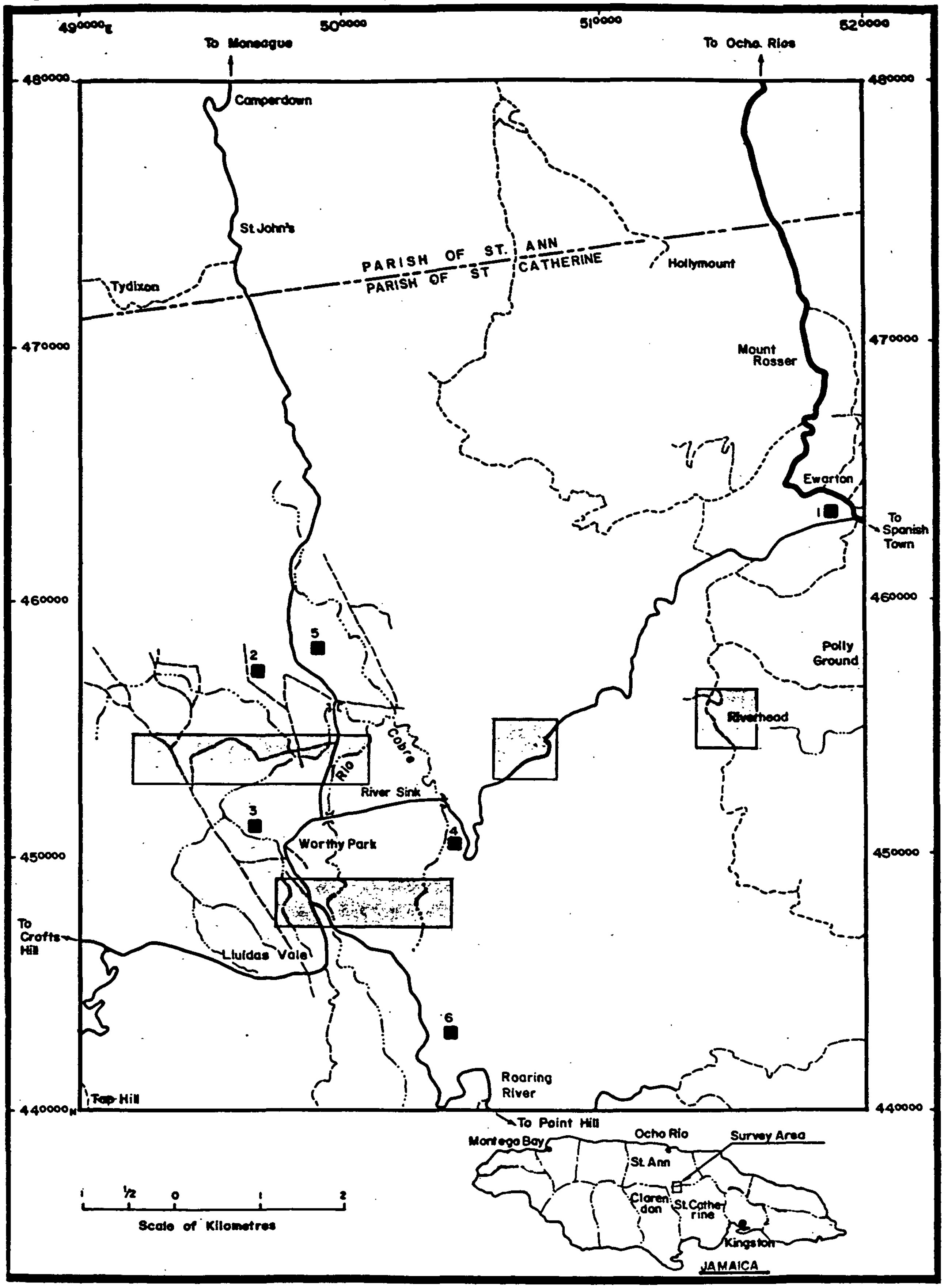
Tydixon	Village of Tydixon
	Main road class A
	Main road unclassified
	Parochial roads
	road leading to
	Seasonal river
	Rainfall recording stations: 1. Ewarton 2. Swansea 3. Worthy Park 4. Charming Hole 5. Corn Ground 6. Grass Piece
	Location of sample areas

2.2 CLIMATE

2.2.1 Rainfall and Potential Evapo-Transpiration

In the survey area nine rainfall recording stations are maintained by the National Meteorological Service; only six out of these nine have records of 20 years or more which is required for statistical analyses. The results thereof are presented in Appendix I. Of these stations, Ewarton is located in the St. Thomas in the Vale basin and the other five (Swansea, Grass Piece, Corn Ground, Charming Hole and Worthy Park) in the Lluidas Vale Basin as indicated in Figure 1. No rainfall station is present in the hilly areas which surround the inland basin; the data from Point Hill rainfall station in St. Catherine are used as being representative for the hilly areas (Appendix I).

Figure. 1. The Lluidas Vale survey area, St. Catherine-St. Ann, Jamaica.



The total annual rainfall in 80% (range of R90 to R10, see Appendix I) of the years varies from 980-1923 mm at Swansea, 992-2059 mm at Worthy Park, 1049-2538 mm at Grass Piece, 1084-2239 mm at Corn Ground, 1124-1979 mm at Charming Hole and 1313-2354 mm at Point Hill. At Ewarton it varies from 925-1807 mm, indicating somewhat drier conditions than in the Lluidas Vale area.

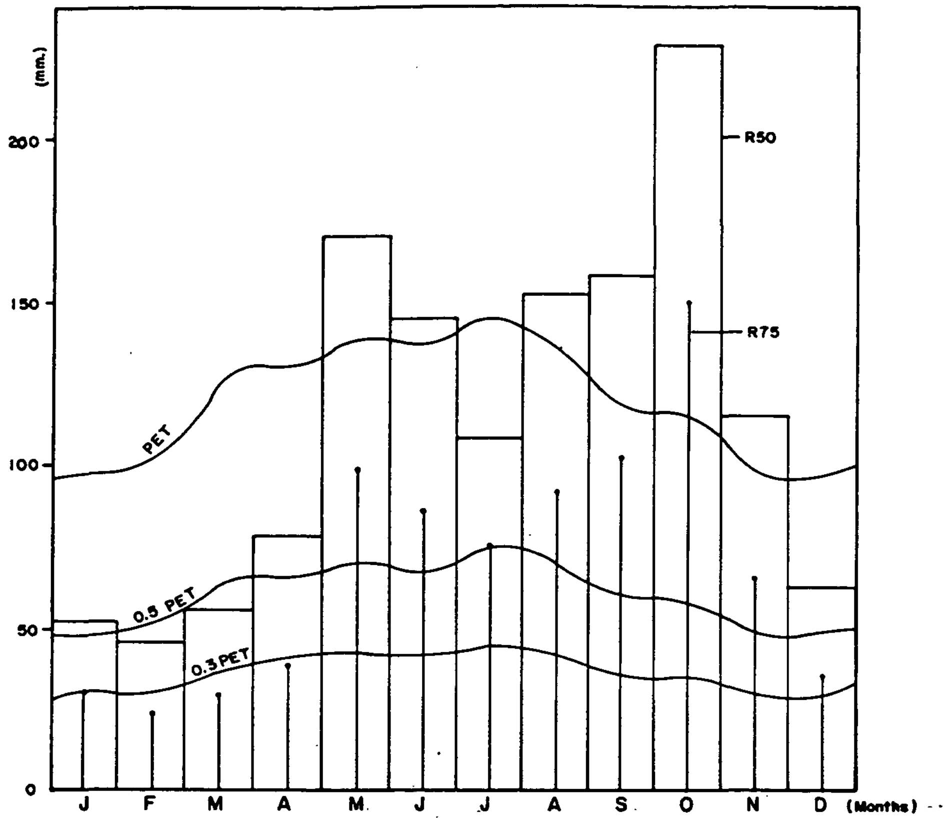
For land evaluation R75 is used. The R75 value indicates the amount of rainfall that will be reached or exceeded in 3 out of 4 years. Rainfall data for Worthy Park show that in 75% of the years the annual rainfall is at least 1247 mm (Table 1 and Figure 2). September and October are the wettest months, followed by May. December to April are the driest months in most years.

Table 1. Mean monthly rainfall (Rmean in mm), dependable rainfall in 75% of the years (R75 in mm), mean monthly potential evapo-transpiration (PET in mm, according to Priestly & Taylor method) and R75/PET ratios for Worthy Park (period: 1900-1988).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year
Rmean	60	51	59	86	185	181	112	159	177	244	140	67	1526
R75	29	23	29	38	98	85	75	91	102	149	64	33	1247
PET	98	101	127	131	139	136	145	136	118	115	97	97	1441
R75/PET	0.29	0.22	0.22	0.29	0.70	0.62	0.51	0.67	0.86	1.29	0.66	0.34	0.86

Source: JAMPLES; raw rainfall data provided by JMS 1989.

Yearly potential evapo-transpiration (PET) for the rainfall recording locations is calculated with the Priestly & Taylor method. This method is described by L'Homme & Eldin (IICA 1983), using linear regression against elevation above mean sea level (msl). PET ranges from 1360 in the hills to 1490 at Ewarton. The PET value for Worthy Park is approximately 1440 mm.



PET: Potential Evapo-Transpiration (mm)
R50: Median monthly rainfall (mm)
R75: Monthly rainfall (mm) reached or exceeded in 75% of the years

Fig. 2. Rainfall-PET histogram for Worthy Park.

The rainfall-PET histogram for Worthy Park shows that the "rainy season", the time period in which the 75%-dependable rainfall (R75) exceeds 0.3xPET, extends from the end of April till the beginning of January. In order to allow for satisfactory growth of (most) annual crops, temperature should not be limiting and "water supply" should exceed 0.5xPET: this period is known as the dependable growing period. It is defined as the period in which R75/PET ranges from 0.5-1.0 (Moist months, see Table 2), i.e. May to August and November, and exceeds 1.0 (Humid months, see Table 2), i.e. October, plus a final period in which remaining soil water can be depleted towards the end of the rainy season (December). The latter period of soil water use (u) has been set at 1 month, provided 0.3 <= R75/PET < 0.5, under the assumption that the soil is deep and freely drained.
Prior to the dependable growing period, there may be a month in which R75/PET is between 0.3-0.5 (April). These conditions usually allow for land preparation (p), when that month is followed by moist or humid months. Months with the same rainfall conditions, but not followed by a moist or humid month, are not considered being part of the rainy season; they are indicated with "m".

Table 2. Minimum length of the dependable growing period in 75% of the years for Ewarton (29 years of observation), Swansea (32 yrs), Worthy Park (90 yrs), Charming Hole (29 yrs), Corn Ground (29 yrs), Grass Piece (20 yrs) and the yearly R75/PET-values.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year
Ewarton	-	-	-	p	M	M	M	M	M	H	M	u	0.76
Swansea	-	-	-	-	M	M	u/M	M	M	H	M	u	0.83
Worthy Park	-	-	-	-	M	M	M	M	M	H	M	u	0.86
Charming Hole	m	m	-	p	M	M	M	M	H	H	M	u	0.91
Corn Ground	-	-	-	p	M	M	M	M	H	H	M	u	0.94
Grass Piece	m	m	-	p	M	M	M	M	H	H	M	u	0.97

Note: -=dry; m=(0.3=<R75/PET<0.5); p= land preparation possible; M= moist; H= humid; u= use of soil moisture at the end of the rainy period
Source: JAMPLES

At Lluidas Vale the 75% dependable growing period (Table 2) extends from May to December; in the last month the soil moisture is deplenished. In the eastern part of the basin (Charming Hole, Grass Piece), land preparation can start in March in most years. In this area too, there are two humid months, i.e. September and October. May does not qualify as a humid month (R75/PET < 1.0). However, rainfall can be over 600 mm during this month (Appendix I). July is a relatively dry month in the growing period. Some rainfall is recorded in January and February at the south-eastern rainfall stations.
At Swansea, located in the central western part of the Lluidas Vale, the dependable growing period is divided in two, whereby the dividing month (July) still has a R75/PET of 0.49. The western part of the basin has no months with 0.3 < R75/PET < 0.5 preceding the 75% dependable growing period, and only one humid month (October).
March is a dry month for all stations; Swansea and Worthy Park have a dry period of 4 consecutive months in most years from January to April.

According to the management of Worthy Park Estate, the period of 1976 to 1985 corresponded with a series of relatively dry years: in 7 out of these 10 years the annual rainfall which WPE-management considers as the "normal" rainfall (about 1500 mm) was not reached.

Although in Ewarton R75 is lower and PET is higher than in Lluidas Vale, the length of the 75% dependable growing period is similar. Land preparation can start in April in most years and the dependable growing period lasts until December. Rainfall peaks are centered around October and June. The annual R75/PET value for Ewarton is the lowest for all mentioned stations.

For the hills surrounding the basins no climatic data are available from rainfall stations in the survey area. Based on the information of the Agro-climatic zones map for Jamaica (SSU 1989i), rainfall should be higher and PET should be lower than in the basins. Yearly R75/PET values will be between 1.00 and 1.25 and the dependable growing period will extend for at least eight months (May-December). The rainfall data from Point Hill are chosen for the hilly part of the area (Appendix I).

A wide range of annual crops can be grown throughout the dependable growing period provided their growing cycle matches the length of the dependable growing period and the temperature is within the acceptable range (see Section 2.2.2). Nevertheless, it should be avoided that crops are in a stage sensitive to heavy rainfall in the months of October, September and May.

Rainfall intensities are not measured in the survey area. Studies of rainfall data from a wider range of stations in St. Catherine, more recent data and analyses of longer records of data can be found in different publications (SSU 1987a, SSU 1989h, SSU 1989i).

2.2.2 Daily air temperature

The daily air temperature, as presented in Appendix I and Table 3, is calculated with linear regression equations, relating elevation above mean sea level (msl) to minimum, mean and maximum day temperatures for all months (SSU 1988a). Temperature requirements of the different crops are defined in JAMPLES (see Chapter 5).

Ewarton which is located in the St. Thomas in the Vale basin at an elevation of 260 m above msl, has temperatures varying from 17 °C (mean Tmin in February) to 30 °C (mean Tmax in August), as can be seen in Table 3. The Lluidas Vale basin at an elevation of approximately 370 m above msl is represented by Worthy Park, has approximately the same rounded off values for Tmin and Tmax, but the yearly mean temperature is lower. Generally January to March are the coolest months and July to September the hottest months. These periods coincide roughly with the driest and the wettest periods respectively.

Since temperature decreases with about 0.5 °C per 100 m increase of elevation, it follows that at the highest elevation in the hilly areas (900 m), the mean daily air temperature will be up to 3 °C less than in Worthy Park.

Table 3. Mean daily air temperature (in °C) for Ewarton (258 m) and Worthy Park (380 m).

Ewarton:	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year
T min	17.8	17.4	17.8	18.8	20.1	20.7	20.7	20.8	20.8	20.5	19.8	18.8	19.5
T mean	22.5	22.5	22.8	23.7	24.6	25.1	25.4	25.8	25.4	25.1	24.4	23.4	24.2
T max	27.4	27.5	28.1	28.7	29.0	29.5	30.1	30.3	29.9	29.5	28.7	27.9	28.9

Worthy Park:	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year
T min	17.2	16.8	17.2	18.2	19.5	20.1	20.1	20.1	20.1	19.8	19.2	18.2	18.9
T mean	21.9	21.8	22.2	23.1	23.9	24.5	24.8	25.1	24.7	24.4	23.7	22.7	23.6
T max	26.7	26.8	27.4	28.1	28.4	28.8	29.4	29.7	29.3	28.8	28.0	27.2	28.3

Source: JAMPLES.

2.2.3 Sunshine duration

Data on mean sunshine duration for Worthy Park are presented in Table 4 (years of recording are not given by JMS 1989). The growth of daylight sensitive crops can be adjusted according to these data.

January to April and July are the sunniest months of the year, corresponding with the "dry season". Expressed as percentage of the maximum possible sunshine hours (i.e. day length) January and February have the most sunshine hours. Overcast conditions occur mainly in May, June, August, September and October which are months of relatively high rainfall.

Table 4. Actual sunshine duration (n in tenths of hours), potential sunshine duration (N in tenths of hours) and actual sunshine duration as percentage of maximum possible sunshine (n/N in %) for Worthy Park.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year
n	6.5	6.5	6.3	6.6	5.8	5.6	6.3	5.9	5.1	4.9	6.1	5.9	6.0
N	11.2	11.6	12.1	12.6	13.0	13.2	13.1	12.7	12.2	11.7	11.3	11.1	12.2
n/N	58	56	52	52	45	42	48	46	42	42	54	53	49

Source: JMS 1989

2.2.4 Relative humidity

Mean daily relative humidity over the year at Worthy Park, as shown in Table 5, is 83%. Early morning data vary around 93% (91-95%) and afternoon data around 73% (64-78%). Relative humidity may influence crop growth through higher or lower probability of fungus infestation.

The months with high relative humidity in the afternoon, i.e. May-June and October-November mainly coincide with the rainy seasons. The periods with the lowest relative humidity coincide with the driest months.

In the hills higher figures for relative humidity are expected, as compared with those measured for Worthy Park. In Ewarton the relative humidity is expected to be more or less similar to the relative humidity in Worthy Park. Foggy conditions occur mainly in September, October and November in the early morning.

Table 5. Relative humidity at 7.00 h in the morning and at 13.00 h. in the afternoon (in %) for Worthy Park (1967-1971).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year
7.00 a.m.	92	93	92	93	93	91	93	93	94	95	92	91	93
13.00 p.m.	70	70	68	64	74	74	72	73	76	77	78	76	73

Source: JMS 1973

2.2.5 Wind

Mean wind speed data are presented in Table 6. The number of years over which these data have been recorded is not known.

The mean wind speed over the year is 0.7 m/s or 60 km/day. The lowest mean wind speed is recorded in September-October (0.4 m/s). In this figure, hurricanes that may occur during these months, are not taken into account. The hurricane season lasts from June to November. The annual probability for Jamaica to be hit by a hurricane is around 20%, according to the National Atlas of Jamaica (Town Planning Department 1971).

The wind direction is mainly north-easterly, because the area is under the influence of the major prevailing wind system of the North-eastern Trade Winds. The Lluidas Vale basin is partly protected from winds by the surrounding hills.
The maximum mean wind speeds occur in January, February, March and April. These high wind speeds are partly related to Northers, i.e. winds controlled by cold high pressure systems from the North American continent, which occur only during the first months of the year. Because of the topography they especially affect the Lluidas Vale basin and negatively influence the citrus blooming.

Table 6. Mean wind speed for Worthy Park (in m/s).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year
Mean	0.8	0.8	0.8	0.9	0.8	0.8	0.7	0.6	0.4	0.4	0.6	0.8	0.7

Source: JMS 1989

2.3 LANDFORMS

The major landforms in the survey area are indicated on the cross-section in Figure 3. The location of this schematic cross-section is shown on the soil map (Enclosure I). Landforms are used as the first entry in the legend to the soil map (see Sub-chapter 4.3); the boundaries between the different landforms are the thicker lines on the soil map.
The following landforms are distinguished:

- Hills and Foothills
- Inland basins
- Plains.

The Hills and Foothills in hard limestone, occupying the major part of the survey area, show a cockpit karst topography. The best examples of cockpit karst are found in the western and north-western part of the survey area at an elevation of 500-600 m above msl. Relief intensity in this steeply dissected area is about 100 m. The limestone hills are connected by saddles.
Separated by the Lluidas Vale fault, the central part of the limestone hills consists of cockpit karst in a more advanced stage of degradation, with wider valley bottoms on a kind of plateau, dipping to the south-east. The elevation in the northern part is about 900 m and in the south-east about 500 m; the relief intensity is less than 200 m.
In the south-west (Top Hill), there is an area of gently sloping doline karst on soft limestone. Another area of doline karst, on hard limestone, occurs in the central-south (Murmuring Brook).

The Inland basins are found at two elevations; the Lluidas Vale basin at around 370 m and the fringe of the St. Thomas in the Vale basin at about 260 m above msl. The Lluidas Vale basin is a flat to undulating in-filled polje, with old alluvial/lacustrine deposits derived mainly from the Central Inlier, overlying degraded white limestone and limestone debris. The drainage is subterranean. Some colluvial admixture is found in the long-stretched plainbands (finger-like fringes of the Inland basin in between the hills, Pfeffer 1986) at the western side. The transition to the limestone hills is quite sharp. The boundaries are determined by faults and lateral corrosion (Landmann 1989). In places along the eastern border, the Lluidas Vale fault is not fully developed; limestone outcrops overlain by layers of alluvium/colluvium derived from conglomerates of the Central Inlier are found. Some small limestone outcrops occur in the northern part, protruding through the old alluvial deposits.
In the large fringes of the St. Thomas in the Vale basin, several large limestone outcrops rise from the alluvial deposits. The major part of this basin has been studied earlier (SSU 1987b).

The Plains (i.e. river plains) are found along the Rio Cobre, at 360-370 m above msl and consist of young alluvium, incised in the old alluvium. The landscape is flat to undulating with different terraces. A small plain is found in the St. Thomas in the Vale basin, not bordering any present day river system.

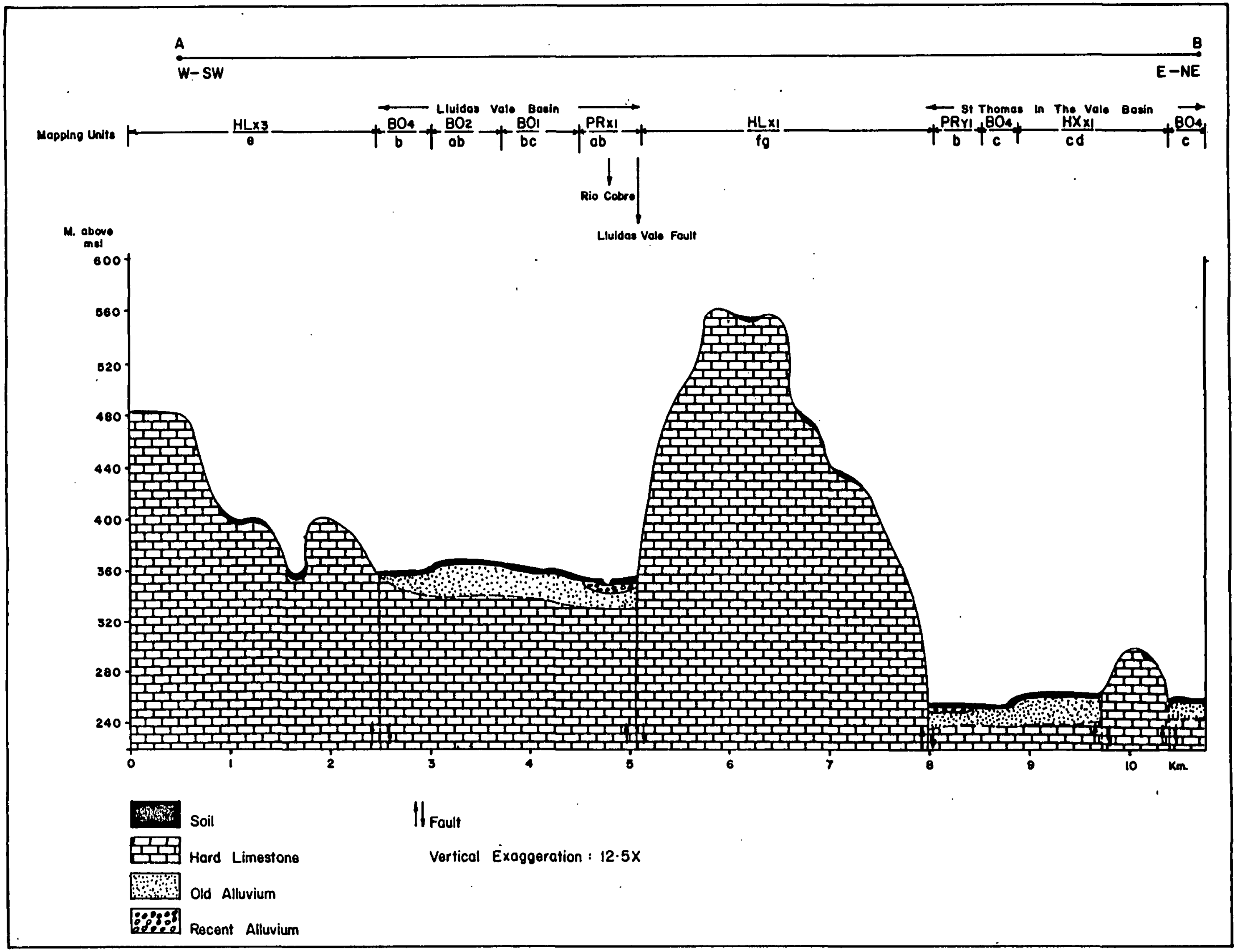


Figure 3. Schematic cross-section of the Lluidas Vale area.

2.4 GEOLOGY

A fairly detailed overview of the formations occurring in the survey area, as well as their period of deposition and age are given in Table 7. These data are mainly based on Geological sheet 19 (Mines and Geology Division, Ministry of Mining and Natural Resources) and on Zans et al. (1962). The geology of the area is shown in Figure 4. Geology is used as the second entry in the legend to the soil map, as described in Sub-chapter 4.3. Although lithology in Jamaica is very important for the soil formation, other factors like tectonic uplift and original landforms are as important (Pfeffer 1986).

Table 7. Geology of the Lluidas Vale area.

Group/Unit	Formation/Lithology	Period	Age/10*6 (years)
-	Recent Alluvium	Pleistocene-Holocene	0-1.5
	Inland Basin deposits	Pleistocene	
White Limestone	Newport Fm.	Miocene	7-26
	Walderston-Brown's Town Fm.	Oligocene	26-37
	Somerset Fm.	Upper Eocene	37-43
	Troy-Claremont Fm.	Middle Eocene	43-48
Yellow Limestone	Chapelton Fm.	Middle-Lower Eocene	48-53
(Volcanics)	Devil's Race Course Fm.	Lower Cretaceous	100-120

The oldest formation in the area is of Cretaceous age, i.e. the Mount Diablo Inlier to the north of Ewarton, and is represented by the Devil's Race Course Formation. This formation mainly consists of lavas and volcaniclastics; a few banded lavas are overlain by volcanic conglomerates. The rock fragments in the conglomerates are mainly andesites. Within this formation, there are four Limestone Members, of which only the Copper Limestone has been mapped in this area.

In some very small patches, the Cretaceous outcrops are surrounded by members of the Chapelton Formation (Yellow Limestone Group), which varies in thickness from 15-150 m. Here, as well as along the southern border of the survey area, adjacent to the Central Inlier, the Albert's Town Member is mainly found and to a very small extent the Guy's Hill Member.
The Albert's Town member is a sequence of bioclastic calcarenites and marly limestone, partly dolomitized in the upper part of the deposit. It is known for its rich and wide variety of fossils.

The rocks of the Yellow Limestone Group are very impure compared to those of the White Limestone Group (98% purity).

Outcrops of the White Limestone Group, overlying the older Cretaceous formations, are mainly shallow-water deposits. The maximum thickness is up to 610 m. The formations recognized are Troy-Claremont, Somerset, Walderston-Brown's Town and Newport.
According to the analyses carried out by the Geological Survey Division and shown in Appendix II, the Troy-Claremont Formation is a re-crystallized tough, compact, micrite to microsparite with patches of sparry crystals. The deposits are usually off-white, cream coloured to pink. Chemical analyses, reflect the high amount of Ca-carbonates and the very low admixture of Mg-carbonates.

Although being of almost the same chemical composition as the Troy-Claremont Formation, the rocks of the Somerset Formation are moderately consolidated, chalky, fine grained and fossiliferous. The rocks of this formation are not re-crystallized.

The Walderston-Brown's Town Formation is found on top of the Somerset Formation. It consists mainly of soft light brown to pink-white compact bioclastic limestone, re-crystallized in places.

The youngest White Limestone Formation in the area is the Newport Formation, which ranges from soft, chalky, nodular to hard, micritic, partially re-crystallized and poorly to moderately bedded limestone.

The process of karstification started during the Miocene, about 12 million years ago. True cockpit-karst is found in the north-western part of the survey area, around Tydixon.

Old Alluvium (Inland basin deposits) overlies the Newport Formation in places where, due to faulting, seasonal lakes developed in depressions. They are found in the Lluidas Vale basin and the fringes of the St. Thomas in the Vale basin. These lacustrine deposits consist mainly of clays.
The deposits in the Lluidas Vale basin originate from the limestone hills in the west (sediment-bearing groundwater from as far as Pedro River is supposed to be deposited) and the Central Inlier in the south. Their thickness is about 25 m.
The deposits from the St. Thomas in the Vale basin as occurring in the survey area, originate from the Central Inlier, in places with admixtures of bauxitic deposits.

Part of the Old Alluvium is overlain by coarser, stratified fluviatile Recent Alluvium, originating from the Central Inlier and surrounding Yellow Limestone deposits. The thickness can be up to 10 m.

Besides the minor faults, two major faults subdivide the survey area into the central hilly section and the two inland basins: the Lluidas Vale fault, stretching from north to south and the Mount Diablo fault from east to west, located east of the Lluidas Vale fault. Faulting took place during the Pleistocene.

Bauxite covers a large part of the Limestone deposits in the survey area. Several theories on the origin of these bauxitic deposits exist (Comer 1974). Mining occurs only in the north-eastern part of the area, close to Village. The best bauxite is found on top of the Walderston Brown's Town Formation at elevations of 300 m and higher. Minor red/yellow coloured bauxitic deposits are found on top of the Troy-Claremont Formation, bordering the road from Lluidas Vale to Ewarton and in the south eastern part of the survey area. No mining is done in these places.

The relicts of several huge landslides are visible around Ewarton. Tertiary rocks slumped into the basin, thereby exposing Cretaceous rocks now at an elevation of 530-610 m above msl. The limestone deposits are obviously very thin in this area, as is shown by the immediate exposure of the Cretaceous rocks.

2.5 HYDROLOGY

In the area there are no perennial rivers, only seasonal rivers. The major seasonal rivers are the Rio Cobre in the Lluidas Vale basin and the Black River in the St. Thomas in the Vale basin. The Rio Cobre flows from the south coming from the Central Inlier, and curves to the east to disappear in the big sinkhole at the bottom of the Lluidas Vale fault. The river re-appears as Black River in Riverhead, flowing in eastern direction towards the major tributary of the Rio Cobre.
In the Lluidas Vale basin, several sinkholes occur which are connected to underground water streams. During heavy rainfall, the waterlevel rises due to saturation of the underground water system. Some sinkholes have become permanently ponded as their bottom outlets are blocked by sediments.

Legend for Figure 4.

Landslide

Fault

Alluvium, Old and Recent

White Limestone Group

Newport Formation

Walderston-Brown's Town Fm.

Somerset Formation

Troy Claremont Formation

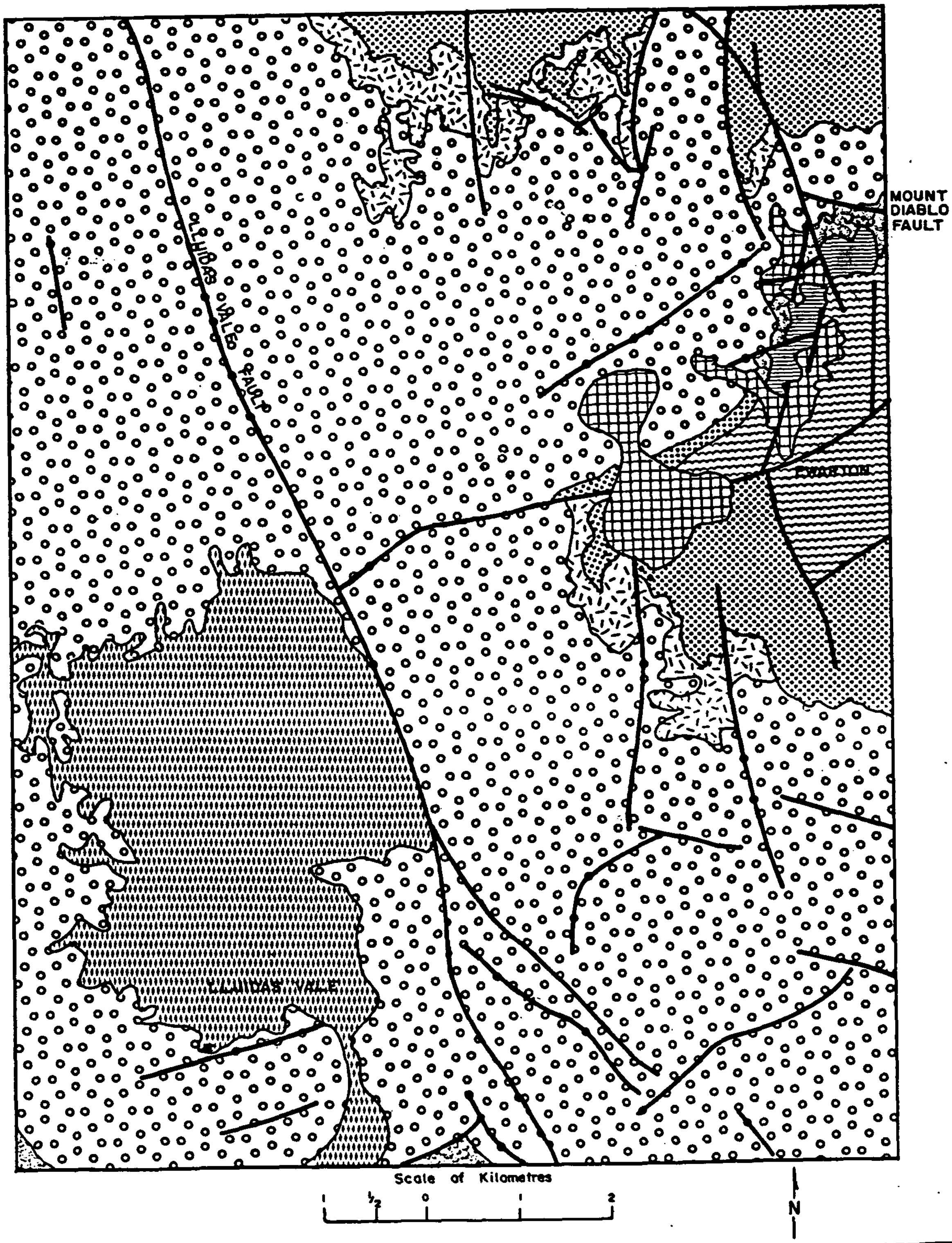
Yellow Limestone Group

Chapelton Formation

Volcanics

Devil's Race Course Formation and Copper Limestone

Figure 4. Map of surface geology of the Lluidas Vale area
(source: Geological sheet 19)



Flooding may occur along the Rio Cobre and around sinkholes in the Lluidas Vale basin after heavy rains because the holes and the underground water channels cannot drain all water at once. After the May rains of 1986, an area of 240 ha was flooded (below the 1250 feet contour line, as shown on toposheet 84C) to a depth of up to 9 m. It took 25 days before all water had disappeared. Minor floods occur every 4 to 5 years, covering an area of about 20 ha close to the big sinkhole for about a few days. Sedimentation takes place during these periods of flooding (up to 30 cm in May 1986). The floods can cause severe damage to the citrus and sugar cane crops.
Except for a small area in the nursery in Charlton, no other locations in the survey area are known to be prone to flooding.

After passing Mount Rosser, on the main road to Ocho Rios, a big "red-mud" lake has been build for the waste disposal of the aluminium factory in Ewarton. In the beginning of the '60s, a programme was started to check for pollution of the ground water down stream. No severe pollution was measured just after filling the lake. No regular monitoring has been carried out since then (WRD 1983). Chicken farmers in the area, however, have experienced problems of water pollution during recent years (pers. comm. farmers in the area).

2.6 LAND COVER AND LAND USE

The major crops grown in the survey area are sugar cane and citrus; other major, but small-scale forms of land use are mixed cropping (annual as well as perennial crops) and grazing. The forests are of indirect agronomical importance, in that they prevent soil degradation and erosion.
The land cover of the Lluidas Vale area is shown in Figure 5. The land cover map is a revised and updated version of the "Chapelton Land Use/Cover map" (prepared at RPPD, June 1986, within the framework of the CRIES project, scale 1:50,000). The units of the map are described below.

Information about the crops grown at Worthy Park Estate has been retrieved from Messrs. Robert G.F. Clarke and Philip Clarke (pers. comm.) and from articles in "The Daily Gleaner"; additional information about small farmers' activities has been gained from the Land Authority Office in Linstead and the Databank of the Ministry of Agriculture, Kingston.

Sugar cane (map unit 4, total: 914 ha) is the most extensively grown crop in the area, for the major part at Worthy Park Estate. Sugar cane is grown there as rainfed crop. Mechanized land preparation is carried out and experiments are being conducted with mechanical reaping of the cane. All other activities such as weeding and cutting are done manually. Chemical fertilizers are applied in split-applications at a rate per crop/ratoon of 560 kg/ha of 17-0-26 and 1340 kg/ha filtermud (organic by-product of the sugar preparation process to which sodium carbonate is added) as P-fertilizer and to increase the pH of the soil.

Several sugar cane varieties are being tested at Worthy Park by a "trial and error" method. Scientific research is done by the Sugar Industry Research Institute in Mandeville.

The sugar mill is located at the Estate (map unit 4A, 10 ha); the average annual production is 21,000 tons of sugar per year, which is about 10% of Jamaica's total sugar production. The sugar is mainly produced for export.
For each ton of sugar, about 9-10 tons of cane are used; Worthy Park has the lowest cane/sugar ratio compared to other sugar factories in Jamaica. The cane is partly (35%) grown in large fields of the Estate (640 ha with a relatively high cane production of 85 tons/ha). The remaining 65% is produced by large farmers in the Bog-Walk area (25%) and in fields of small farmers (40%) of Tydixon and other villages west and south of Lluidas Vale, outside the survey area. Small farmers have a mean acreage of about 1 ha, manually prepared, under cane. The sugar production per ha is smaller for small farmers than at the Estate, partially due to the poor transportation facilities from the fields to the factory. During the out-of-crop season and when times are hard for sugar production, farmers grow other crops (Craton and Walvin 1970).

<u>Coffee</u> (map unit 5, total: 40 ha) is grown on lands leased by Worthy Park Estate to CIDCO. The fields are located in the hills, along the road from Ewarton to Lluidas Vale. The production is considered low; the trees are in poor condition. The management level of the fields is moderate, i.e. fertilizers are used but not the proper type nor in the right quantities and ratios. Picking is done manually by women. The coffee produced in this area is lowland coffee for consumption within Jamaica. Although St. Catherine used to be one of the leading parishes in coffee production, the acreage under coffee is low nowadays.

<u>Citrus</u> orchards (map unit 6, total: 389 ha), mainly with oranges, are found within Worthy Park Estate as well as at Ewarton. Very few orchards are located in the hills.
The Estate expanded the area under citrus since 1980, by planting and grafting the former improved pastures with oranges, tangerines and uglies. In the beginning of this century, these areas were used for cocoa and bananas. The present citrus acreage is about 360 ha. No irrigation is applied,

but regular fertilizing and some spraying are done. Half the area has trees of an average age of 30 years, which receive 4.5 kg of 18:9:18 fertilizer per tree per year at a density of 250 trees per ha. The other half of the area has trees which are 3 years old (on average) and receive 2.7 kg of 18:9:18 per tree at a density of about 475 trees per ha. The whole area is treated with herbicides.
The citrus yields decrease from south to north, as a result of differences in rainfall and soil conditions. Praedial larceny plays an important role in yield losses next to fungus infestations which cause the fruit to fall off in the earliest stages of growth.
Citrus yields for the older trees are about 80 kg/tree; yields for the younger trees have not been established yet. Trials on the density of the trees as well as on improving the external fruit quality (through spraying) are carried out at the Estate. The citrus is produced for the fresh fruit and for the juicing market, in Jamaica as well as abroad.
In Ewarton and Riverhead there are two nurseries (map unit 7; 8 ha) which produce citrus seedlings, but also other fruit and food trees, as well as ornamental plants. Several citrus orchards are located close to these nurseries.

Food forests (map unit 8, total: 391 ha) are usually located in the surroundings of rural communities and along the main roads, like the road from Ewarton to Ocho Rios. According to the data of the Agricultural Census of 1988 (see Appendix IIIA), the food forests, cultivated by small farmers, mainly include bananas (grown by 58% of the farmers), coffee (38% of the farmers), cocoa (20%) and other tree crops like citrus and pimento (60%). These products are sold to the Jamaican industries and markets. Fruits of other tree crops like mango, otaheiti apple, guava, ackee and breadfruit are mainly for home consumption. Mango and otaheiti apple are also sold along the roads. At the time of the Census in August 1988 about 990 ha of land in the survey area was in use as food forests and for domestic crops, as described under mixed crops below.

Mixed crops (map units 9 and 10, total: 370 ha) are grown intensively and extensively. From the quarterly reports of the extension officers of Lluidas Vale and Ewarton about interviews of small farmers (see Appendix IIIB), it follows that pulses (mainly gungo peas) and vegetables (mainly carrots, cho-cho) are the major subsistence crops grown. Whenever possible, products are sold to higglers of Kingston and Spanish Town or sold at the market of Linstead. Pumpkins and pineapples are locally grown under intensive cultivation at high management level (irrigation). Pumpkins are sold on the export market; the pineapple production went down due to a break-down of the irrigation system.

The areas of intensive mixed crops immediately north and south of the Worthy Park Estate mainly comprise small farmers' sugar cane fields.

Poultry enterprises (map unit 11, total: 16 ha) i.e. large chicken-coops are found in Ewarton, Polly Ground and Charlton, many of which were destroyed by hurricane Gilbert in 1988. Production of chickens was to satisfy part of the Jamaican demand for chicken meat. It is claimed that due to water pollution from the red mud lake, the rearing of chickens is in problems (see Sub-chapter 2.5). From 1989 Worthy Park Estate started developing large a chicken farm in the area.

Pastures and grasslands (map units 12 and 13, total: 292 ha) mainly occur as unimproved grassland scattered in between the hills and also in the inland basins. Very few cattle graze on these lands, which are not maintained. Almost every farm households interviewed in the 1988 Agricultural Census had at least one donkey; only very few cattle was found on the small farmers' enterprises.
Former improved pastures within the Worthy Park Estate have now been converted into citrus orchards; the cattle of the Estate (500 heads) is kept on 800 ha of marginal pastures, partly in the survey area.

Forests (map units 14, 15, 16 and 17, total: 7425 ha) cover about two-third of the survey area (mainly in the hills) and play their role in maintenance of the watersheds. The vegetation varies from thin, poor, secondary forests (Vernon 1958) in the south and west to lush broad-leaf forests, including valuable species of trees, in the central-northern part of the area. The broad-leaf forests are partly mixed with coniferous trees at the highest elevations in the north of the survey area.
Some areas surrounding the Lluidas Vale (40 ha) have been planted by the Estate to timber (mahoe, mahogany, cedar, kola-nut), but those trees were usually cut by small farmers for use as yam-sticks, before they reached any market value.
The bamboo forests found in the Lluidas Vale grow along Rio Cobre and some sinkholes. Very little use is made of the bamboo. Some coconuts are planted in between the bamboo. A small coconut forest is found along the river, close to Worthy Park Estate.

Miscellaneous types of land cover are residential areas (map unit 1, total: 255 ha) as mentioned in Chapter 2.1, a small mining area in the north-east of the survey area (map unit 2, 16 ha) and some lakes, including the ALCAN red mud lake (map unit 3, 40 ha). Some eroded lands, surrounding the landslides in Ewarton, now under a very thin grass cover, have been indicated separately (map unit 18, 266 ha).

Legend for Figure 5.

Miscellaneous:

---- roads

1. Rural residential areas
2. Bauxite mines
3. Lakes (3A: red-mud lake)

Crops:

4. Sugar cane (4A: sugar mill)
5. Coffee
6. Citrus
7. Nurseries
8. Food forests (> 85% of fruit trees)
9. Intensive mixed crops (> 60% of annual crops)
10. Extensive mixed crops (15-60% of annual crops)

Livestock:

11. Chicken farms

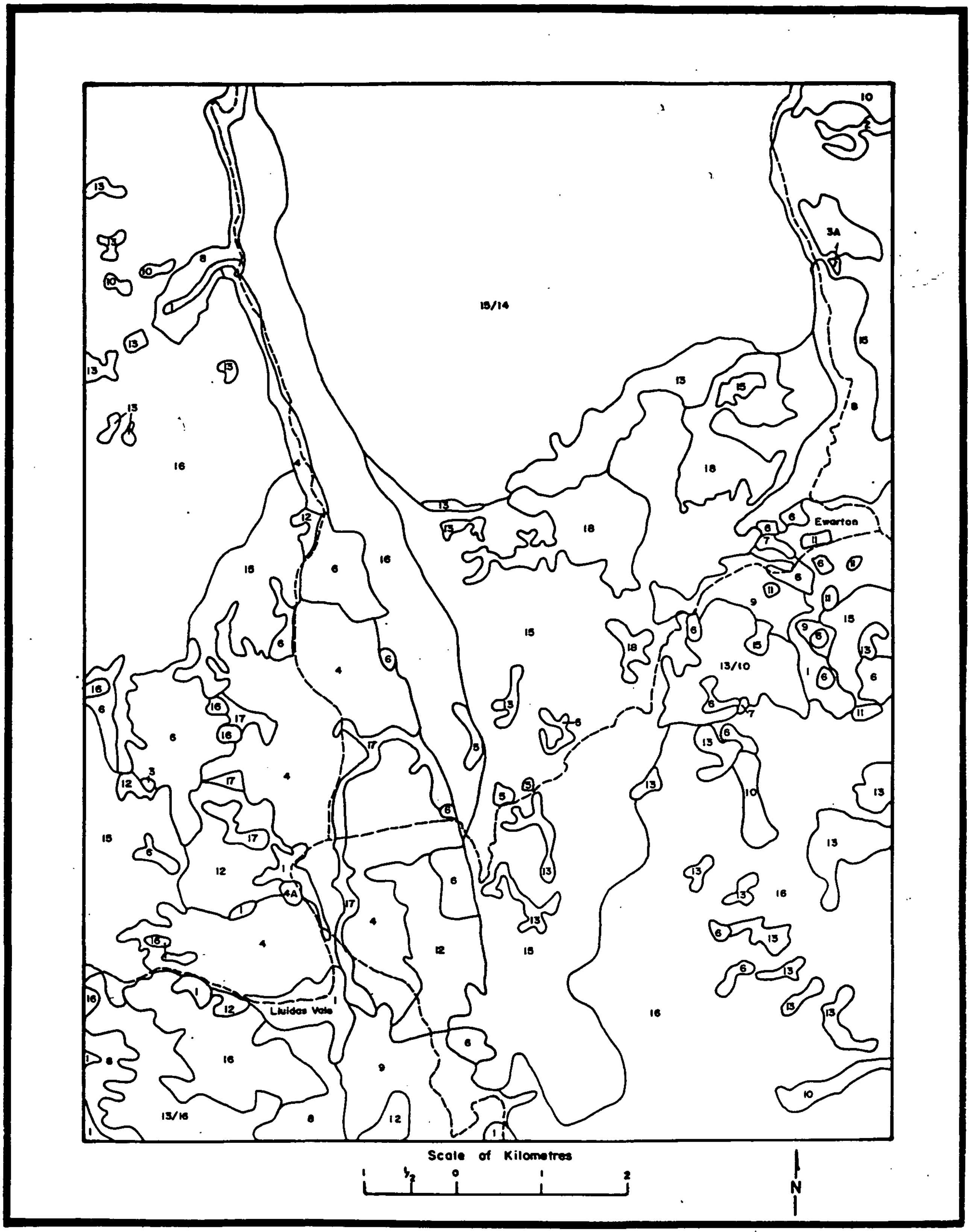
Grasslands:

12. Improved pasture
13. Unimproved pasture/grassland

Forests:

14. Coniferous forests
15. Broad-leaf forests (including commercially valuable species)
16. Degraded broad-leaf forests
17. Bamboo forests (including coconut trees)
18. Eroded lands

Figure 5. Land cover map of the Lluidas Vale area (prepared by P. van Gent).



3. MATERIALS AND METHODS

3.1 OFFICE PREPARATIONS

Prior to the field work, relevant and available maps and other materials were studied. The most important maps and photographs are listed in Table 8.

Table 8. Maps and photographs used during office preparations.

type	number	scale	publisher	year
Toposheets	84A, 84C	1:12,500	Survey Dept.	1972
Toposheet	G	1:50,000	Survey Dept.	1973
Toposheets	8, 12	1:50,000	Survey Dept.	82/83
Geological sheet	19	1:50,000	Mines & Geology Div.	1970?
Validation index map	108, 128	1:12,500	RRC (1958-1970)	1958/68
Land use map	-	1:50,000	CRIES/RPPD	1986
Aerial photographs (black&white)	R. 28: 50-57 R. 31:14-21	1:24,000	Survey Dept.	1961
-do- coloured infrared	R3.St6A:19-22 R6.St5:34-36	1:50,000	Survey Dept.	1983

Note: R= run; St= strip

Climatological data (rainfall, sunshine duration, relative humidity, wind) were retrieved from Jamaica Meteorological Service (JMS 1973, JMS 1979).
The main sources of information on geology and hydrology were the Synopsis of the Geology of Jamaica (Zans et al. 1962) and Water Resources Appraisal of the Upper Rio Cobre Basin (WRD 1983).
Information on land use came, apart from field observations, from the sources as mentioned in Chapter 2.6, i.e. CRIES/RPPD (1982), Data Bank of the Ministry of Agriculture, the Land Authority Office in Linstead and the Management of Worthy Park Estate.
The validation index sheets, which accompany the Soil and Land Use Surveys No. 1 (Vernon 1958) and No. 24 (Barker 1968), give information on the soils and its capabilities for land use as surveyed in the '50s and were used for comparison of the mapping units between the present and the former survey.

At first Aerial Photo Interpretation (API) of black/white photographs was carried out, revealing preliminary soil boundaries, accompanied by a preliminary legend. On basis of this interpretation 4 sample areas were selected on map sheet 84C, two of which were located in the hills and two in the inland basin. These sample areas were expected to show the majority of the soils and their physiographic relations. The location of the sample areas is indicated in Figure 1. The toposheets 84A and 84C (1:12,500) were used as field maps; the boundaries of the API units and sample areas were manually transferred to these maps.

The slope map was prepared from a 1:25,000 copy of the base map; the areas of different slope classes were identified with the help of a transparent sheet on which the distances of the contour lines were indicated at 2, 5, 8, 16, 30 and 50% slopes, the so-called slope-ruler.

The base map for the final soil map at scale 1:25,000 was prepared from the reduced toposheets 84A and 84C. From the reduced map, a sepia copy was derived through Xerox, after which another copy was prepared at sepia film. The soil boundaries were drawn on this sepia film copy, so that the final soil map has a subdued background of the topographical features.

3.2 FIELD PROCEDURES

The field work was carried out mainly in two periods: June 1986 and late 1988/early 1989. The majority of the observations for map sheet 84C and all for map sheet 84A were done in the latter period.

Auger borings and profile pits were used for the characterization of the various soils. In the sample areas auger observations were done along transects and the remaining observations were made according to the "free survey" technique. A total of 263 observations was made (on average: 1 observation/42 ha, with about a double density of observations in the inland basins).

A total of 30 profile pits was described, 22 of which are presented in this report. These 22 pits are the best representatives of the identified soil series, and have complete soil description and analytical data. Each pit was 1 m by 1.5 m wide and 150 cm deep or to the bedrock, whichever was shallower. The soils are described according to the Guidelines for Profile Description (SSU 1989a), partially based on the Guidelines from FAO (1977). The colour notation is according to the Munsell Soil Color Charts (Munsell 1975). From each horizon described, a bulk sample was taken for chemical and textural analyses. Samples from selected horizons were taken for moisture availability determination. An additional set of samples was taken from each profile to serve as a reference for soil correlation purposes, in so-called correlation boxes.

During the field work the API map gradually evolved into the soil map by regular updates. Simultaneously, the legend to the soil map was developed into its final shape.

Two excursions to the survey area were organized for all Soil Survey Staff, in May and December 1988. Students from the College of Agriculture in Port Antonio carried out summer work in the survey area.

3.3 MAP COMPILATION

After checking the consistency of the map, the two field maps were compiled into a final soil map which was manually transferred to the 1:25,000 base map. The slope map was superimposed onto this map, after which the final version of the soil map was obtained and the legend was added. A blue-print copy of the final soil map is added to the report as Enclosure 1.

3.4 LABORATORY PROCEDURES

The soil samples taken in the field were delivered to the laboratory, where they were dried overnight at 35-40°C (air-dry). Subsequently the gravel is taken out and the soil material was crushed in a cross beater mill, after which the soil was passed through a 2 mm sieve, giving the fine earth fraction. This fraction was used for the chemical and textural analyses. Separate samples (core rings and soil clods) were taken for bulk density and moisture content determinations.

The procedures for chemical and physical analyses (SSU 1988c) are described below, as carried out on the samples taken in 1988 and later.

Available K: Potassium is extracted with 0.5 M acetic acid. In the extract K is determined flame-photometrically.

Available P: (according to Truog). Phosphate is extracted with 0.002 M sulphuric acid, buffered at pH 3.0 with ammonium sulphate. The phosphate in the extract is determined spectro-photometrically.

Bulk density: Bulk density is determined by drying a known volume (100 cc) of undisturbed soil at 105°C, after which the oven-dry weight of the soil is divided by the volume of the soil.

Calcium carbonate: (according to Van Wesemael; only in samples with pH(H_2O) > 6.5). Gravimetric determination of the loss of weight, after treatment with 4N $HClO_4$.

CEC(-NH_4OAc): For the cation exchange capacity, the sample is leached subsequently with 1 M ammonium acetate at pH 7.0, 80% ethanol to wash out the excess of ammonium and 10% KCl at pH 2.5 to replace the absorbed ammonium. In the leachate, ammonium is determined by distillation and titration.

EC (1:2.5): The electrical conductivity is measured in a 1:2.5 soil-water extract.

Exchangeable acidity/aluminium: (only in samples with pH < 5.5). The soil is leached with 1 M KCl. Exchangeable acidity (Al + H) and aluminium are determined titrimetrically.

Exchangeable bases: Exchangeable Na and K are determined flame-photometrically in the leachate of the CEC-determination. Exchangeable Ca and Mg are determined in the same leachate using an atomic absorption spectro-photometer.

Organic carbon: (according to Walkley and Black). Organic matter is oxidized with an excess of potassium dichromate in an acid medium. The excess is back-titrated with ferrous ammonium sulphate.

Particle size analysis: (pipette method). The sample is pre-treated with H_2O_2 and sodium acetate, in order to remove organic matter and $CaCO_3$. After dispersing with Na-hexametaphosphate, the clay and silt fractions are calculated for samples, taken from the suspension with a pipette. The total sand fraction is determined by wet sieving; the different sand fractions are determined after dry sieving.

pH (H_2O): Potentiometric determination in a 1:2.5 soil-water suspension.

pH (KCl): Potentiometric determination in a 1:2.5 soil-1 M KCl suspension.

Total N: (according to Kjeldahl). Digestion of the sample with sulphuric acid, potassium sulphate and selenium, is followed by distillation of the ammonium obtained and subsequent titration.

Water dispersible clay (natural clay): As clay determination for particle size analysis, but without pre-treatment (i.e. no adding of H_2O_2, sodium acetate and Na-hexametaphosphate).

Water holding capacity (pF values): After the sample is saturated with water, it is brought to different moisture tensions (pF-values). When the moisture content in the sample is in equilibrium with the tension set, the sample is weighed. After that it is brought to a higher tension (maximum pF 2.7). Finally the dry weight is determined. The moisture content is calculated from the weight at a specific tension and the dry weight. At pF 3.0 to 4.2, the moisture content is determined from soil clods.

Chemical analyses for samples taken before 1988 are analogue to the procedures as described above, except for calcium carbonate (formerly the rapid gravimetric determination of the loss of weight after treatment with 5N HCl, was used) and texture. For texture determination, the hydrometer method was used, whereby the clay and silt fractions are determined with a hydrometer after dispersion, usually resulting in lower clay figures as compared to the pipette method. This is followed by wet sieving, washing and drying of the particles from the suspension. The sand fractions in the dried sample are determined by sieve analyses.

Derived values, necessary for soil classification were calculated as follows (SSU 1989b):

Al-saturation: Aluminium saturation is calculated as the exchangeable Al divided by the sum of the exchangeable bases and exchangeable acidity; the quotient is multiplied by 100%.

Available moisture: Moisture content at pF 2.0 minus moisture content at pF 4.2.

BSP: The Base Saturation Percentage is calculated as the sum of the exchangeable bases divided by the CEC(-NH_4OAc); the quotient is multiplied by 100%.

CEC-clay: CEC(-NH_4OAc) divided by the clay percentage; the quotient is multiplied by 100%. CEC-clay is not corrected for organic carbon following the USDA-convention.

Dispersion ratio: Water dispersible clay divided by the clay percentage obtained using the dispersing agent; the quotient is multiplied by 100%.

C/N: Organic carbon divided by total nitrogen.

ECEC: The Effective CEC is the sum of exchangeable bases (in NH_4OAc) and exchangeable acidity (in 1 M KCl).

ECEC-clay: ECEC divided by the clay percentage; the quotient is multiplied by 100%. ECEC-clay is not corrected for organic carbon.

ESP: The Exchangeable Sodium Percentage is calculated as the exchangeable Na divided by the CEC(-NH_4OAc); the quotient is multiplied by 100%. If there is soluble Na, the quantity must be determined and subtracted from the exchangeable sodium, before calculating the ESP.

Exchangeable Ca: Only in $CaCO_3$-rich, non-saline (ECe < 4 MS/cm) soils the exchangeable Ca is estimated by CEC(-NH_4OAc) minus the sum of exchangeable (Mg + Na + K).

Sum of exchangeable bases: Sum of exchangeable (Ca + Mg + Na + K)

4. THE SOILS

4.1 PREVIOUS WORK

As mentioned in Chapter 1, Jamaica has been surveyed in the '60s, which resulted in the publication of the "Soil and Land Use Surveys" (RRC 1958-1970) accompanied by a soil map at scale 1:50,000. The Lluidas Vale area was surveyed as part of the parishes of St. Catherine (Vernon 1958) and St. Ann (Barker 1968).

As was noted in the Montpelier Soil Survey Report (SSU 1989e), the soil concepts as identified during the former "Soil and Land Use Surveys" are not always satisfactory because of the wide range of characteristics that can be ascribed to some of these concepts. In addition, the boundaries of the map units were often found to be incorrect; this was found more in the western part of the island than in the first surveyed areas (e.g. St. Catherine and St. Andrew). The general information in the "Soil and Land Use Surveys" on relief and drainage, vegetation, the population, agriculture and infrastructure indicate a thorough study of these subjects at the time, but part of the information has now become obsolete.

The new surveys of the Jamaican soils started in 1983 under the Jamaica Soil Survey Project of the Ministry of Agriculture. This survey is a part of these new surveys, aiming at the same time at developing a new methodology for soil survey and land evaluation (SSU 1989f). In these surveys, soils are classified according to the USDA Soil Taxonomy.

Apart from the island wide soil survey, some ad-hoc surveys have been carried out at the Worthy Park Estate (pers. comm. WPE-management). These included a survey for economically viable land use, concluding that 800 ha within the inland basin were sound for "plantation crops" like sugar cane and citrus.

4.2 CLASSIFICATION OF THE SOILS

4.2.1 General

In order to fully comprehend the soils of Jamaica, they have to be grouped in a classification system. A soil taxonomic classification system is a creation of man in which each class or taxonomic unit has a central concept, which is used as a basis for classification. A permissible range in characteristics deviating from the central concept, defines the domain of the taxonomic unit.

For instance the concept of a certain taxonomic unit may require shallow soils over limestone rock. Then the range in soil depth allowed within that taxonomic unit is from 25 to 50 cm.

The most comprehensive taxonomic classification system available to date is the USDA Soil Taxonomy (Soil Survey Staff 1975 and 1987). This system has been used by the staff of the RPPD since 1978.

The USDA Soil Taxonomy presents the following advantages:
- it enables an understanding of the relationships between soils and their environment, thus allowing for the comparison or transfer of knowledge between similar geographical locations, both nationally and internationally
- it can be used to distinguish well defined mapping units during the survey
- it provides a basis for the interpretation of soil data for selected kinds of land use (i.e. land evaluation).

4.2.2 The use of USDA Soil Taxonomy in Jamaica

The USDA Soil Taxonomy is a hierarchical system in that units at the highest level of generalization are subdivided into more detailed sub-units, which are in turn further subdivided and so on. The hierarchical sequence in the successive categories from high to low is as follows:
ORDERS-SUBORDERS-GREAT GROUPS-SUBGROUPS-FAMILIES-SERIES.

The grouping of soils in a specific unit at each level is based on combinations of relatively permanent diagnostic soil characteristics, whose occurrence and range can be established by relatively simple measurements and observations in the field and laboratory (e.g. texture, colour, soil reaction, depth to bedrock, soil temperature, cation exchange capacity, organic carbon content). From the level of the orders down to that of the series the diagnostic characteristics become more narrowly defined.

ORDERS consist of soils with similar properties, resulting from the same soil forming processes, which acted to the same degree on the parent material or rock. Six out of the ten orders that are recognized by Soil Taxonomy have been identified in the Lluidas Vale survey. The dominant, generalized characteristics of these orders are briefly discussed so as to enhance the user's understanding of the technical classification which is used in Sub-chapter 4.5 in the description of the soil mapping units. All details are explained in the Keys to Soil Taxonomy (Soil Survey Staff 1987).

<u>Oxisols</u> are very strongly weathered soils high in low-activity clays, in which the clay content does not show the substantial increase like in Alfisols or Ultisols, or strongly weathered soils which have more than 40% of clay in the surface 18 cm.

<u>Vertisols</u> are mineral soils that have 30% or more clay, deep wide cracks when dry and intersecting slickensides or wedge-shaped natural structural elements. The shrinking and swelling is due to the high amount of montmorillonitic clay minerals.

<u>Ultisols</u> are mineral soils which have a horizon with a higher clay content due to illuviation and a low base saturation in the subsoil (125 cm below the upper boundary of the illuvial horizon).

<u>Mollisols</u> are mineral soils that have a thick dark coloured surface layer which has a high organic matter content. The soils have a high base saturation throughout to a great depth and a moderate to strong structure.

<u>Alfisols</u> are mineral soils with a substantial accumulation of clay in the B-horizon and a high base-saturation in the subsoil (opposite to Ultisols). They do not have the dark coloured topsoil of Mollisols.

<u>Inceptisols</u> are mineral soils that have one or more horizon(s) developed through soil forming processes in which minerals are altered or removed, but not accumulated. In general Inceptisols have weakly differentiated profiles and are on recent land surfaces or on old land surfaces that are being rejuvenated.

SUBORDERS are subdivisions of orders, based on characteristics that produce classes with the greatest genetic similarity. These characteristics are mainly soil temperature and soil moisture regime.

GREAT GROUPS are subdivisions of suborders based on uniformity of type and sequence of major horizons and their features. At this stage of classification, horizons are considered with the following features:

- accumulation of clay, iron and/or humus
- occurrence of thin, hard pans, which interfere with root growth and the movement of water
- occurrence of similar temperature and soil moisture regimes
- occurrence of similar base saturation.

Some characteristics that are considered in this survey at the great group level are: high base saturation (Eutro-), low CEC and ECEC in the illuvial horizon (Kandi-), an off-white sandy eluvial horizon (Alba-), grey colours (Chromu-) and a thick illuvial clay horizon (Pale-)

SUBGROUPS are divisions of great groups. The constituents of the "Typic" subgroup have characteristics that are representing the central segment of the group. The other subgroups have the properties of one great group and also one or more properties of another great group, suborder or order and are known as "intergrades".

FAMILIES are members of a subgroup. Each family has physical and chemical properties that affect soil management in a similar way. Families in the survey area are predominantly distinguished on the basis of:
- particle size class of the control section
- mineralogy of the corresponding horizons
- soil temperature regime.

The SERIES is the lowest category in Soil Taxonomy. A series may have virtually the whole range in characteristics that is permitted for a specific family, but it must have one or more specific properties that have a restricted range and can be deduced with reasonable accuracy while mapping. Series mainly are of a pragmatic nature; series in a specific family have similar suitability for agriculture.

In Jamaica, Series names are used as the "root" for naming the soil mapping units. Series names used in the present survey, are partly based on the Green Book soil concepts (RRC 1958-1970). The range of characteristics of the new soil concepts is much more narrowly defined than in the original Green Book concepts. Some of the Green Book soil concepts were omitted and for some soils, new series had to be defined, not related to any of the Green Book soil concepts.

The classification of the soils recognized in this survey is presented in Appendix V; it shows the Soil Series names, the USDA classification at Subgroup and family level, and the mapping units in which the Soil Series occur.

An example of the use of the nomenclature is Tydixon sandy loam (Jamaican Series level); these soils are classified as coarse loamy over clayey, mixed, isohyperthermic Aeric Albaquults. The hierarchical nature of the system is reflected in the name of the taxonomic unit. For instance, Aeric Albaquults at subgroup level consist of the following contributions at the different levels:

-ults	stands for the order of Ultisols
-aqu-	stands for the suborder of Aquults
-Alb-	stands for the great group of Albaquults
Aeric	stands for the Aeric subgroup of the Albaquults.

At family level is added: "coarse loamy over clayey, mixed, isohyperthermic" for the particle size of the control section, the mineralogy of the control section and the soil temperature regime respectively.

4.3 COMPILATION OF THE MAP LEGEND

The legend to the soil map (see Appendix VII) consists of a listing of the different mapping units appearing on the soil map. The legend is structured using three entries, according to the Soil Legend Framework for Jamaica (SSU 1988b). The first entry is Landforms, followed by Lithology, while the third entry represents the general soil characteristics. On the map (not in the legend) the map units are subdivided in phases based on the average slope gradient.

Three different landforms are distinguished within the Lluidas Vale Survey, i.e. Hills and Foothills, Inland Basins, and River Plains (see Sub-chapter 2.3). They are described in terms of their overall relief intensity, average slope gradient and mean elevation. Relief intensity is defined as the vertical distance between high points (e.g. summits) and low points (e.g. valleys). Table 9 gives the specifications of the occurring landforms.
Areas of non-soil key out at the first level as miscellaneous land types (N).

Table 9. Landforms of the Lluidas Vale area.

code - landform	overall relief intensity (m)	slope class (average slope gradient)	mean elevation above msl. (m)
H - Hills and Foothills	20-200	variable, but >16%	260-900
B - Inland Basins	5-20	almost flat to undulating (0-16%)	260 and 370
P - Plains (i.e. river plain)	<10	almost flat to gently undulating (0-5%)	260 and 350

The second entry of the legend is Lithology (see Sub-chapter 2.4). A differentiation is made between Parent rocks which denotes the non-consolidated bedrock underlying the soil profile, and Parent materials which is an unconsolidated derivative of one or several types of parent rock. The different parent rocks/materials as distinguished during the Lluidas Vale Survey are listed in Table 10.
Within the miscellaneous land type, two subdivisions are recognized: ponds (p) and rural residential areas (u).

Table 10. Lithology of the Lluidas Vale area.

code	lithology
Parent rocks:	
L	Hard Limestone
J	White rubbly and soft yellow Limestone
X	Hard Limestone and fluvio-colluvial admixtures
Parent materials:	
O	Old Alluvial deposits
R	Recent Alluvium
F	Fluvio-colluvial deposits

The third entry is for soil characteristics; a short description of the major soil(s) within the mapping unit is given.

Each mapping unit description starts with a code (for correlation to the map), and is followed by the name of the major Soil Series, a short description of the characteristics of the major soil(s) and the USDA Soil Taxonomy classification name.

The code is made up of three symbols referring to the legend entries, the first for landform, the second for lithology and the third for soil characteristics (arabic figure). In case the mapping unit includes only one soil (whereby 25% of inclusions are allowed), the mapping unit is called Consociation (see Glossary) and the code will look like (e.g.) BO3. If two or more major soils are distinguished within the map unit, x or y are placed in between the second and third abbreviation, and the code will look like (e.g.) PRx1 or BOy1. The "x" indicates the mapping unit is a Complex; the "y" indicates an Association. A complex has such an intricate soil pattern that even at a larger scale of mapping, the pattern can not be drawn, while in an association it can be mapped. Both types of mapping units allow for 25% of (minor) inclusions.

Next is the name of the major Soil Series, in case of a consociation, followed by the texture of the topsoil. For complexes and associations the names of the major soils are given, but the textures of the topsoil are omitted, unless they are the same for all major soils.

This is followed by the descriptive part of the legend including a.o. soil depth, drainage class, moist colours, textural class and special features. Terminology for textural classes can be found in Appendix VII, which presents the legend to the soil map. The soil depth classes used by the Soil Survey Unit are: very shallow < 25 cm; shallow 25-50 cm; moderately deep 50-100 cm; deep >100 cm. The map unit description is terminated with the USDA Soil Taxonomy classification name at family level for the major soils. The definitions of the particle size classes as used at family level can be found in the Glossary and in Appendix VII.

Mapping units are further differentiated, where appropriate, into slope classes. They are indicated on the map, but not in the legend. The key to the slope classes is shown in Table 11. Stoniness is not separately indicated on the map, due to its strong relationship with soil depth. The latter is already indicated in the descriptive part of the map units.

Table 11. Key to the slope classes.

code	average slope gradient (%)	single slope	complex slopes
a	0-2	almost flat	flat to almost flat
b	2-5	very gently sloping	gently undulating
c	5-8	gently sloping	undulating
d	8-16	sloping	rolling
e	16-30	moderately steep	hilly
f	30-50	steep	steeply dissected
g	>50	very steep	v. steeply dissected

4.4 GENERAL CHARACTERISTICS OF THE SOILS

The Lluidas Vale area is characterized by Old and Recent Alluvial Deposits of the Lluidas Vale Inland basin and the fringes of the St. Thomas in the Vale (or Linstead) Inland basin, surrounded by Hills and Foothills (Figure 3). The distribution of the soils is largely determined by the physiography (Sub-chapter 2.3) and parent rocks/materials (Sub-chapter 2.4), as is described in the following three Sections. Classification of the described soil characteristics is according to SSU (1987c and 1989a), partially summarized in the Glossary. Table 12, at the end of this Sub-chapter, shows a summarized overview of Soil Series characteristics.

4.4.1 Soils of the Hills and Foothills

The soils over limestone Hills and Foothills have by far the largest extent in the survey area. Mountain Hill, St. Ann variant I, Swansea and Bonnygate soils are found over Eocene hard White Limestone, mainly in bauxitic deposits. Union Hill and Union Hill variant I soils are formed over formations of Eocene, Miocene and Oligocene White Limestone. On soft rubbly Yellow Limestone Mount Rosser and Carron Hall soils have developed. All these soils occur mainly in dissected and steeply dissected areas and partly in hilly areas. Due to the prevailing steep slopes, erosion is a problem when the soils are not kept under a vegetation cover.
According to the Agro-climatic Zones map of Jamaica (SSU 1989i) the whole area is located in the wetter part of the Intermediate Moisture Availability Zone (MAZ) and the drier part of the Wet MAZ; the soil moisture regime is predominantly udic, whereby the Union Hill and Union Hill variant I soils occur in the transition zone of the ustic to udic soil moisture conditions, in the Eastern part of the survey area.

<u>Mountain Hill soils</u> are deep, well drained, red, fine textured, and occur in undulating valley bottoms. The structure is weak to moderately well developed in heavy clay; the structure is mainly determined by clay-aggregates of 0.5-1 cm in diameter. The organic matter content is high. The soils have a gibbsitic mineralogy, and a low CEC and base saturation. The available phosphorus content is extremely low, as is the inherent fertility (related to the Effective Cation Exchange Capacity, ECEC). The available water capacity (AWC) is moderate and the permeability is high. The low pH in the topsoil differentiates Mountain Hill soils from other deep, red soils developed in bauxitic deposits.

Bonnygate soils are very shallow, excessively drained, and fine textured but stony. The colour range of these soils is quite wide, from dark yellowish brown to dark red, but the majority of the soils is yellowish brown to yellowish red. Bonnygate soils occupy steep and very steep slopes, susceptible to erosion, in an intricate pattern with limestone outcrops. The soil structure is not very well developed. The amount of organic carbon varies, but most soils have a moderate organic matter content. The soils are of mixed mineralogy, contain free calcium-carbonate and are slightly alkaline. The soils are highly permeable and droughty.

St. Ann variant I soils are deep, well drained to excessively drained, dark red to red and fine textured, with gibbsitic clay-aggregates throughout the profile. They occur on the less steep slopes of the steeply and very steeply dissected, well developed karst landscape and in small valley bottoms. The clay-content in the subsoil increases to 80-90%. The structure is good, but the silty topsoil makes the St. Ann variant I soils susceptible for erosion of the A-horizon. The organic matter content of the topsoil is high. The mineralogy of these slightly alkaline soils is gibbsitic. Consequently the Cation Exchange Capacity (CEC) and inherent fertility are low. Phosphorus availability is extremely low as P-fixation occurs to a great extent. The permeability is high and the soils are slightly susceptible to drought. The true St. Ann soils are supposed to be Rhodic Eutrudoxs, which have not been described in any of the Soil Survey Reports yet.

Swansea soils are intermediates between the very shallow Bonnygate soils and the deep St. Ann variant I soils. The soils are moderately deep, well to excessively drained, dark brown to red and yellowish red silty clay over clay. The depth varies considerable over short distances. They occur on less steep slopes and on saddles. The appearance and properties of Swansea soils are mainly the same as those of St. Ann variant I soils, i.e. high in organic matter in the topsoil, gibbsitic mineralogy, low inherent fertility and strong P-fixation. The soils have a moderate AWC and a high permeability.

Union Hill soils as described in the Linstead-Bog Walk report (SSU 1987b) are shallow, well drained, reddish brown to dark yellowish brown and fine textured. The soils occur in rolling to steeply dissected areas associated different formations of limestone outcrops. Their structure is moderately well developed. The organic matter content in the topsoil is high. The inherent fertility is moderate in these neutral to slightly alkaline soils. Union Hill soils show cracks in the topsoil in dry periods. Therefore the infiltration is high in and immediately after the dry season, while the permeability is moderate when the soils are wet. The AWC is low.

Union Hill variant I soils are deep, well drained, dark (greyish) brown to strong brown and yellowish brown and fine textured. They occur in the same areas as Union Hill soils, but on less steep slopes. Consequently the soils are deeper and have a higher organic matter content in the topsoil. The structure is moderately well developed; very slightly developed vertic properties are found. The soils have a low CEC and inherent fertility. P-fixation seems a problem like in the St. Ann variant I soils. The AWC is moderate, and the soils have a high permeability, thus making them susceptible to drought.

Mount Rosser soils are shallow, well drained and dark greyish brown to strong brown. The texture is fine, with limestone gravels and stones. The soils occur on the steep to very steep slopes over soft and rubbly limestone, associated with the Mount Diablo Inlier. The soil structure is not very well developed. The organic carbon content is high. The inherent fertility of these calcareous soils is high, while the mineralogy is mixed. The AWC is low and the soils are highly permeable and susceptible to drought.

Carron Hall soils are described in the Linstead-Bog Walk survey report (SSU 1987b) as follows: moderately deep, well drained, brown, cracking clay over a yellowish brown to brownish yellow subsoil. Carron Hall soils occur mainly in areas bordering the soft limestone outcrops surrounding the Central Inlier. These highly calcareous soils are of montmorillonitic mineralogy and show marked swell-shrink properties. The inherent fertility and base-saturation are high. The AWC is low. During the Watermount Survey (toposheets 85A and 85C) the characteristics of these soils will be further defined.

4.4.2 Soils of the Inland Basins

Two Inland Basins are recognized in the survey area, i.e. the Lluidas Vale basin and the north-western "fringes" of the Linstead basin. Soils mapped in the Old Alluvial deposits of the Lluidas Vale basin are Pennants variant I, Tydixon, Knollis and Brysons variant I and II, related to different deposit- and erosion levels. They have high exchangeable magnesium contents, a low AWC and are typically mottled in the subsoil resembling "corned beef" (see Section 4.5.1). They all have an almost flat to gently sloping topography; the Pennants variant I soils partially are more dissected by gullies to a rolling topography. The Lluidas Vale basin lies in the wetter part of the Intermediate Moisture Availability Zone (MAZ, SSU 1989i); the soil moisture regime is udic.

In the Linstead basin Linstead variant I, Rosemere variant I and Riverhead soils are found in Old Alluvial deposits. These soils occur on the boundary of the dryer and wetter part of the Intermediate MAZ; soil moisture regime is

ustic to udic. In the soil classification, the moisture regime is indicated as udic.
In addition to the Old Alluvial deposits, some rolling fluvio-colluvial deposits are found in the south-eastern part of the Lluidas Vale basin, on which the Donnington variant II soils have developed.

Pennants variant I soils are deep, imperfectly drained, reddish and yellowish brown, and moderately textured, over a red-light grey mottled, very acid, fine textured subsoil. The textural change between the surface layers and the subsoil is abrupt. The soils occur on the (gently) undulating, northern terrace of the Lluidas Vale Basin; the terrace is dissected by gullies. The structure of the soil is well developed; in places slight cracking of the topsoil is observed. The organic matter content is high, but not high enough for a mollic epipedon. The mineralogy is mixed and the ECEC is moderate to high; up to 90% of the exchange complex is occupied by aluminium. The AWC is low, as is the permeability. The subsoil is droughty. Pennants variant I soils differ from Pennants soils (SSU 1987b) in that they show less prominent vertic properties and they are not neutral.

Tydixon soils are deep and poorly drained. The topsoil is greyish and the subsoil is grey, yellowish brown and slightly reddish mottled. The soils show an abrupt textural change from the moderately coarse textured topsoil, including an albic horizon, to the fine textured subsoil. Tydixon soils occur at similar elevations as Pennants variant I soils, while Knollis soils (described below) occupy somewhat higher positions in the landscape. The soil structure is moderately well developed. The topsoil has a very low organic matter content and a very low ECEC; the ECEC of the subsoil is moderate, while the exchange complex is largely occupied by aluminium. The permeability of Tydixon soils is low in the subsoil and the AWC is low throughout.

Knollis soils resemble Pennants variant I soils, but they occur on a somewhat more elevated, almost flat, terrace. The soils are deep and imperfectly to poorly drained. The topsoil is very dark grey(-ish brown) and the subsoil is mixed strong brown, yellowish brown and red, light grey mottled. The mottling becomes more pronounced with increasing depth. The soil is fine textured throughout and the structure is moderately well to well developed. There is a high organic matter content in the topsoil. The soil mineralogy is mixed; the subsoil is acid. The AWC is low, as is the permeability. Knollis soils are susceptible to drought.

Linstead variant I soils are deep, moderately well drained to imperfectly drained, fine textured and "corned beef" mottled. They occur in small patches on (gently) undulating slopes in the north-western part of the Linstead Basin. The structure is moderately well developed. Compared to Linstead soils of the Linstead-Bog Walk area (SSU 1987b), Linstead variant I soils do not have a montmorillonitic, but mixed mineralogy and no clear swell/shrink properties. The organic matter content is moderately high. The CEC is low as is the inherent fertility; the subsoil is neutral. The AWC and permeability, as in all soils formed over Old Alluvium, are low.

Rosemere variant I soils are like Rosemere soils as described in the Linstead-Bog Walk area (SSU 1987b), as well as like Linstead and Linstead variant I soils, from morphological and physiographical point of view. They are deep, moderately well drained with a "corned beef" mottled pattern in red-grey colours in heavy clay. The structure is weak to moderately well developed, with some pressure faces; the mineralogy is mixed. Rosemere variant I soils are very acid with a moderate ECEC (in comparison to Rosemere soils), a high exchangeable aluminium content below the top soil and a base saturation rapidly decreasing with depth. The inherent fertility is low. The AWC and permeability are low.

Riverhead soils, are deep, moderately well drained, mottled, fine textured and of mixed mineralogy. They resemble both Linstead and Rosemere soils and their respective variants and occur only in a small extent. The topsoil is dark and has a high organic matter content. Riverhead soils do not have the low pH and the high exchangeable aluminium levels of the Rosemere variant soils and the very low CEC of the Linstead soils. The AWC and the permeability are low.

Donnington variant II soils are different from all Inland Basin soils described so far. The soils are moderately deep, well drained, medium to moderately fine textured, and of mixed mineralogy. The colours of the different elements vary from yellowish red to strong brown in a reddish grey matrix. The soils are formed on transported pre-weathered conglomerates originating from the Central Inlier and occurring in a rolling landscape. The structure of the stone-size conglomerates is easy to recognize in the subsoil. The inherent fertility is high, as is the base saturation. Throughout the profile the pH is low and exchangeable acidity is present. The AWC is low and the soils are susceptible to drought. Erosion may occur where the soils are not kept under a vegetation cover.

Brysons variant I and Brysons variant II soils occur in the plainbands (Pfeffer 1986) of the Lluidas Vale Basin. Both soils are deep, imperfectly (to poorly) drained, fine textured with slickensides and cracks. They have yellowish red to red and strong brown mottles in a grey matrix. The mottling pattern and colours are more outspoken in the Brysons variant II soils, and resemble to a great extent those of Pennants variant I soils. Brysons variant I soils occupy the outer edges of the plainbands, while the Brysons variant II soils are located in the centre and towards the inland basin. Both soils are on gently undulating slopes. The Brysons variant I soils are slightly alkaline and have a montmorillonitic mineralogy. The CEC, base saturation and inherent fertility are high throughout the profile. The Brysons variant II soils have a mixed mineralogy, a heavy clay to great depth, and a moderately high CEC compared to the Brysons variant I soils; the pH of the subsoil is low and exchangeable aluminium levels are high. The AWC of both soils is low as is the permeability, although through cracks infiltration can be high, when the soils are not saturated with water yet.

4.4.3 Soils of the Plains

The soils of the River Plains over Recent (Holocene) Alluvium comprise Lluidas and its two variants, Rose Hall, Rose Hall variant I and Prospect variant I. Lluidas soils and its variants predominate on the terraces formed by the Rio Cobre within the Lluidas Vale basin. In a small area of Recent Alluvium occurring near Ewarton, Prospect variant I and Rose Hall variant I soils have developed. The soils are stratified. Like in most of the Old Alluvial soils, medium to high amounts of magnesium (1-10 me/100 g) are found on the exchange complex of Recent Alluvial soils. The soils of the Plains occur in an almost flat to gently undulating landscape, less dissected than the Old Alluvial deposits. The Plains are found mainly in the wetter part of the Intermediate Moisture Availability Zone (SSU 1989i). The soil moisture regime is udic.

Lluidas soils are deep, well drained, dark brown to dark greyish brown, medium textured soils on gently undulating slopes of the lowest terrace of the Rio Cobre. The soils are stony in places. The soils are high in organic matter throughout. The structure of the soil is moderately well developed. The topsoil is slightly acid over an alkaline subsoil; free carbonates are present in the subsoil. The mineralogy is mixed; the CEC and inherent fertility are high. The AWC is high so that Lluidas soils are not prone to drought.

In between the two terrace levels of the Lluidas soils and the two variant soils as described below, another level of fluvio-colluvial origin exists which mainly occurs in gullies in Old Alluvial deposits. The Rose Hall soils in this area, have topsoils of varying depths of clayey Recent Alluvial material resembling the Lluidas soils over, and partly mixed with Old Alluvium. The soils are deep, imperfectly drained, reddish brown over a gleyed subsoil. The mineralogy is mixed and the soils do not show the clear swell/shrink properties as described in the Linstead-Bog Walk survey report (see SSU 1987b). The soils have not been studied in detail, but reference is made to the latter report.

Lluidas variant I soils are found in an intricate pattern together with Lluidas variant II soils. The soils are deep, moderately well to well drained, dark brown to dark reddish brown and moderately fine to fine textured. They occur on the gently undulating, higher terrace level of the Rio Cobre. The major difference between the variants and the Lluidas soils is that Lluidas variant I soils have a high organic matter content in the topsoil, which decreases abruptly with depth and Lluidas variant II soils are low in organic matter throughout. The structure of Lluidas soils and its variants is the same. The CEC is high. The mineralogy is mixed; CEC-clay is lower than in the Lluidas soils. The AWC is high and the permeability is lower than in the Lluidas soils.

The soils on Recent Alluvium, with some admixture of colluvium, in the Linstead Basin are Prospect variant I and Rose Hall variant I soils. They are deep, dark brown over yellowish red to reddish brown and strong brown, slightly acid to neutral clays. Prospect variant I soils are well drained and have a medium to moderately fine texture. They occupy the outer parts of the Recent Alluvial deposits, surrounding the Rose Hall variant I soils, which are moderately well drained, moderately fine to fine textured and show slight shrink/swell properties and cracks. The mineralogy of both soils is mixed with a very high CEC a high inherent fertility. Although free calcium-carbonate is present and most horizons are saturated with bases, some exchangeable aluminium may occur below the topsoil. The $CaCO_3$ is supposed to be the result of colluvial deposition (secondary lime) from the surrounding limestone escarpment. The AWC is high and the permeability is moderate to moderately high.

Table 12. Summarized overview of the Soil Series characteristics.

Key:

Depth of soil: very shallow, shallow, moderately deep, deep (see Sub-chapter 4.3).

Drainage class: excessively drained, well drained, moderately well drained, imperfectly drained, poorly drained (see SSU 1987c).

Colour subsoil: d: dark, str: strong, l: light, y: yellow or yellowish, r: reddish, br: brown or brownish, gr: greyish, mottled.

Texture top/subsoil: st: stony, gr: gravelly, C: clay, L: loam(-y), S: sand(-y), Si: silt(-y), medium textured, moderately fine textured, fine textured.

pH range (0-50 cm): -

Calcareousness: 0, +, ++, +++ (see SSU 1989a).

AWC: Available Water Capacity: high, moderately low, low (see SSU 1987c).

Fertility according to Buol: see next page.

Erosion risk: low, moderately, high (see SSU 1987c)

Stoniness: non stony, fairly stony, stony (see SSU 1989a).

Management problems (see Appendix VII): nutrient availability, erosion, rooting conditions, workability (by hand), mechanization (mechanized workability), drainage, pH. The management problems are not given in order of importance and are not necessarily of equal importance.

Fertility Capability Classification (Buol and Couto 1981):

The classification system consists of three levels: Soil Type, Substrata Type and Condition modifiers.

Soil type: texture of plough layer or surface 20 cm, whichever is shallower:
- L: loamy topsoil < 35% clay, but not loamy sand or sand
- C: clayey topsoil: > 35% clay

Substrata Type: texture of the subsoil, only used when there is a textural change or hard, root restricting layers within 50 cm:
- C: clayey subsoil: > 35% clay
- R: rock

Condition modifiers: specific properties noted if a specific range of conditions is encountered:
- g: (gley) soil or mottles with a chroma <= 2 within 60 cm of surface and below all A-horizons, or saturated with water for > 60 days in most years.
- a: (aluminium toxicity) aluminium saturation > 60% within 50 cm.
- h: (acidity) 10-60% aluminium saturation within 50 cm, or pH between 5.0 and 6.0.
- i: (high phosphate fixation) % free Fe_2O_3/% clay > 0.15, or hues of 7.5 YR or redder and a granular structure.
- v: (vertisol) very sticky and plastic clay, severe topsoil swelling/shrinking.
- k: (K-deficiency) exchangeable K < 0.20 me/100 g soil.
- b: (basic reaction) free $CaCO_3$ within 50 cm of soil surface (fizzing with HCl) or pH > 7.3.

Interpretation of Fertility Capability Classification for management:

Soil Types and Substrata Types:
- L: Good water holding capacity, medium infiltration capacity
- C: Low infiltration rates, potential high run-off if sloping, difficult to till except when "i" modifier is there.
- R: Susceptible to soil deterioration from erosion exposing undesirable subsoil. Priority should be given to erosion control.

Condition modifiers:
- g: Denitrification frequently occurs in anaerobic subsoil, and tillage operations and certain crops may be adversely affected by excess rain unless drainage is improved.
- a: Plants sensitive to aluminium toxicity will be affected unless lime is deeply incorporated. Extraction of soil water below depth of lime incorporation will be restricted. Lime requirements are high.
- h: Strong to medium soil acidity. Requires liming for most crops.
- i: High P fixation capacity. Requires high levels of P fertilizer. Sources and method of P fertilizer application should be considered carefully.
- v: Clayey textured topsoil. Tillage is difficult when too dry or too moist but soils can be highly productive.
- k: Low ability to supply K. Availability of K should be monitored and K fertilizers may be required frequently for plants with a high need for K.
- b: Basic reaction. Rock phosphates and other non-water-soluble phosphate should be avoided. Potential deficiency of certain micro-nutrients, principally iron and zinc.

A: Soils of the Hills and Foothills

Series name	Depth of soil	Drainage class	Colour subsoil	Texture top/ subsoil	pH-range (0-50 cm)	Calcare-ousness	AWC	Fertility acc. to Buol	Erosion risk	Stoni-ness	Management problems
Mountain Hill	deep	well	red	C/C	4.3-4.8	0	mod.	Caik	mod.	non	nutrient av.
Bonnygate	very shallow	exc.	(d.)y.br y. red red	st CL/ st C	8.1-8.3	+++	low	CRib	high	stony	erosion rooting cond. nutrient av. workability
St. Ann var. I	deep	well-exc.	d. red red	SiC/C	7.5-7.6	+	mod.	Cikb	mod.	non-fairly	nutrient av. mechanization
Swansea	mod. deep	well-exc.	y. red red	SiC/C	6.7-7.2	+	mod.	Cikb	mod.	stony	workability mechanization rooting cond. nutrient av.
Union Hill	shallow	well	r. brown str. br. y. brown	st C/ st C	7.7-7.9	+++	low	CR(i)(v)kb	mod.-high	stony	rooting cond. erosion workability
Union Hill var. I	deep	well	d. gr. br. str. br y. brown	C/C	8.0-8.1	++	mod.	Cikb	mod.	fairly	erosion nutrient av. mechanization
Mount Rosser	shallow	well	str. br. y. brown	st C/ C-CL	7.8-8.3	+++	low	CRikb	high	stony	erosion rooting cond. nutrient av.
Carron Hall	mod. deep	mod. well-well	y. brown br. yellow	gr C/SiC	7.1-7.4	+	low	C(v)k	low-mod.	non	nutrient av. workability mechanization

Series name	Depth of soil	Drainage class	Colour subsoil	Texture top/ subsoil	pH-range (0-50 cm)	Calcare-ousness	AWC	Fertility acc. to Buol	Erosion risk	Stoni-ness	Management problems
Pennants var. I	deep	imp.	l. grey y. brown red	CL/C	4.7-4.7	0	low	LC(g)ak	low-mod.	non	drainage pH nutrient av.
Tydixon	deep	poorly	l. grey y. brown br. y.	SL/C	4.9-6.5	0	low	LCgak	low	non	drainage pH nutrient av.
Knollis	deep	imp.-poorly	str. br. y. brown l. grey	CL/C	7.1-5.2	0	low	Cg(a)	low	non	drainage workability
Linstead var. I	deep	mod. well-imp.	str. br. y. red red	CL/C	6.6-6.7	0	low	LCgk	low	non	drainage nutrient av.
Rosemere var. I	deep	mod. well	str. br. l. grey red	C/C	6.9-4.0	0	low	Ca(g)k	low	non	drainage nutrient av. workability
Riverhead	deep	mod. well	br. y. y. red l. grey	C/C	6.3-6.8	+	low	C(g)k	low	non	drainage workability
Donnington var. II	mod. deep	well	y. red r. grey str. br.	CL/ gr (C)L	4.5-5.3	0	low	Lh	low-mod.	fairly	nutrient av. rooting cond. mechanization
Brysons var. I	deep	imp.	d. y. red l. grey str. br.	C/C	7.0-4.9	+	low	Cvb	low	non	drainage pH workability
Brysons var. II	deep	imp.-poorly	l. grey y. brown br. y.	C/C	6.8-8.2	+ +	low	C(g)v	low	non	drainage workability mechanization

Series name	Depth of soil	Drainage class	Colour subsoil	Texture top/ subsoil	pH-range (0-50 cm)	Calcare- ousness	AWC	Fertility acc. to Buol	Erosion risk	Stoni- ness	Management problems
Lluidas	deep	well	r. grey r. brown gr. brown	medium	6.3-7.1	+	high	Lb	low	fairly	workability nutrient av. mechanization
Rose Hall	deep	imp.	d. r. br. mottled	CL/C	6.8-7.1	+	mod.	Cg(b)	low	non- fairly	drainage
Lluidas var. I	deep	well- mod. well	d. r. br.	mod. fine	5.9-7.4	+	mod. high	C(b)	low	non- fairly	workability rooting cond.
Lluidas var. II	deep	mod. well- well	d. r. br. mottled	mod. fine- fine	6.8-7.1	+	high	C(g)(k)b	low	non	drainage workability mechanization rooting cond.
Prospect var. I	deep	well	y. red str. br.	mod. fine	6.8-5.9	+	high	L(g)	low	non	nutrient av.
Rose Hall var. I	deep	mod. well	y. red str. br. mottled	mod. fine- fine	7.2-5.8	0	high	C(v)	low	non	drainage nutrient av.

4.5 DESCRIPTION OF THE SOIL MAPPING UNITS

4.5.1 General

The soil map of the Lluidas Vale area has 25 mapping units of which 11 are in the Hills and Foothills, 8 in the Inland Basins and 4 in the River Plains. Two miscellaneous land types are specified. Fourteen of the mapping units are consociations (mainly in the Plains and Inland basin), 9 are complexes and 2 are associations, the majority of which occurs in the Hills and Foothills. The location of the different mapping units is shown on Enclosure 1 (Soil map of the Lluidas Vale area, scale 1:25,000). Profile descriptions to which is referred in the mapping unit descriptions are found in Appendix IV. The USDA Soil Taxonomy Classification of the soils of the different mapping units is given in Appendix V. Appendix VI shows how the present mapping units are related to the former "Green Book" mapping units (RRC 1958-1970).

In the soil mapping units descriptions, the following aspects will show:

- For soil classification USDA Soil Taxonomy is used. However, for the horizon designations, the Guidelines for Soil Description (FAO 1977) are followed. The definitions of subsoil designations are basically the same in the two documents, except for "s". Bs, in this report, is used for the accumulation of sesquioxides (Fe and Al) in situ as prescribed in the FAO Guidelines. In the Keys to Soil Taxonomy (Soil Survey Staff 1987) the designation "s" is only used for illuvial accumulation of sesquioxides (and organic matter).

- In addition to the designations used in Keys to Soil Taxonomy (Soil Survey Staff 1987), in the present survey the following additions are used at subgroup level:

* <u>Para</u>lithic Hapludolls for Hapludolls formed over soft, continuous and coherent, underlying parent rock.
* <u>Ruptic</u> Lithic Eutrudoxs for Eutrudoxs that have a discontinuous lithic contact within 125 cm, whereby > 50% of the volume to 125 cm is hard rock. Typic Eutrudoxs may have a discontinuous lithic contact, but with less than 50% of the volume to 125 cm depth being rocks. Lithic Eutrudoxs have a continuous lithic contact within 125 cm.
* <u>Humic</u> Hapludalfs for Hapludalfs with a high organic matter content (> 12 kg O.C. to 1 m depth) but without the colour requirements for a mollic epipedon.

- Soil series to be recognized as major Series (status A or C, SSU 1989j) should occupy over 300 ha (island wide). A square of 300 ha is indicated in the lower right of the the soil map. Several of the described Series in this survey report are still at the D-level (minor Series and Series variants). Many soils described in this survey area are given variant-names related to Series described in the Semi-detailed Soil Survey of the Linstead-Bog Walk Area (SSU 1987b). These variant names are confined to soils that usually do not cross the Great Group boundaries.

- Mineralogy classification at USDA family level for Oxisols has been based on the following assumption: if the CEC-clay is less than 8 meq/100 g clay, the mineralogy is gibbsitic; if it is equal to or more than 8, the mineralogy is mixed (SSU 1989j). Clay mineralogy has not been analytically determined, but is derived from the field characteristics of the soils and the CEC-clay.

Figure 6.

Mottle pattern in the subsoil of some soils developed over Old Alluvium (photo by G.R. Hennemann).

- The mottle pattern, as typically occurring in the lower part of the subsoil of soils developed over Old Alluvium as shown in Figure 6, is referred to as "corned beef". The polyeder like pattern in the soils is mainly red, grey and strong brown coloured. The clay minerals of these subsoils, as analysed for Linstead soils, consist of about 40% kaolinite, about 15% montmorillonite and a very small amount of illite (SSU 1987b, p. 36). Preliminary results of the JA 04 study on similar soils (ISRIC 1990) confirm the "strongly kaolinitic nature of the subsoil with substantial amounts if 2:1 clays, and the absence of gibbsite" (G.R. Hennemann, pers. comm.).

4.5.2 Mapping units of the Hills and Foothills

HL1 Mountain Hill clay (27 ha)

The HL1 consociation consists of deep, well drained, red, fine textured Mountain Hill soils. The soils occur on (gently) undulating slopes in depressions in the limestone karst landscape, mainly in the central part of the hills, along the road through the hills from Ewarton to Lluidas Vale.

Mountain Hill soils belong to the clayey, gibbsitic, isohyperthermic family of Rhodic Kandiudoxs. A representative profile is given in Appendix V, under pit no. 108.

Brief profile description: Mountain Hill soils are deep, and formed in bauxitic deposits over hard limestone. The topsoil (A horizon) is a weak red to dark red, heavy clay of about 15 cm thick over a kandic horizon (Bs1,2) of dark reddish brown to dark red and dusky red clay which is at least 1 m thick. Characteristic for this soil are the low pH and high exchangeable acidity content in the upper part of the soil.

Soil properties affecting management: Mountain Hill soils are very acid in the topsoil and have a low natural fertility. The soils contain a high amount of available potassium (K) and a very low amount of available phosphorus (P). The soils strongly fix P, when added as fertilizer. Workability by hand of the soils is good; mechanized agriculture is limited by the small extent and inaccessibility of the areas where the soils occur..

Inclusions: Within mapping unit HL1, Bonnygate soils as described under heading HLx1 occur, intricately associated with limestone rock outcrops.

Present land use: The soils of the HL1 mapping unit are mainly covered by lowland coffee (Coffea canephora) and sugar cane. Some small scale farming occurs as well.

HLx1 Bonnygate - rock outcrops - St. Ann variant I complex (5008 ha)

The HLx1 complex consists of:
a) shallow, excessively drained, yellowish red to yellowish brown, fine textured Bonnygate soils (45%),
b) limestone rock outcrops (30%), and
c) deep well drained to excessively drained, red and dark red, fine textured St. Ann variant I soils (20%).
The soils occur in bauxitic deposits over hilly to steeply dissected hard limestone in the karst landscape. The best developed cockpit karst features occur in the north-western part of the survey area and the less developed in the south-east. The north-central part is like a plateau with hilly features. Although the soil pattern is very intricate, Bonnygate soils and rock outcrops are found mainly on the steepest slopes and St. Ann variant I soils on the less steep slopes and in small depressions.

Bonnygate soils are members of the clayey-skeletal, mixed, isohyperthermic family of Lithic Oxic Eutropepts. St. Ann variant I soils belong to the clayey, gibbsitic, isohyperthermic family of Kandiudalfic Rhodic Eutrudoxs. Representative profiles are described in Appendix IV, under pit no. 014 and 054 respectively.

Brief profile description: Bonnygate soils have a maximum depth of 20-25 cm of (dark) yellowish brown to yellowish red, clay loam to clay topsoil with many limestone gravels and stones. The subsoil of 15-20 cm is dark brown to yellowish red clay over hard limestone. The soil can be deeper in solution-crevices in the underlying rock; the boundary to the limestone is sharp.

St. Ann variant I soils are deep (especially compared to the Bonnygate soils). The up to 30 cm thick topsoil (A horizon) is a dark reddish brown to dark red silty clay. The subsoil (Bs1,2), which reaches to at least 1 m consists of dark red and red clay; the field texture is usually indicated as clay loam, with a granular structure of many small (0.5-1 cm) clay aggregates. "Natural clay" analysis indicates that very little clay-sized particles are present in the actual situation, as a result of very low dispersion. St. Ann variant I soils have a kandic horizon. The profile is high in organic matter.

Soil properties affecting management: Bonnygate soils are slightly alkaline and have a moderate capacity to store nutrients. The available-P content is very low. Since the soils are shallow, root penetration is limited; however, trees extend their roots through crevices and cracks. The moisture retention capacity is low and the permeability is high, which makes the soils droughty. Mechanized agriculture is impossible due to the stoniness of the soils, the occurrence of rock outcrops and steepness of slopes. Land preparation by hand is possible. Loss of topsoil may result in long-term reduction of productivity of the land. Erosion is enhanced by removal of the vegetation.

St. Ann variant I soils are slightly calcareous and slightly alkaline throughout. The capacity to store nutrients is low. Available P is extremely low and P-fixation is a problem. The soils are porous to a great depth and highly permeable and have a low moisture retention capacity. Susceptibility to erosion is moderate, due to the high silt content of the topsoil. St. Ann variant I soils are easily worked by hand and mechanized land preparation is possible as well, except for the fact that these soils usually occur in small patches.

Inclusions: Included in this mapping unit are soils similar to St. Ann variant I, but with a humic topsoil. These soils have not been described separately. Appendix VII, pit no. 066, shows another inclusion, which is less red than St. Ann variant I soils, and which is classified as Kandiudalfic Eutrudoxs.

Present land use: Within mapping unit HLx1, the Bonnygate soils are mainly left ruinate or in use for fruit and food trees, while St. Ann variant I soils are under pasture, sometimes planted with sugar cane or left ruinate.

HLx2 Bonnygate - rock outcrops - Swansea complex (620 ha)

The HLx2 complex consists of:
a) shallow, excessively drained, yellowish red to yellowish brown, fine textured Bonnygate soils (35%),
b) limestone rock outcrops (25%), and
c) moderately deep and well drained to excessively drained, red to yellowish red, fine textured Swansea soils (25%).
This mapping unit mainly occurs in the well developed cockpit karst area in the north west of the survey area, where mature karst and saddles alternate, and on the less steep slopes on the steep faultlines.

Bonnygate soils are members of the clayey-skeletal, mixed, isohyperthermic family of Lithic Oxic Eutropepts. Swansea soils belong to the clayey, gibbsitic, isohyperthermic family of Kandiudalfic Ruptic-Lithic Eutrudoxs. Representative profiles are described in Appendix IV, under pit no. 014 and 068 respectively.

Brief profile description: Bonnygate soils and limestone rock outcrops are described under the heading of HLx1.

Swansea soils are formed on bauxitic deposits and on average 60-70 cm deep with a great variability in depth over short distances. In more than 50% of the area, the soils have hard limestone rock within 125 cm. The topsoil (A horizon) is about 10 cm thick, reddish, strong to dark brown silty clay. The subsoil (Bs), on average 50-60 cm thick, is yellowish red to dark red clay; the red colour becomes more prominent with depth. Like in the St. Ann variant I soils, Swansea soils have a kandic horizon.

Soil properties affecting management: Bonnygate soils, as described under mapping unit HLx1, are of limited value for agricultural use, because of their shallowness, droughtiness and stoniness.

Swansea soils are slightly calcareous but neutral in reaction. The inherent fertility is low, as is the capacity to store nutrients. P-availability is extremely low. Depth for root penetration is limited, but compared to Bonnygate soils, more favourable for most crops, including tree crops. The moisture retention capacity is low to moderate and the porosity of the soils is high. Manual workability is no great problem, but mechanization is impossible due to the shallow sites in the area and rock outcrops. As long as the soils are kept under a vegetation cover, erosion can be maintained at acceptable levels.

Inclusions: Mapping unit HLx2 includes soils similar to Swansea soils, but with a higher organic matter content in the topsoil (as shown in Appendix VII, pit no. 067). To a very limited extent St. Ann variant I soils are found in small depressions.

Present land use: The soils of mapping unit HLx2 are mainly left ruinate. Small areas are used for tree crop cultivation (Bonnygate soils) or are under unimproved pasture. In a few places, sugar cane is grown.

HLx3 St. Ann variant I - Bonnygate complex (1890 ha)

The HLx3 complex consists of:
a) deep well drained to excessively drained, red and dark red, fine textured St. Ann variant I soils (50%), and
b) shallow, excessively drained, yellowish red to yellowish brown, fine textured Bonnygate soils (25%).
This mapping unit occurs in the hilly areas on the central northern plateau-like part of the limestone landscape and to a smaller extent on undulating to rolling slopes in the southern part of the survey area

St. Ann variant I soils are members of the clayey, gibbsitic, isohyperthermic family of Kandiudalfic Rhodic Eutrudoxs. Bonnygate soils belong to the clayey-skeletal, mixed isohyperthermic family of Lithic Oxic Eutropepts. Profile descriptions, representing these soils, are to be found in Appendix IV, under pit nos. 054 and 014.

Brief profile description: Both soils are described under the heading of mapping unit HLx1.

Soil properties affecting management: Under the heading of soil mapping unit HLx1, the characteristics influencing the soil management are discussed. Crop cultivation on Bonnygate soils is mainly hampered by soil depth and steep slopes. P-availability is very low in both soils.

Inclusions: Included in this mapping unit are Mountain Hill soils (see under HL1) in the deeper valley bottoms. Part of the St. Ann variant I soils has a humic topsoil, which is included in HLx3 as well. As in all mapping units with Bonnygate soils, limestone rock outcrops are associated with these soils.

Present land use: Some soils in this mapping unit are in use for small scale farming, while the major part is under forest or left ruinate.

HLx4: Union Hill - Union Hill variant complex (257 ha)

The HLx4 complex consists of two related soils, viz.:
a) shallow, well drained, reddish brown and strong brown to dark yellowish brown, fine textured Union Hill soils (50%), and
b) moderately deep to deep, well drained, dark brown to strong brown, moderately fine to fine textured Union Hill variant I soils (25%).

Both soils occur on moderately steep to very steep slopes over different (younger and older) formations of hard limestone, whereby the Union Hill variant I soils occupy the less steep slopes.

Union Hill soils are members of the clayey-skeletal, mixed, isohyperthermic family of Lithic Vertic Eutropepts. Union Hill variant I soils belong to the clayey, mixed, isohyperthermic family of Humic Kandiudalfic Eutrudoxs. Representative soils for these Series are described in Appendix 1.6 of Soil Survey Report No. 2 (SSU 1987b) and Appendix IV of the present report, under pit no. 105 respectively.

<u>Brief profile description</u>: The mean depth of Union Hill soils is about 45 cm. The topsoil (A horizon) is (dark) brown and dark yellowish brown and locally strong brown, stony and gravelly clay loam to clay. The subsoil is strong brown to yellowish brown starting at an average depth of 25 cm and containing few manganese (Mn) concretions. The texture of this Bw-horizon is clay. Union Hill soils swell and shrink weakly.

Union Hill variant I soils are the deep, more developed variants of Union Hill soils, with a dark brown to dark greyish brown surface layer (A horizon) of about 25 cm and a clay loam to clay texture. Few gravels and stones are encountered in the top soil. The organic matter content is high, but the colour of the topsoil is not dark enough to qualify for a mollic epipedon. The subsoil (Bs1,2 horizon) of at least 1 m thickness, is still dark greyish brown and strong brown, developing to strong and yellowish brown at greater depth. The texture of the subsoil is clay over hard limestone. The boundary between soil and hard rock is knife sharp. The B horizon is a kandic horizon.

<u>Soil properties affecting management</u>: Union Hill soils are non to slightly calcareous and neutral to slightly alkaline. The inherent fertility is low, as is capacity to store nutrients at field pH. The topsoil is very low in available P and high in K. The soil is porous throughout with a high infiltration when dry, and a low permeability when wet. The moisture retention capacity is low. Soil depth of Union Hill soils precludes the development of deep root systems, except where crevices occur in the underlying limestone. Workability by hand is hampered by stoniness and consistence. Removing the soil cover results in erosion. Mechanized land preparation is inhibited by slope and the occurrence of rock outcrops.

Union Hill variant I soils are similar to Union Hill soils in as far as the limiting factors are concerned. However, Union Hill variant I soils have a higher moisture retention capacity, due to the higher organic matter content. Depth of the soil is not limiting for rooting of crops. Workability is easy by hand; mechanization is limited because of the small patches these soils occupy in the stony and rocky surroundings.

Inclusions: In the valley bottoms of the hilly landscape, some old alluvium has been deposited, on which Riverhead soils and Linstead variant I soils have developed. These soils are discussed under the headings of mapping units BO4 and BO6 respectively. Union Hill soils are associated with limestone rock outcrops and to a small extent with very shallow Bonnygate soils (see HLx1).

Present land use: The soils of mapping unit HLx4 having less steep slopes are mainly under food forest. To a small extent they are used for mixed crop cultivation. The steep slopes are either under forest or are left ruinate.

HLx5 Union Hill - Bonnygate complex (772 ha)

The HLx5 complex consists of:
a) shallow, well drained, reddish brown and strong brown to dark yellowish brown, fine textured Union Hill soils (55%), and
b) shallow, excessively drained, yellowish red to yellowish brown, fine textured Bonnygate soils (20%).
Mapping unit HLx5 is found in the Grass Piece area over rolling doline karst, alternating with limestone rock outcrops (Landmann 1989). Around Ewarton, the mapping unit is found in rolling to hilly surroundings, dissected by small valleys with old alluvial deposits. Areas of this mapping unit are also mapped further north of Ewarton, in the rolling footslopes of the fault line.

Union Hill soils are members of the clayey-skeletal, mixed, isohyperthermic family of Lithic Vertic Eutropepts. Bonnygate soils belong to the clayey-skeletal, mixed, isohyperthermic family of Lithic Oxic Eutropepts. Representative soils for these Series are described in Appendix 1.6 of Soil Survey Report No. 2 (SSU 1987b), and Appendix IV of the present report, under pit no. 014 respectively.

Brief profile description: The range of characteristics of Union Hill soils is described under the heading of HLx4, while Bonnygate soils have been discussed under mapping unit HLx1.

Soil properties affecting management: Both soils are relatively shallow, droughty, low in available P and difficult to work. Further details concerning management aspects are described under the headings of HLx1 and HLx4.

Inclusions: South of the Lluidas Vale, where this mapping unit partially occurs, some thin recent alluvial deposits are found in the poljes (Landmann 1989). In the area of Ewarton, on old alluvial deposits, Rosemere variant I (see B05) and Riverhead soils (see B06) are found to a small extent. Outcrops of the Mount Diablo Inlier, as occurring to the north of Ewarton, consist of some calcareous shales and Cretaceous limestone rock outcrops. Soils formed there, on the steep slope of the fault, are very thin and not described in detail.

Present land use: Unimproved pasture, citrus and small scale farming are the major forms of agricultural land use within mapping unit HLx5. The remaining part of the land is covered by forest.

HLx6: Bonnygate - rock outcrops - Union Hill complex (69 ha)

The HLx6 complex consists of:
a) shallow, excessively drained, yellowish red to yellowish brown, fine textured Bonnygate soils (40%),
b) limestone rock outcrops (20%), and
c) shallow, well drained, reddish brown and strong brown to dark yellowish brown, fine textured Union Hill soils (40%).
This mapping unit is very small and occurs north of Ewarton just above the fault line, at about 710 m, in an area of typically round shaped, small cone karst.

Bonnygate soils are members of the clayey-skeletal, mixed, isohyperthermic family of Lithic Oxic Eutropepts. Union Hill soils belong to the clayey-skeletal, mixed, isohyperthermic family of Lithic Vertic Eutropepts. In Appendix IV, under pit no. 014 and in Appendix 1.6 of Soil Survey Report No. 2 (SSU 1987b), two representative profiles are described.

Brief profile description: Bonnygate soils, rock outcrops and Union Hill soils are discussed under heading HLx1 and HLx4 respectively. Under the same headings information on the management of these soils can be found.

Present land use: The soils of mapping unit HLx6 are under secondary forest or left ruinate; the accessibility of the area is poor.

HLx7 Bonnygate - Union Hill - St. Ann variant I complex (207 ha)

The HLx7 complex consists of:
a) shallow, excessively drained, yellowish red to yellowish brown, fine textured Bonnygate soils (20%),
b) shallow, well drained, reddish brown and strong brown to dark yellowish brown, fine textured Union Hill soils (35%), and
c) deep well drained to excessively drained, red and dark red, fine textured St. Ann variant I soils (35%).
This mapping unit comprises the areas of the landslides north and west of Ewarton, whereby the different slope classes to a great extent are related to the soils occurring in that part of the landslide. The steep upper parts consist of Cretaceous rock outcrops (mainly limestone) with sporadic very shallow Bonnygate soils; this area is very susceptible to erosion. On the steep and hilly gorge of the landslide and rolling to hilly foothills, mainly Union Hill and St. Ann variant I soils are found.

Bonnygate soils are members of the clayey-skeletal, mixed, isohyperthermic family of Lithic Oxic Eutropepts (Appendix IV, pit no. 014). Union Hill soils belong to the clayey-skeletal, mixed, isohyperthermic family of Lithic Vertic Eutropepts (Appendix 1.6 of SSU 1987b). St. Ann variant I soils are clayey gibbsitic, isohyperthermic, family-members of Kandiudalfic Rhodic Eutrudoxs (Appendix IV, under pit no. 054).

Brief profile description: The respective soils of mapping unit HLx7 are described under the headings of HLx1 and HLx4, as are the properties affecting the management of the soils.

Inclusions: No included soils are defined here; Cretaceous and Eocene limestone rock outcrops occur on the higher slopes. Colluviation took place in the landslide area, resulting in accretion of topsoil at the lower slopes.

Present land use: The upper part of the landslide has some grassland and forest or is bare; the lower sections are under forest, and are to some extent in use for small scale agriculture.

HJ1 Mount Rosser clay (13 ha)

The HJ1 consociation consists of shallow, well drained, dark greyish brown, fine textured Mount Rosser soils. These soils occur on soft limestone outcrops, on the steep and very steep slopes which are found at the boundary of the Mount Diablo Inlier and the surrounding hard limestone. This area is located at the fault line north of Ewarton.

Mount Rosser soils are members of the fine, mixed, isohyperthermic family of Paralithic Hapludolls. A representative profile is described in Appendix IV, under pit no. 090.

Brief profile description: The soil extends over about 40-50 cm with a gradual (paralithic) boundary to the soft rubbly limestone. The topsoil is a 25 cm deep, dark greyish brown clay loam with a high organic matter content, which classifies as a mollic epipedon. The subsoil (Bw horizon) is strong brown to yellowish brown and brownish yellow. The texture varies between loam and clay with limestone gravels and stones, which originate from the surrounding hard limestone.

Soil properties affecting management: Mountain Hill soils are strongly calcareous and slightly alkaline. The inherent fertility is high. P-availability is very low and available K is high. The moisture retention capacity is low and the soils are moderately permeable. Run-off and erosion can be considerable when the soils are water saturated and not kept under a proper cover. To work the soils by hand is possible, but land preparation will enhance erosion. Slope and extent of the area preclude mechanization.

Inclusions: Bonnygate soils (see HLx1) and associated limestone rock outcrops are included in this mapping unit.

Present land use: The soils of mapping unit HJ1 are under forest, including food and fruit-trees.

HJ2 Carron Hall silty clay (33 ha)

The HJ2 consociation consists of moderately deep, moderately well drained, yellowish brown to brownish yellow, fine textured, cracking Carron Hall soils. The soils occur on the very gently sloping to sloping foothills of the Central Inlier over soft and rubbly limestone in the south-western part of the survey area.

Carron Hall soils are members of the fine, montmorillonitic, isohyperthermic family of Vertic Eutropepts, which are described in Soil Survey Report No. 2 (SSU 1987b, Appendix 1.7).

Brief profile description: Carron Hall soils are 50-90 cm deep over soft rubbly limestone. The topsoil (A horizon) is dark brown to dark greyish brown gravelly clay, about 20-30 cm deep. The subsoil is mainly a (dark) yellowish brown clay, becoming more brownish yellow at greater depth. The soft limestone admixture increases with depth. In places, limestone gravels and shells are found in the profile. Swell/shrink properties of the soil are apparent.

Soil properties affecting management: Carron Hall soils are strongly calcareous and mildly alkaline. The inherent fertility is moderate and compared to all other soils over limestone, the amounts of available P and K are high. The moisture retention capacity is moderate. Permeability depends on the moisture condition of the soil. When wet, it is low, so that run-off can be high. When dry, the soil is highly permeable. Workability, by hand as well as mechanized, is determined by the prevailing moisture conditions; only a narrow range of soil moisture conditions allows for land preparation. Stoniness hampers mechanization.

Inclusions: Carron Hall soils, as described in this mapping unit, occur together with Union Hill soils (see HLx4) and limestone rock outcrops

Present land use: Soils of the HJ2 mapping unit are locally used for mixed farming and sugar cane, while the majority of the area is under forest.

HXx1 Union Hill - Riverhead complex (26 ha)

The HXx1 complex consists of
a) shallow, well drained, reddish brown and strong brown to dark yellowish brown, fine textured Union Hill soils over hard limestone (45%), and
b) deep, moderately well drained, yellowish brown to brownish yellow with light grey and red, mottled, fine textured Riverhead soils over old alluvium (35%).
The Union Hill soils occur over rolling to hilly slopes, while the Riverhead soils occupy the undulating valley bottoms in between the limestone hills in the central-eastern part of the survey area, near Riverhead.

Union Hill soils are members of the clayey-skeletal, mixed, isohyperthermic family of Lithic Vertic Eutropepts. Riverhead soils belong to the fine, mixed, isohyperthermic family of Humic Hapludalfs. Representative profiles are presented in Appendix 1.6 of Soil Survey Report No. 2 (SSU 1987b) and in Appendix IV, pit no. 099, of this report.

Brief profile description: Union Hill soils are described under the heading of mapping unit HLx4. The range of characteristics of Riverhead soils is presented in mapping unit description B06.

Soil properties affecting management: Union Hill soils have limited rooting capacity in slightly calcareous soil and at the same time have a low nutrient and moisture availability. Riverhead soils are deep, but the heavy texture restricts the root penetration. Moisture retention is low. Nutrient availability is moderate. Further details can be found under "Brief profile description" of the relevant mapping unit descriptions.

Inclusions: The Union Hill soils of this mapping unit occur mainly together with limestone rock outcrops; in the valley bottoms, soils are found which are similar to Riverhead soils, but neutral to slightly alkaline and less mottled.

Present land use: Within mapping unit HXx1 Riverhead soils are mainly in use for citrus, and partly left ruinate, while Union Hill soils are under mixed crops, unimproved pasture or left ruinate.

4.5.3 MAPPING UNITS OF THE INLAND BASINS

B01 Pennants variant I clay loam (549 ha)

The B01 consociation consists of deep, imperfectly drained, red, strong brown and grey mottled, fine textured Pennants variant I soils. These soils are formed in old alluvial/lacustrine deposits, derived from the conglomeratic material of the Central Inlier. Pennants variant I soils occur on a (gently) undulating terrace, at an elevation of about 360 m, in the northern and western part of the basin. The terrace in places is incised, which results in a rolling topography. In the northern part of the basin this rolling topography is found as well: the former doline structure has been covered by the old alluvial deposits.

Pennants variant I soils are members of the fine, mixed, isohyperthermic family of Vertic Haplohumults. A representative profile is described in Appendix IV, as pit no. 109.

Brief profile description: Pennants variant I soils are well developed and deep. The top layer (A horizon) of about 20 cm thickness, is a very dark greyish brown to dark brown and sometimes dark yellowish brown clay loam, which is neutral to slightly acid. In places, it has some red mottles. The subsoil (Btg1) is mixed yellowish brown to strong brown and red clay (see Figure 6). The acidity increases with depth to the very acid subsoil (Btg2) which is dark/light grey clay with red, strong brown and yellowish red mottles. Generally the soils contain iron-manganese concretions; their quantity as well as the gravelliness increases towards the gullies. Pennants variant I soils do not show prominent vertic properties, contrary to Pennants soils (SSU 1987b). The topsoil shows cracks and the subsoil has pressure faces and few, intersecting slickensides.

Soil properties affecting management: The topsoil of Pennants variant I soils is neutral to slightly acid, but in the subsoil the pH(H2O) becomes strongly acid. The ECEC is moderately high but the exchange complex is largely occupied by aluminium and only to a small extent by calcium, magnesium and potassium. The ratio of absorbed Ca over Mg is low (1:4). The moisture retention capacity of the soils is low, as is the permeability. This causes the soils to be saturated easily after heavy showers. Susceptibility to sheet erosion exists, but is no major threat to the maintenance of the soil condition. Manual workability is no problem in the topsoil, but becomes difficult when the deeper layers have to be tilled for sugar cane cultivation. Mechanized land preparation is possible over a fairly wide range of soil moisture conditions.

Inclusions: Within mapping unit BO1, soils similar to Pennants variant I are found, but with a somewhat better drainage, a more gravelly topsoil and usually many more Fe-Mn concretions. These soils are located along the gullies, which incise the major terrace on which Pennants variant I soils occur. In places soils like Pennants variant I soils are found, which have with a mollic epipedon, which can be classified as Vertic Hapludolls.

Present land use: The major part of the soils of mapping unit BO1 is in use for sugar cane; citrus is planted on the more undulating to rolling areas. To a small extent the soils are under pasture.

BO2 Tydixon sandy loam (145 ha)

The BO2 consociation consists of deep, poorly drained, light grey and yellowish brown, mottled Tydixon soils, which are moderately coarse over fine textured.
These soils are developed in old alluvial/lacustrine deposits, originating from the Central Inlier as well as from the Pedro River area (Clarendon). They

occur in the north-western part of the Lluidas Vale basin on almost flat to undulating slopes of a terrace at approx. 370 m.

Tydixon soils are members of the coarse loamy over clayey, mixed, isohyperthermic family of Aeric Albaquults. Appendix IV, pit no. 110 gives the description of a representative profile.

Brief profile description: The soil of Tydixon soils is deep and moderately well developed. The top layer (A horizon) is up to 25 cm thick and consists of dark brown, dark yellowish brown or dark greyish brown sandy loam, in places sandy clay loam. Below the topsoil an eluvial horizon is present, which is light grey or light greyish brown sandy loam, sometimes with yellowish brown to brownish yellow mottles. This albic (E) horizon is not more than 15 cm thick and is discontinuous in places. Towards the subsoil, there is an abrupt textural change to the Btg-horizon, which has red mottles in a light grey or light grey mixed with yellowish brown/brownish yellow clay, with pressure faces. Sometimes brown mottles are found as well. The soil is acid throughout.

Soil properties affecting management: The major problems of Tydixon soils is the very strong acidity, especially in the mottled subsoil, and the very low permeability. Root penetration is limited by chemical as well as physical properties. The capacity to store nutrient is low and the exchange complex is mainly occupied by aluminium. Exchangeable bases and available P contents are low. Workability of the topsoil, either by hand or mechanized, is no problem.

Inclusions: To a small extent, Pennants variant I soils, as described under BO1, are included in this mapping unit.

Present land use: The soils of mapping unit BO2 are planted with citrus; until the beginning of the '80s, most of this land was under improved pasture.

BO3 Knollis clay loam (112 ha)

The BO3 consociation consists of deep, imperfectly to poorly drained, strong brown to yellowish brown/brownish yellow and grey, mottled, fine textured Knollis soils.
They occur in the southern part of the Lluidas Vale basin at a higher elevation than the Pennants variant I soils. The soils are formed in old alluvial/lacustrine deposits and occur on almost flat to gently undulating slopes at an average elevation of 375 m.

Knollis soils belong to the fine, mixed, isohyperthermic family of Aquic Argiudolls, represented by pit no. 111 in Appendix IV.

Brief profile description: Knollis soils are deep, well developed over conglomeratic material, originally coming from the Central Inlier. The topsoil (A horizon), high in organic matter, is very dark greyish brown clay. The thickness usually does not exceed 25-30 cm. The subsoil (Btg1 horizon) has strong brown, yellowish brown, brownish yellow colours and some red mottles in the 30-50 cm clay layer. The substratum is light grey and some yellowish brown and brownish yellow, with strong brown mottles in clay (see Figure 6). Throughout the profile iron-manganese concretions are found. The soil is acid in all horizons.

Soil properties affecting management: Like in Pennants variant I soils, acidity is a major limitation for most crops on Knollis soils, although conditions are somewhat less restrictive in the latter: the CEC of Knollis soils is higher and the aluminium saturation level is lower. Very high exchangeable Mg-contents are found. The high Mg levels are related to the parent material. The relatively flat topography impedes surface drainage, but is favourable for mechanized agriculture. Manual land preparation is difficult because of the heavy texture of the topsoil.

Inclusions: In the somewhat better drained locations, Pennants variant I soils (see mapping unit BO1) are found. In the area Rhodic Paleudalfs are described as well (ISRIC 1990).

Present land use: The soils of mapping unit BO3 are used for sugar cane cultivation and improved pasture.

BO4 Linstead variant I clay loam (97 ha)

The BO4 consociation consists of deep, moderately well to imperfectly drained, strong brown to yellowish brown and red Linstead variant I soils over old alluvium of the Linstead basin.
The topography is gently undulating to rolling; the soils are found in the central-eastern part of the survey area, between Ewarton and Riverhead.

Linstead variant I soils are members of the fine, mixed, isohyperthermic family of Aquic Kandiudalfs. These soils are represented by pit no. 084 in Appendix IV.

Brief profile description: Linstead variant I soils are moderately well developed to a great depth. The topsoil is 20-25 cm of dark brown and dark yellowish brown clay loam. Below a thin reddish un-mottled transition horizon (Bw), the Btg horizons are found; they are strong brown to red with yellowish brown mottles developing into red, yellowish red, and some brownish yellow mottles. The texture is clay to clay loam. The subsoil shows clay skins and some pressure faces in the argillic horizon. The soils are acid throughout.

Soil properties affecting management: Linstead variant I soils are acid throughout, but because of admixtures from the surrounding limestone hills and outcrops, the soils can be slightly calcareous. The acidity, together with the low permeability, are the major constraints. The nutrient storage capacity is low as well; base saturation is high. Workability by hand is not difficult. Mechanization should not be a problem, although Linstead variant I soils only occupy small areas.

Inclusions: Mapping unit B04 includes Union Hill soils and limestone outcrops, as described under HLx4. Riverhead soils developed in close vicinity of Union Hill soils are found to be less acid.

Present land use: The soils of mapping unit B04 are mainly used for vegetable growing and fruit trees; towards the hills lands are left idle.

B05 Rosemere variant I clay (38 ha)

The B05 consociation consists of deep, moderately well drained, strong brown, dark brown, red and light grey mottled, fine textured Rosemere variant I soils.
They are developed in old alluvial deposits of the Linstead basin, close to the village of Riverhead. They originate from the Central Inlier. Rosemere variant I soils occur in very gently sloping valley bottoms.

Rosemere variant I soils are members of the clayey, mixed, isohyperthermic family of Typic Paleudults. A representative profile is described in Appendix IV, under pit no. 098.

Brief profile description: The soil of Rosemere variant soils I is deep. The neutral topsoil (A horizon) has a thickness of about 25 cm and is dark brown to dark yellowish brown clay. Very few small cracks are observed. The subsoil (Bt horizon), varying in depth between 20 and 35 cm is strong brown and yellowish brown, red mottled, clay with pressure faces. The substratum is light grey with a well developed "corned beef" mottle pattern, in red and strong brown. The soils have a deep clay bulge. Mn-concretions are found throughout most profiles. The subsoil shows some weakly developed pressure faces.

Soil properties affecting management: Rosemere variant I soils are neutral in the topsoil and acid in the subsoil. Natural fertility is low; the soils are low in Ca, Mg and available P. Aluminium on the exchange complex increases to more than 80% within 50 cm from the surface. The moisture retention capacity is low, as is the permeability. Workability by hand of Rosemere variant I soils is poor in view of the heavy texture. Mechanized agriculture is difficult, because the range in soil moisture, allowing for land preparation, is small. The extent of Rosemere soils is small.

Inclusions: Union Hill soils (see HLx4) are included in this mapping unit. Within the area delineated by mapping unit B05, some recent alluvial deposits are found along the Black River, which rises to the south of Riverhead.

Present land use: The soils of mapping unit B05 are in use for citrus and unimproved pasture. Part of the area is left ruinate, with scattered guava trees.

B06 Riverhead clay (48 ha)

The B06 consociation consists of deep, moderately well drained, mixed yellowish brown to brownish yellow, light grey and red, fine textured Riverhead soils over old alluvium.
Riverhead soils occupy the undulating valley bottoms and some flat areas in the Linstead basin near Riverhead.

Riverhead soils belong to the fine, mixed, isohyperthermic family of Humic Hapludalfs. A representative profile is presented in Appendix IV, under pit no. 099.

Brief profile description: Riverhead soils are deep, well developed soils, formed in old alluvium. The humic topsoil (A horizon) has a thickness of about 30 cm and consists of a dark brown to dark yellowish brown clay. The subsoil (Bt1 horizon), 20-50 cm, is a yellowish brown to brownish yellow clay with red mottles. The substratum (Bt2 horizon) is a "corned beef" coloured clay, whereby light grey, yellowish red and brownish yellow are the major colours and red a minor colour. Throughout the profile, manganese concretions are found. Clay cutans start in the Bt1 horizon. They become less prominent in the Bt2 horizon.

Soil properties affecting management: Riverhead soils are slightly calcareous and neutral to slightly alkaline in reaction. The natural fertility is moderate, and the soils are low in available P. Due to the heavy texture and the moderately weakly developed structure the subsoil is not easy to penetrate by roots. Moisture retention is low, as is the permeability. Since the topsoil is heavy textured, the soil can only be prepared manually with some difficulty. Mechanization is no problem.

Inclusions: Like the other soils developed in old alluvium in the Linstead basin, limestone outcrops occur through the alluvial deposits. In places Union Hill soils have developed on these outcrops (see HLx4).

Present land use: Within mapping unit BO6 the Riverhead soils are mainly in use for citrus and unimproved pasture; a nursery is located in the area.

BF1 Donnington variant II (187 ha)

The BF1 consociation consists of moderately deep, well drained, medium textured Donnington variant II soils, with a wide range in colours, from yellow and grey to red.
The soils are developed on transported, pre-weathered conglomerates from the Central Inlier, which have been deposited in the south-eastern part of the Lluidas Vale basin and form a ridge-like, rolling landscape along the border of the basin.

Donnington soils are members of the loamy-skeletal, mixed, isohyperthermic family of Typic Eutropepts. Appendix IV, pit no. 001 shows a representative profile.

Brief profile description: Donnington variant II soils are moderately deep over soft, weathered conglomerates. The topsoil (A horizon) is 10-25 cm thick and is mainly a dark brown clay to clay loam; in places the topsoil is gravelly. The subsoil (CB horizon) often reflects the original structure of the conglomerates of gravel to stone size, fully weathered, soft yellow, strong brown, reddish brown to red and grey gravels, which, crushed and sieved as a soil sample, are of clay or clay loam texture. The paralithic contact can occur at various depths.

Soil properties affecting management: Donnington variant II soils are acid throughout, with high amounts of Al amounts on the exchange complex. Characteristic for Donnington variant II soils are the high amounts of exchangeable Mg in relation to exchangeable Ca (ratio Ca/Mg is 1:2 to 1:6). Due to imbalances in nutrient uptake, this is considered unfavourable for plant growth. Root growth of trees is not inhibited by the rotten rock; for annual crops rooting will be more difficult. Moisture retention is low and the soils are highly permeable. The rolling topography may induce erosion after removal of the vegetation cover. Manual land preparation is easy, but mechanized agriculture is limited by soil depth and slopes.

Inclusions: On the ridges of the rolling landscape of mapping unit BF1, soils have developed which are intergrades between deeply weathered and degraded Pennants variant I soils and Donnington variant II soils. These soils are moderately well drained and do not have a well developed mottle pattern like the Pennants soils, but are further developed than Donnington variant II soils. To a small extent limestone rock outcrops occur. In places, conglomerates are visible at the surface as well.

Present land use: The soils of mapping unit BF1 are in use for pasture and to a very small extent for citrus.

BFx1 Brysons variant I - Brysons variant II complex (68 ha)

The BFx1 complex consists of
a) deep, imperfectly drained, mottled strong brown, yellowish brown and grey, fine textured Brysons variant I soils, and
b) deep, imperfectly to poorly drained, prominently red and strong brown mottled, yellowish brown to brownish yellow, fine textured Brysons variant II soils.
These soils have developed in flat to gently undulating plainbands, at an elevation of approx. 360 m, south and west of the Lluidas Vale basin. The variant I soils are located on the outer sides of the plainbands, while the variant II soils are found more centrally in the plainbands and towards the major basin.

Brysons variant I soils belong to the very fine, montmorillonitic, isohyperthermic family of Entic Chromuderts. Brysons variant II soils are members of the very fine, mixed, isohyperthermic family of Aquentic Chromuderts. These soils are represented by pit nos. 004 and 003 respectively in Appendix IV.

Brief profile description: Brysons variant I soils have a deep soil, with a neutral topsoil (A horizon) of 20 cm of dark brown to brown clay, with a high organic matter content. A transition (CA horizon) is formed by a strong brown, light grey or yellowish brown clay layer of 20-50 cm, with mainly strong brown mottles. In this horizon, pressure faces and slickensides occur which continue into the substratum (Cu horizon) of very pale brown and light grey clay with strong brown mottles. Mn concretions occur in most profiles.
Brysons variant II soils, as compared to Brysons variant I soils, are more degraded, i.e. they have less prominent vertic properties and more explicit gley features expressed by prominent mottling. Also, the influence of the surrounding limestone hills is less, resulting in an acid subsoil in the Brysons variant II soils. The latter have a high organic matter content in the dark (yellowish) brown and very dark greyish clay topsoil (A horizon). In places the topsoil is clay loam. The depth is 10-30 cm. The transition zone (CA horizon) consists of (dark) yellowish brown clay. The Cg horizon is light grey and yellowish brown to brownish yellow. Prominent red and strong brown mottles start at 40 to 50 cm depth. Mn concretions are not found in the profiles; vertic properties are less apparent.

Soil properties affecting management: Brysons variant I soils are slightly calcareous throughout. The inherent fertility is high, with high quantities of Ca and Mg at the exchange complex. In the subsoil there is more Mg than Ca at the complex. The moisture retention capacity of the soil is moderate; permeability is low. After heavy rains, the plainbands are known to be flooded temporarily. Manual field preparation is possible for the topsoil; digging deep plant-holes is difficult; due to the vertic properties, the soil can be worked by heavy equipment only over a short range of soil moisture conditions.

Brysons variant II soils are acid throughout. The exchange complex contains high quantities of exchangeable Mg; aluminium is present in reasonable quantities. Physically the soils have the same capacity for moisture storage as the Brysons variant I soils. Since the vertic properties are less prominent, the soil moisture range over which the land preparation can be done is wider. The high clay content of these soils makes manual preparation of seedbeds impossible.

Inclusions: Pennants variant I soils (see BO1) are included in this mapping unit.

Present land use: The plainbands, in which mapping unit BFx1 occurs, are mainly under citrus. They used to be under improved pasture.

4.5.4 MAPPING UNITS OF THE PLAINS

PR1 Lluidas loam-silty loam (87 ha)

The PR1 consociation consists of deep, well drained, dark greyish brown, medium textured Lluidas soils.
The soils are formed on recent alluvium, deposited by the Rio Cobre and originating from the Central Inlier. Lluidas soils border the Rio Cobre and are on the lowest terrace, which has a flat to gently undulating topography. The boundary to the next terrace level is sharp.

Lluidas soils belong to the fine silty, mixed, isohyperthermic family of Fluventic Hapludolls. They are represented by pit no. 112 of Appendix IV.

Brief profile description: Lluidas soils are deep over recent alluvium. The topsoil is a dark brown to dark reddish brown, loam to silty loam, gravelly in in the major part of the terrace. The subsoil is mainly dark reddish grey when wet (pinkish grey when dry) silt loam and gravelly in places. The profile is stratified and dark layers do occur, representing former A horizons. The organic matter content in the topsoil is high and remains moderately high throughout. In places, white feldspar gravels are found.

Soil properties affecting management: Lluidas soils are slightly calcareous and neutral to slightly alkaline. The natural fertility is high and there are no nutrient imbalances. P-availability is medium. The moisture retention capacity and permeability are high. Flooding occurs after heavy rainfall, because the Rio Cobre can not drain all water instantaneously. Rainfall may cause slaking of the topsoil, with some standing water as result. Gravelliness of the topsoil may restrict manual land preparation, but not the mechanized operations. The gravels throughout the soil do not prevent roots from penetrating.

Inclusions: To a considerable extent riverwash is found on which no soils have developed yet. The level of deposition is a few meters below the terrace on which the Lluidas soils are present. The riverwash consists of sandy, gravelly to stony conglomerates, originating from the Central Inlier. In places very gravelly variants of Lluidas soils are found.

Present land use: The soils in mapping unit PR1 are in use for large scale sugar cane farming. Along the Rio Cobre, bamboo forest is found, in places alternated with coconut trees.

PR2 Rose Hall clay loam - clay (93 ha)

The PR2 consociation consists of deep, imperfectly drained, dark reddish brown over a mottled grey and brownish yellow, fine textured Rose Hall soils.
These soils occur in the large gullies (elevation approximately 347 m, Landmann 1989) extending from the recent alluvial plain into incised old alluvial deposits. The topography is undulating.

Rose Hall soils are members of the fine, mixed, isohyperthermic family of Aquic Eutropepts. Since no profile description of these soils in the Lluidas Vale area is available, the reader is referred to Appendix 1.16 of Soil Survey Report No. 2 (SSU 1987b).

Brief profile description: Rose Hall soils are deep over recent alluvium. The topsoil (A horizon) is dark brown to dark reddish brown gravelly clay loam to clay, over a dark brown mottled yellowish brown to very pale brown clayey B horizon. The subsoil is strong brown and red mottled light greyish brown clay in a mixture of old and recent alluvial deposits.

Soil properties affecting management: Rose Hall soils are slightly calcareous and slightly alkaline, with a moderate inherent fertility. Permeability of the upper part of the profile is high. Due to physiography, the soils are prone to flooding and will have low oxygen availability in part of the year. Manual workability is no problem; mechanization is difficult, mainly because of topography.

Inclusions: At the lowest parts of the gullies very gravelly and stony soils are found, of recent alluvial origin. At the higher parts of the gullies, soils like Pennants variant I occur. They are usually gravelly and rich in Fe-Mn concretions.

Present land use: The soils of the PR2 mapping unit are planted to sugar cane or are left ruinate.

PRx1 Lluidas variant I - Lluidas variant II complex (297 ha)

The PRx1 complex consists of
a) deep, well to moderately well drained, dark reddish brown, fine textured Lluidas variant I soils, and
b) deep, moderately well to well drained, dark reddish brown, in places mottled, fine textured Lluidas variant II soils.

The soils occur on the major terrace (elevation about 350 m) of the river plain of the Rio Cobre, which occupies the central part of the Lluidas Vale basin. Most slopes are gently undulating and some parts are almost flat.

Lluidas variant I soils are members of the moderately fine, mixed, isohyperthermic family of Typic Hapludolls. Lluidas variant II soils belong to the fine, mixed, isohyperthermic family of Typic Eutropepts. Typical profiles are described in Appendix IV; the pit nos. are 010 and 107 respectively.

Brief profile description: Both variants of Lluidas soils are deep and moderately well developed over recent alluvium. The topsoil of Lluidas variant I soils is about 25 cm thick and dark brown to dark reddish brown gravelly clay to silty clay. The organic matter content and the base saturation of the A horizon are high. The subsoil (Bw horizon) is dark brown to dark reddish brown gravelly silty clay, clay loam or sandy clay loam of 25-40 cm thickness. The substratum (Cg horizon) shows some very slight gley features: a brown to dark brown clay loam to sandy clay loam with strong brown and brownish yellow mottles. The organic matter content decreases abruptly with depth.

Lluidas variant II soils, as compared to Lluidas variant I soils, have a similar organic matter content, but a less abrupt decrease with depth, and the topsoil is not as dark. The topsoil ranges from dark brown to brownish grey, loam to silty clay loam. The stratified subsoil is reddish brown with few (light) yellowish brown mottles. The texture throughout the major part of the Bw horizon is silty clay to silty clay loam; in the more gravelly parts, the matrix in between the gravels exists of sandy loam and loam. In the substratum (C/Cg horizon) there may be some gley mottling. The matrix colour remains dark brown to dark reddish brown.

Soil properties affecting management: Lluidas variant I and Lluidas variant II soils basically have the same characteristics that affect the management. Both are neutral to slightly alkaline and have a slightly calcareous subsoil. The capacity to store nutrients and the moisture retention capacity are high. Gravellines is causing a workability problem as in the Lluidas soils. The Mg content on the exchange complex is high, and of the same order as the exchangeable Ca.

Inclusions: Locally, within this mapping unit, in places where small streams or gullies occur, the surface is very to extremely gravelly, which limits workability.

Present land use: Both Lluidas variant soils of mapping unit PRx1 are under large scale sugar cane cultivation.

PFx1 Prospect variant I - Rose Hall variant I complex (29 ha)

The PFx1 complex consists of
a) deep, well drained, yellowish red to strong brown, moderately fine and medium textured Prospect variant I soils, and
b) deep, moderately well drained, yellowish red, yellowish brown and strong brown, mottled, moderately fine and medium textured Rose Hall variant I soils.
Both soils occur in recent alluvium on almost flat slopes, in the north-western fringes of the Linstead basin (Ewarton-Charlton). They are influenced by limestone colluvium from the nearby escarpment and the limestone hills.

Prospect variant I soils are members of the fine loamy, mixed, isohyperthermic family of Typic Hapludolls. Rose Hall variant I soils belong to the fine, mixed, isohyperthermic family of Vertic Eutropepts. The two soils are represented by the descriptions of pit no. 047 and 046 respectively, of Appendix IV.

Brief profile description: Prospect soils are developed in deep, stratified, recent alluvium. The topsoil has about 30 cm of dark brown sandy clay loam to sandy clay, containing limestone gravels (mollic A horizon). The subsoil (25-50 cm) is yellowish red to strong brown sandy loam, clay loam and sandy clay with faint gley mottles. The AC horizon has the same colours and sandy clay to sandy loam texture as the C horizons. Throughout the subsoil, fluviatile gravels are found as well as secondary limestone gravels. The subsoil has some white specks of feldspars.

Rose Hall variant I soils are silty in texture and have slightly developed vertic features. The topsoil, which is up to 35 cm thick, is dark brown to brown, silty clay loam to sandy clay loam and shows cracks. The transitional AC horizon is yellowish red to reddish brown, silty clay and silt loam down to the subsoil, which starts at 50-70 cm depth. The Cg horizon is yellowish red to dark yellowish brown, silty clay to silty clay loam with gley mottles and Mn-stains. The soil shows pressure faces, but no intersecting slickensides.

Soil properties affecting management: Prospect variant I soils are slightly calcareous and neutral to slightly alkaline. Relatively high amounts of exchangeable Ca and Mg are found on the exchange complex, while the subsoil also contains some exchangeable Al. Available P and K are low and high respectively. The moisture retention capacity is high. The soils are prone to flooding, due to their low physiographic position. Workability, manual as well as mechanized, is no problem. Rose Hall variant I soils chemically resemble the Prospect variant I soils. Physically, Rose Hall variant I soils are less permeable. They are also more susceptible to slaking.

Present land use: The soils of mapping unit PFx2 are mainly under large scale citrus cultivation; a nursery for fruit trees and ornamental plants is located in this area as well.

4.5.5 MISCELLANEOUS MAPPING UNITS

Np Ponds (37 ha)

Ponds indicated on the map include several small ponds (sinkholes) in the Lluidas Vale basin and two red-mud lakes, close to the ALCAN mining area in the north-east of the survey area.

Nu Rural residential areas (329 ha)

The major residential areas are Ewarton, Lluidas Vale and the residential area of Worthy Park Estate.

5. AGRONOMIC INTERPRETATION OF SURVEY DATA

5.1 INTRODUCTION

During soil surveys, data about the soil and other land resources are collected. These data have to be interpreted for the user of the soil map and report. This can be done in several ways. In the former Soil and Land Use Surveys (RRC 1958-1970) the Land Capability Classification System of Klingebiel and Montgomery (1961) was used. This system allows for the identification the arable acreage, but not for the identification of specific land use recommendations. This shortcoming of the Land Capability Classification System has been duly recognized since the Soil and Land Use Surveys include tables of "recommended crops for soils"

Since 1986, land use performance is assessed using the Jamaica Physical Land Evaluation System (JAMPLES). This software package was developed at the Rural Physical Planning Division (SSU 1986a, 1989c and 1989d) using the general principles and procedures of the "Framework for Land Evaluation" (FAO 1976). Fundamental to the "Framework" approach is that the evaluation of land use performance is only meaningful in relation to a clearly defined use.

The ultimate assessment of the suitability of land for a specific use usually is based on socio-economic land evaluation, which is not considered in this report. Often, limiting factors are more in the people than in the land.

5.2 METHODS

The JAMPLES procedure includes four main stages:

Stage 1- Data gathering and storage: Data on climate, soils and topography (land characteristics) as well as agro-ecological crop requirements (land use requirements) collected during the soil survey are stored in the computer.

Stage 2 - Data analysis: The land evaluation process starts with the selection of the relevant land utilization types (LUTs), each of which has specific land use requirements (see Sub-chapters 5.3 and 5.4). Land characteristics, which are single attributes of land that can be measured or estimated, are used to rate the land qualities of specific land units (Sub-chapter 5.5). Subsequently, land qualities are matched with land use requirements (Sub-chapter 5.6). First, the current limitations of a land unit for a particular crop are determined. Subsequently, by means of a computer programme, an assessment is made of these limitations which can be solved through land improvements. The technical and socio-economic setting specified for the land utilization type determines which land improvements can be implemented (Sub-chapter 5.3 and 5.8). Finally, the computer prints the tables with the provisional land suitability classification.

Stage 3 - Interim validation of results: During this critical stage provisional results are checked and validated against field observations (ground truth). Although some research on citrus and sugar cane is carried out at Worthy Park Estate, no overview of research data and results is readily available. A simulation model has been developed for sugar cane, sorghum and tobacco for yields in the Lluidas Vale area (CRIES/RPPD 1982).

Stage 4 - Recommendations: Suitability classifications of individual land units for specific LUTs are shown in tables and discussed in Sub-chapter 5.9. This information can be used by planners and agriculturists who have to identify and/or recommend feasible land use alternatives for the study area. The assumptions (Sub-chapter 5.8) should be carefully read before implementing the recommendations.

5.3 LAND UTILIZATION TYPES

The potential suitability of a land unit for a specific crop varies with the level of technology and capital-intensity available to the farmer and his management skills. The actual suitability is further determined by socio-economic factors, including Government policy towards agricultural production.

Many types of agricultural land use exist in Jamaica (CRIES/RPPD 1982). In view of this complexity, land utilization types (LUTs) are defined as management systems which produce a particular crop in a defined technical and socio-economic setting. This setting is described under the general heading "major kind of land use" (MLU).

Each LUT is identified by a unique code, for instance "MLU-B/yam" (see Sub-chapter 5.9). Table 13 shows which combinations of MLUs and crops are considered to be relevant for the survey area.

Table 13. Land utilization types (MLU/ crop systems) considered relevant for the Lluidas Vale area.

Crops:	Management system			
	MLU-A	MLU-B	MLU-C	MLU-D
sugar cane	+	+	+	+
maize	+	+	+	+
tobacco	+	+	+	+
groundnut	+	+	+	+
pigeon pea	+	+	-	-
common bean	+	+	+	+
red pea	+	+	+	+
onion	+	+	+	+
cassava	+	+	-	-
yam	+	+	-	-
cocoyam	+	+	-	-
sweet potato	+	+	-	-
calaloo	+	+	+	+
cabbage	+	+	+	+
tomato	+	+	+	+
cucumber	+	+	+	+
pumpkin	+	+	+	+
coconut	+	+	+	+
cocoa	+	+	+	-
coffee (arab.)	+	+	+	+
coffee (cane.)	+	+	+	+
breadfruit	+	+	-	-
citrus	+	+	+	+
ackee	+	+	-	-
mango	+	+	+	+
pimento	+	+	-	-
forestry	+	+	-	-
natural forest	+	-	-	-
banana	+	+	+	+
plantain	+	+	-	-
pineapple	+	+	+	+
unimproved pasture	+	-	-	-
improved pasture	-	+	+	+
ginger	+	+	+	+

+ : relevant LUTs; - : non relevant LUTs

Four MLUs are considered in this land evaluation:

MLU-A: Mixed, non-commercial (subsistence) rainfed farming based on low technology and low capital-intensity.

Land use is of a permanent nature on holdings of less than 2 hectare each; the majority of the holdings is 0.4 to 2 ha (see Appendix IIIA). Each holding consists of several small plots which occur generally over a larger area. Capital intensity of farming is low, limiting physical inputs to land clearing, burning and shallow tillage before sowing or planting. All field activities are carried out manually, the main tools being the spade, fork and machete. Weeding practices are generally at a low level as are erosion- and drainage control. Manure, where available, is used to correct and/or maintain the nutrient status of the soil but chemical fertilizers and lime are seldom applied. Therefore a fallow period is needed to regenerate the soil fertility status.

Local varieties of annual, perennial and tree crops are grown in a mixed cropping system. A limited number of climatically adapted tree crops is grown on the homestead. Average yields remain low at the prevailing level of technology and capital-intensity. Farmers are mainly without formal education. They follow traditional cultivation methods and show little inclination towards change if such changes involve taking risks. Support from the Extension Service is needed.

MLU-A includes activities such as the rearing of local breeds of goats on marginal land or of chicken on the homestead, while bee-keeping is practiced by very few farmers. The produce is mainly used for subsistence but occasional surpluses are sold on the local market.

<u>MLU-B</u>: Mixed, commercial (rural market oriented) rainfed farming using intermediate technology and intermediate capital-intensity.

Land tenure is of a permanent nature. Farm size varies from 2 to 4 ha and plots are somewhat fragmented. Technology and capital intensity are at intermediate level. Cultivation is sometimes mechanized but most field maintenance practices are carried out manually. Additional labour may be required. Soil drainage works are seldom used whereas simple soil conservation measures are common practice. Weeding is done by hand and commercial pesticides are used. Other physical inputs include liming, manuring and the application of fertilizer. The rate, kind and application of chemical fertilizers is not based on crop and soil specific recommendations. As a result, only simple nutrient deficiencies and toxicities can be remedied under good management.

Most farmers have at least primary schooling. They are willing to adopt improved methods where benefits can be clearly demonstrated. Recommendations on agronomic practices are provided by the Extension Service.

MLU-B is mainly based on a mixed cropping pattern, but in some small fields annual crops are grown in pure stands. Mainly local crop varieties are grown. Simple moisture control measures are taken to optimize rainfall efficiency for crops.

The produce is mainly sold at rural markets. MLU-B requires adequate marketing facilities and good infrastructure.

MLU-C: Mixed, commercial (rural/urban market oriented) rainfed farming with supplementary irrigation under intermediate technology and intermediate capital-intensity.

Land tenure is of a permanent nature. Farm size varies from 4 to 10 ha and plots are mainly clustered. Management, technology and capital intensity are at intermediate level. Cultivation is often mechanized but some field maintenance practices are carried out manually. Additional labour is required. Moderate use is made of drainage works and soil conservation practices. Most weeding is done by hand but commercial pesticides are used. Other physical inputs include liming, manuring and the application of fertilizer. The rate, kind and application of fertilizers is based on general recommendations for particular crops but they are not soil specific. As a result, only simple nutrient deficiencies and toxicities can be corrected under good management.

MLU-C mainly differs from MLU-B in that it uses supplementary irrigation (mainly furrow and /or sprinkler). The irrigation facilities allow farmers to remedy possible periods of water shortage during the rainy season - enhanced risk security- but the irrigation capacity is not adequate for year-round irrigation.

Most farmers have at least primary schooling. They are willing to develop and adopt improved methods. General recommendations on agronomic practices are provided by the Extension Service, partly based on results of agricultural research.

The land use system is based on a single cropping pattern and sound crop rotation. Local and high yielding crop varieties are produced, mainly to be sold at rural and urban markets. This MLU requires good marketing facilities and infrastructure.

MLU-D: Commercial (urban/export market oriented) rainfed/irrigated farming based on high technology and high capital intensity.

Land tenure is of a permanent nature. Farms are mainly large (more than 10 ha) and consist of contiguous plots. They are operated by highly skilled managers, who often have a degree or diploma in agricultural education. The level of capital intensity, technical know-how and management is high. Field operations (e.g. cultivation, sowing, fertilizer application, spraying) are predominantly mechanized, but hired, manual labour is used at harvesting. Irrigation (i.e. furrow, sprinkler or drip) can be widely used for periods of low rainfall. This requires a high demand for a reliable supply of good quality piped water (this is more applicable in the Ewarton area than in the Lluidas Vale area, where sufficient water sources are not available). Adequate use is made of drainage works and soil conservation practices. Pesticides, herbicides and inorganic fertilizers are widely applied using site specific recommendations.

Physical soil characteristics are the main source of limitations at this level of technology. "Moderate" limitations related to impeded drainage are solved through artificial drainage. Limitations of a chemical nature can be remedied in MLU-D.

Modern farming and marketing techniques are used to maximize yields and economic returns. This includes the growing of high yielding crop varieties in pure stands and in agriculturally sound rotations. In case of irrigated pastures, beef and dairy are the main produce. All produce is sold at the urban market or exported. This makes a good infrastructure necessary.

5.4 LAND USE REQUIREMENTS

FAO (1976) defines land use as the set of conditions necessary or desirable for the successful and sustained operation of a given land utilization type.

The set of land use requirements, as worked out in the LANDEV-module (SSU 1989c) and related to the efficient functioning of a particular LUT, includes:

a) Crop requirements.
Physiological requirements vary from one crop to the other and also between crop varieties. For a particular crop, there will be a difference between the physiological requirements for minimum and optimum growth. Crop requirements as applied in the present study are mainly derived from

international sources and complemented with Jamaican expertise (see SSU 1989c).

b) Management requirements.
Each type of LUT has specific management requirements related to the technical and socio-economic setting described for the MLU (see SSU 1989c)

c) Conservation requirements.
JAMPLES determines whether a land unit is physically suitable for the sustained application of a LUT. The absence of risk of environmental degradation through erosion is therefore considered as a land use requirement.

5.5 LAND QUALITIES

Each land unit is characterized by one or a set of single attributes, called land characteristics, which are recorded during the field survey and measured in the laboratory stage. Table 14 shows how land qualities used in JAMPLES are described, using one or more land characteristics. For example, the land quality "moisture availability" to a particular crop is rated using the land characteristics rainfall, potential evapo-transpiration and soil moisture retention.

The land quality ratings are derived from land characteristics using the rating system developed at the Rural Physical Planning Division (SSU 1987c). Land qualities are complex attributes of land which act in a manner distinct from the actions of other land qualities in their influence on the suitability of land for a specified use (FAO 1976). For convenience sake, they are grouped into two categories based on their general effect on crop productivity, viz:

a) Land qualities related to the agro-ecological conditions:
- adequacy soil moisture regime (MR)
- limitations of air temperature regime (TR)
- adequacy of soil reaction (PH)
- adequacy of nutrient retention (NR)
- adequacy of nutrient availability (NA)
- absence of calcium carbonate toxicity (CC)
- absence of aluminium toxicity (AL)
- absence of salinity hazard (SA)
- absence of sodium toxicity (SO)
- availability of oxygen in the root zone (OX)
- adequacy rooting conditions (RC)

b) Land qualities related to water and land management:
- absence of a long term erosion hazard (E)
- ease of cultivation (workability, W)
- ease of irrigability of the land (I)

Table 14. Land qualities and associated land characteristics as considered in JAMPLES.

Land qualities	Land characteristics
Moisture availability	monthly rainfall; monthly PET; available water capacity of soil
Temperature regime	air temperature
Nutrient retention capacity	effective cation exchange capacity (ECEC) in upper 30 cm
Soil reaction	pH(H2O) (1:2.5) in upper 50 cm
Nutrient availability	exchangeable Ca, Mg and K (1M Na4OAc at pH 7); organic matter content; available phosphorus (Truog) in upper 30 cm; (also: pH, salinity, sodicity, CaC03 and Al)
Ca-carbonate toxicity	CaC03 content in upper 50 cm
Aluminium toxicity	percentage of ECEC saturated with exchangeable aluminium in upper 50 cm
Excess of salts	electrical conductivity in saturated paste; depth of occurrence of salts within 100 cm from the surface
Sodicity hazard	exchangeable sodium (ESP) percentage in upper 50 cm
Availability of oxygen	soil drainage class
Ease of rooting	soil depth to physical root limiting layer; drainage class; stoniness/rockiness; porosity; vertic properties
Erosion hazard	soil texture; soil structure; organic matter content; slope angle and length; rainfall erosivity; present vegetation cover
Ease of cultivation/ resp. mechanization	consistence; stoniness and/or rockiness; soil depth; slope angle; ESP
Ease of irrigability	available water capacity; soil permeability; slope angle; monthly rainfall

5.6 MATCHING OF LAND QUALITIES WITH LAND USE REQUIREMENTS

During the matching process the land qualities of a particular land unit, as characterized by its major soil(s), are compared with the land use requirements of individual LUTs. The matching module of JAMPLES calculates the factor ratings. Each factor rating indicates the degree in which a particular land use requirement is satisfied, under current conditions, by the corresponding land quality.

Three factor ratings, or classes of limitation, are recognized in JAMPLES (see Appendix VIII), viz:

- 0: not/slightly limiting (i.e. very high grade of availability or absence of risk of land quality for specified crop under current conditions)
- 1: moderately limiting
- 2: strongly limiting

The above classes of limitations correspond with an <u>anticipated</u> yield reduction of less than 20%, 20 to 50% and over 50% from targeted yields respectively. Due to lack of data, these figures could not be checked in the field.

5.7 LAND SUITABILITY CLASSIFICATION

The potential suitability of a tract of land for a particular crop varies with technical and socio-economic setting (MLU) in which the crop is produced. The land suitability classification is derived from the factor ratings, taking into account those land improvements that are applicable for the specified MLU (see SSU 1989c).

The output of JAMPLES is checked by the soil surveyor, who uses the agricultural expertise available for the survey area, before final recommendations are made (Sub-chapter 5.9). The land suitability classification system is discussed below.

Two land suitability orders are considered in JAMPLES in accordance with the format proposed in "A Framework for Land Evaluation" (FAO 1976), viz. suitable (S) and not-suitable (N). Classes within orders are indicated with numerals and reflect the respective degree of suitability or non-suitability. Four land suitability classes are recognized in JAMPLES (see Table 15), viz:

- Highly suitable (S1): This type of land has no significant limitations to sustained application of a given use, or only minor limitations that will not significantly reduce productivity and will not raise inputs above acceptable levels. In most years the specified crop will produce from to 80 to 100 percent of the targeted yield.

- Moderately suitable (S2): This type of land has limitations which, when combined, are moderately severe for sustained application of a given use. The limitations of the land will reduce productivity and increase required inputs to the extent that the overall advantage to be gained from the use, will be appreciably lower to that experienced for S1 land, but the inputs will be satisfactorily covered by the returns. In most years, the considered crop will produce from 40 to 80 percent of the targeted yield.

- Marginally suitable (S3): When land is rated S3 its aggregate limitations are severe for sustained application of a given use. Productivity will be so reduced that the inputs will be only marginally covered. In most years, the specified crop will produce from 20 to 40 percent of the targeted yield.

Land on which in most years a crop produces less than 20% of the targeted yield is termed not-suitable (N). It can either be currently not-suitable, i.e. have limitations that are so severe as to preclude successful sustained use of the land in the given manner, or permanently not-suitable, i.e. show no potential for sustained agriculture irrespective of the type of land improvements.

The class "not-relevant" (--) is used if a particular land use is not pertinent within the socio-economic context of the survey area.

Suitability subclasses are indicated in the suitability symbol with common letters, where the land suitability of a specified use is either S2 or S3. Each letter reflects the nature of a major limitation for the envisaged land use. Additional insight with regard to the nature of these limitations can be derived from Appendix VIII. Where relevant, subclasses are indicated in the output tables (see Sub-chapter 5.9) using small letters:

- t: air temperature is limiting for the crop under consideration.
- w: high rainfall is a constraint for good production
- r: rainfall is low and highly variable thereby limiting growth of the specified crop (MLUs A and B)
- f/p: soil/terrain conditions are unfavourable after land improvement. Only the most stringent condition is indicated: f for soil fertility and p for physical/topography related constraints.
- e: soil erosion is a risk under sustained application of the indicated use.

Table 15. Agro-ecological land suitability classes determined with the land evaluation module.

Suitability Order	Class
S: suitable	S1: highly suitable
	S2: moderately suitable
	S3: marginally suitable
N: not-suitable	

The following example shows an interpretation of the suitability classification: Lluidas soils on a 0-2% slope in the Worthy Park area rate S2pw for citrus under management level C, which means the land is moderately suitable. The main problems for sustained and successful land use at the considered level of inputs and technology are gravelliness and fine-textured topsoil (p) and too little dry months to prevent the citrus being infested by fungus (w).

5.8 MAIN ASSUMPTIONS

This land evaluation study is based on a number of assumptions which should be read before using the results (Sub-chapter 5.9), viz:

- Land suitability is determined for sustained agricultural use (long term productivity) without environmental degradation.

- Sound crop rotations and good management skills are used to maintain sustained productivity. Such rotations reduce the incidence of diseases and pests and optimize the efficiency of fertilizer application and irrigation.

- The cost of solving strongly limiting conditions of drainage is assumed to be prohibitive within the prevailing socio-economic context. Minor limitations (factor rating = 1) for drainage, however, can be solved for MLU-D.

- Rainfed farming of a particular crop is not recommended in areas where the risk of crop failure resulting from conditions of "drought" exceeds 25% during the envisaged growing season (MLUs A and B).

- An adequate supply of water of good quality and the existence of a good distribution system are assumed when rating land suitability for irrigated crops (MLUs C and D).

- The targeted (or optimum) yield of a particular crop changes with the technical and socio-economic setting in which it is produced. That is, it generally increases as the level of technology increases. This aspect can be illustrated using data from ILACO (1981). The "targeted" yield of rainfed maize in the tropics is about 1 to 1.5 metric tonnes/ha for MLU-A, 2.5-3.0 metric tonnes/ha for MLU-B and 4.0-5.0 metric tonnes/ha for MLU-D.

- For most crops it is not yet feasible to quantify yield depressions which result from partial deficiencies of specific land qualities, due to a scarcity of relevant research data.

- Year to year variations in yields, which are due to the variability in space and time of rainfall, can be in the order of 40% for rainfed crops and 20% for irrigated crops (ILACO 1981).

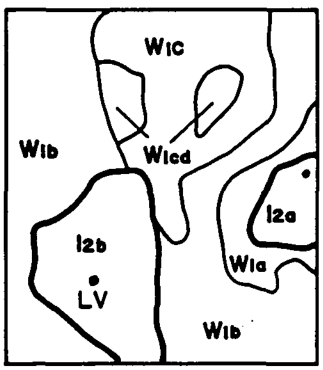
- At the present scale of mapping, small areas of "minor" soils are included in each mapping unit (see Sub-chapter 4.3). The response of these "included" soils to management practices, and hence their suitability for a given use, can differ from that of the major soils. Land suitability recommendations in this study are for the majority of the major soils and two included soils. There is always the need for on-site checking of soil conditions before developing a tract of land into a particular use. In case the development of modern farms is envisaged, the field investigations should be followed by crop variety and fertilizer trials. Trial plots provide farmers and investigators with an insight into soil-water-crop relations allowing for cost analysis (pre-feasibility study).

- JAMPLES is the first stage of a "two stage" approach to land evaluation. The recommendations are mainly based on the analysis of agro-ecological factors. Socio-economic factors, however, will further determine the "actual" suitability rating. The availability of a market for the produce, quality of the produce, price of the produce, incidence of preadial larceny and adequacy of infrastructure are some socio-economic factors that strongly determine the "actual" viability of a LUT.

5.9 RESULTS AND RECOMMENDATIONS

Agro-ecological limitations for the Lluidas Vale area for specific forms of land use, determined with the matching module of JAMPLES, are listed in tabular form in Appendix VIII. These tables indicate per major soil which land qualities are most limiting for specific crops under current conditions. The key to the final suitability classification of the land mapping units for specific crop/management systems is shown in Table 16. In this key reference is made to Table 16.1 to 16.21 where land suitabilities for the 34 selected crops produced under 4 different management systems, are listed by soil series.

The main limitations are briefly discussed below per major agro-climatological zone as shown in Figure 7. The delineated zones are the Intermediate and Wet moisture availability zone, and 4 temperature classes. They correspond with the Hills and Foothills (W1), the Lluidas Vale Inland basin (I2b) and the fringes of the Linstead Inland basin (I2a). In the discussion, reference is made to the soils of the different mapping units, as described in Sub-chapter 4.4 (Table 12) and 4.5. The suitability statements are for the dominant soil(s) of the mapping unit and as such not site specific. There always is the need for site specific investigations, prior to developing a specific area for agriculture. Recommended soil conservation practices for a specified land use are shown in Appendix IX.



Intermediate moisture availability zone:
I2: 0.75<=R75/PET<1.00. The main 75%-DGP is 5-7 months long and followed by 2-4 dry months, 2-3 rainy months or a second 75%DGP of 1-3 months, and 0-2 consecutive dry months.

Wet moisture availability zone:
W1: 1.00<=R75/PET<1.25. The main 75%-DGP of 6-9 months is preceded by a short rainy season or a second 75%-DGP of 2-3 months, and followed by 1-3 consecutive dry months (cumulative).

Thermal classes:	Tmin	Tmean	Tmax (°C)
a: hot	19-22	24-26	29-32
b: warm	17-19	22-24	27-29
c: mod. warm	16-17	20-22	25-27
d: cool	13-16	17-20	22-25

Figure 7. Agro-ecological zones in the Lluidas vale area (E: Ewarton, LV: Lluidas Vale; scale 1:250,000). Source: SSU 1989i.

The Hills and Foothills of the Lluidas Vale area are predominantly in the Wet moisture availability zone, with R75/PET values varying between 1.00 and 1.25 (W1, SSU 1989i). Point Hill is the representative rainfall station for this area, although located outside the survey area. The dependable growing period (DGP) is 8-9 months, starting in April-May, followed by 3-4 consecutive dry-rainy months. The wettest months are October, September and May. The average temperature gradually decreases from 24-26°C to 17-20°C as elevation increases from about 250 m to about 900 m (thermal classes a to d). The mapping units occurring in this agro-ecological zone are HL, HJ and HX. They represent the following soils: Mountain Hill, Bonnygate, St. Ann variant I, Swansea, Union Hill, Union Hill variant I, Mount Rosser and Carron Hall (see Table 16).

Based on the statistical analyses of the climatic factors rainfall, PET and temperature, the Hills and the Foothills are too wet to allow for good ripening and reaping of sugar cane. Tree crops, such as citrus, ackee, mango and pimento also need a clear dry period for optimal growth and production. Rainfall is adequate for most annual crops; in most years planting can start in May. Average temperatures are not optimal for several crops, like sugar cane, tobacco, coconut, banana and cocoa. For lowland coffee (C. canephora), the temperature is too low; for upland coffee (C. arabica), temperature is favourable at the higher elevations (> 600 m).

Mount Rosser soils are not suitable for most kinds of agricultural use. However, they are marginally suitable for natural forest and unimproved pasture under low management (MLU-A), and improved pasture under an intermediate management level (MLU-B). Depth and susceptibility to erosion on the steep to very steep slopes are the major limitations for other types of agriculture.

Moderately deep Swansea soils (and similar inclusions in mapping unit HLx2; see Table 16.9) are not suitable for the considered crops at higher management levels, except for improved pasture. At low management level (MLU-A and B), some annual crops can be grown on the lower slopes (8-16%), though the soils are still marginally suitable. On steeper slopes growing of crops is not recommended. Most tree crops will have problems due to the limited rooting conditions and stoniness.

Marginally suitable for most annual crops and moderately suitable for tree crops at low management levels are St. Ann variant I soils (and similar inclusions in mapping unit HLx1; see Table 16.8). They are moderately suitable for both perennial and annual crops at higher input/management levels. Rooting is a problem for some crops. The area is suitable for most tree crops that do not require a marked dry period for good growth and production. For annual crops workability is a problem, due to stoniness; on slopes steeper than 8% agricultural activities, apart from growing tree crops, are not recommended. In addition, soil fertility is limiting at low management levels (low nutrient availability), which can be solved only partially at higher management levels (low nutrient retention).

Mountain Hill soils physically have the same properties as St. Ann variant I soils. Moreover, the exchangeable aluminium level is an important management problem at low level, so that soils are not suitable for Al-sensitive crops; since the Al-problem is severe, it can be overcome at higher management levels, but only for most tree crops. For annual crops at the level of MLU-D, these soils remain moderately suitable.

Union Hill variant I soils are marginally to moderately suitable for most crops, grown under low management. The major limitation is soil fertility. At the higher slopes, erosion causes additional problems for sustained agriculture. Slopes of more than 16% should be left under forest, land pressure allowing; they can only be cultivated under low management. At the highest management level (D), stoniness and slope limit mechanized agriculture; on the lowest slopes (5-8%) tree crops will perform well. Climatological characteristics of the area are more favourable in the transitional zone between the Hills and the Linstead Basin, where crops like coffee, citrus, cocoa and mango will grow well.

The Lluidas Vale Inland basin is in the Intermediate moisture availability zone (see Figure 7); the R75/PET value ranges from 0.75 to 1.00 (I2 zone, SSU 1989i). The DGP, starting in May, lasts for about 8 months followed by 1-4 dry months, as shown by rainfall data of Worthy Park. Two to three months still have some rainfall, but these amounts are not considered sufficient for satisfactory growth of annual crops. The wettest month is October. September is also a wet month in the eastern part of the basin (Charming Hole). Average temperatures are around 22-24°C, i.e. the area is in the warm temperature zone. Soil mapping units in the Lluidas Vale basin are BO1 to BO3, BF1 and BFy1 (see Table 16), representing the following soils over old alluvium, i.e. Pennants, Tydixon, Knollis, Donnington and Brysons variants I and II. Lluidas, Rose Hall, Lluidas variants I and II are the major soils in mapping units PR1, PR2 and PRx1, developed over recent alluvium.

Air temperature in the Lluidas Vale basin is too cool for coconut and too hot for upland coffee. For proper ripening/harvesting of sugar cane, ackee and mango the dry period is somewhat too short. Under this rainfall regime, citrus will be rather susceptible to fungus infestation. For crops like tobacco, cocoyam, cocoa, banana and plantain, the area will be too dry in some years, due to the erratic nature of rainfall. The area becomes dryer from the south-west to the north-east; the latter area is considered too dry for satisfactory growth of most annual crops.

Conditions of the soils over Old Alluvium in the Lluidas Vale Basin limit possibilities for agricultural production. The soils are considered not suitable at the lowest management/input level, except for natural forest and unimproved pasture. At management level B and C the soils are not suitable for agriculture either, except for sugar cane, cocoyam and improved pasture; Pennants soils show marginal suitability for most other crops considered. At high management levels (MLU-D) most soils are marginally suitable to moderately suitable for annual and perennial crops, showing fertility problems related to low nutrient retention and lowering of high exchangeable aluminium levels (e.g. Pennants variant I soils) or physical problems like poor workability and poor internal drainage (e.g. Brysons variant I soils).

The soils over young alluvium show marginal suitability at low management level, but moderate to high suitability with increasing management level (B-D) for most crops. Major limitation is the hard consistence of the dry soil and gravelliness in places. Coffee and cocoa do not grow very well on these soils, mainly due to climatological constraints.

The Linstead Inland basin lies in the Intermediate moisture availability zone (see Figure 7). The R75/PET value is in between 0.75 and 1.00 (I2 zone, SSU 1989). The DGP lasts from May to December (about 8 months) and is followed by 3-4 predominantly dry months. Usually April is the onset of the rainy season. October is the wettest month. The outer part of the Basin extends into the W1 zone. Rainfall conditions in this area are transitional between those observed at Ewarton and Point Hill. The altitude is around 250 m; consequently, the temperatures are higher, compared to the Lluidas Vale basin. Within units B04 to B06, as mapped in the area, the following major soils occur: Linstead, Rosemere variant I and Riverhead. These soils are formed over old alluvium. Prospect variant I soils and Rose Hall variant I soils in mapping unit PFy1 have developed over recent alluvium (see Table 16).

In the Linstead basin, temperature conditions for cabbage and upland coffee are not optimal. Due to the high rainfall variability in the Ewarton area, many annual crops, like beans, red peas, calaloo and some tree crops suffer from drought in some years. In the W1 zone, climatologically adapted annual crops can be grown without problems.

All soils developed on old alluvium and under low management levels are not considered suitable for agricultural use, except for natural forest and unimproved pasture.

At higher management levels, Linstead soils still show drainage problems, except for sugar cane and unimproved pasture. At the highest level, poor drainage remains the main soil physical limitation. Sugar cane grows well in the area, provided the soils have been drained artificially.

Rosemere variant I soils are marginally suitable at higher MLU-levels; for annual crops the major problem remains soil fertility (low nutrient availability and presence of exchangeable aluminium); physical problems generally limit the growth of tree crops (high bulk density, poor drainage).

Riverhead soils, showing workability problems and moderate drainage are highly suitable for a wide range of crops under high management.

The soils over young alluvium, Prospect variant I and Rose Hall variant I, are marginally suitable at low management level, moderately suitable at medium management level and highly suitable under high management for most of the 34 crops considered. The high bulkdensity may restrict the growth of tree crops; other crops do not experience problems.

Table 16. Key to the suitability classification of the different soils for selected crops within specific MLUs.

Map unit	Slope-phase	Major soils series	Suitability table
HL1	c	Mountain Hill	16.17
HLx1	efg	Bonnygate	*
	cd	St. Ann variant I	16.7
HLx2	efg	Bonnygate	*
	de	Swansea	16.10
HLx3	cd	St. Ann variant I	16.7
	efg	Bonnygate	*
HLx4	def	Union Hill	-
	cd	Union Hill var. I	16.15
HLx5	def	Union Hill	-
	efg	Bonnygate	*
HLx6	efg	Bonnygate	*
	def	Union Hill	-
HLx7	efg	Bonnygate	*
	def	Union Hill	-
	cd	St. Ann variant I	16.7
HJ1	efg	Mount Rosser	16.12
HJ2	cd	Carron Hall	-
HXx1	def	Union Hill	-
	ab	Riverhead	16.11
BO1	bc	Pennants variant I	16.18
BO2	ab	Tydixon	16.19
BO3	ab	Knollis	16.20
BO4	bc	Linstead variant I	16.11
BO5	bc	Rosemere variant I	16.13
BO6	bc	Riverhead	16.14
BF1	d	Donnington variant II	16.1
BFy1	b	Brysons variant I	16.3
	b	Brysons variant II	16.2
PR1	ab	Lluidas	16.21
PR2	bc	Rose Hall	-
PRx1	ab	Lluidas variant I	16.4
	ab	Lluidas variant II	16.16
PFy1	b	Prospect variant I	16.6
	b	Rose Hall variant I	16.5

Note: -: Union Hill, Rose Hall and Carron Hall soils are not evaluated with JAMPLES for this area, only for the Linstead-Bog Walk area (SSU 1987b)

*: Bonnygate soils have similar suitability as Mount Rosser soils, see Table 16.12.

Table 16.1 Suitability of Donnington variant II soils for selected crops within specific technical and socio-economic settings (MLUs); month of planting/sowing: May.

Crop	slope (%)	agro-ecological suitability class for: MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rain)
sugar cane	8-16%	S3fw	S2w	S2pw	S2pw
maize	8-16%	S3f	S1	S2p	N
tobacco	8-16%	N	S2f	S2p	N
groundnut	8-16%	N	S2f	S2p	N
pigeon pea	8-16%	S2fw	S2w	--	--
common bean	8-16%	N	S2f	S2p	N
red pea	8-16%	N	S2f	S2p	N
onion	8-16%	N	S2f	S2p	N
cassava	8-16%	S2fw	S2w	--	--
yam	8-16%	N	S3p	--	--
cocoyam	8-16%	S3fr	S2r	--	--
sweet potato	8-16%	N	S2f	S2p	N
calaloo	8-16%	S2fr	S2r	S2p	N
cabbage	8-16%	N	S2fr	S2p	N
tomato	8-16%	N	S2f	S2p	N
cucumber	8-16%	N	S2f	S2p	N
pumpkin	8-16%	S3f	S1	S2p	N
coconut	8-16%	S3pt	S2pt	S2pt	S2pt
cocoa	8-16%	S3pr	S2pr	S2p	--
coffee (arab.)	8-16%	S3pt	S2pt	S2pt	--
coffee (cane.)	8-16%	S3p	S2p	S2p	--
breadfruit	8-16%	S3p	S2p	--	--
citrus	8-16%	S3pw	S2pw	S2pw	S2pw
ackee	8-16%	S3pw	S2pw	--	--
mango	8-16%	S3pw	S2pw	S2pw	S2pw
pimento	8-16%	N	S3pw	--	--
forestry	8-16%	S3p	S2p	--	--
natural forest	8-16%	S1	--	--	--
banana	8-16%	N	S3pr	S3p	S3p
plantain	8-16%	S3fr	S2r	--	--
pineapple	8-16%	S2fw	S2w	--	--
unimpr. pasture	8-16%	S2f	--	--	--
impr. pasture	8-16%	--	S1	S1	S1
ginger	8-16%	S3fw	S2w	S2pw	S2pw

Climatic data: R75= 1328 ; Rav= 1551 ; PET= 1447 (mm/yr); R75/PET= .9099999

Table 16.2 Suitability of Brysons variant II soils for selected crops within specific technical and socio-economic settings (MLUs); month of planting/sowing: May.

		agro-ecological suitability class for:			
Crop	slope (%)	MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rain
sugar cane	2- 5%	N	N	N	N
maize	2- 5%	N	N	N	N
tobacco	2- 5%	N	N	N	N
groundnut	2- 5%	N	N	N	N
pigeon pea	2- 5%	N	N	--	--
common bean	2- 5%	N	N	N	N
red pea	2- 5%	N	N	N	N
onion	2- 5%	N	N	N	N
cassava	2- 5%	N	N	--	--
yam	2- 5%	N	N	--	--
cocoyam	2- 5%	N	N	--	--
sweet potato	2- 5%	N	N	N	N
calaloo	2- 5%	N	N	N	N
cabbage	2- 5%	N	N	N	N
tomato	2- 5%	N	N	N	N
cucumber	2- 5%	N	N	N	N
pumpkin	2- 5%	N	N	N	N
coconut	2- 5%	N	N	N	N
cocoa	2- 5%	N	N	N	--
coffee (arab.)	2- 5%	N	N	N	--
coffee (cane.)	2- 5%	N	N	N	--
breadfruit	2- 5%	N	N	--	--
citrus	2- 5%	N	N	N	N
ackee	2- 5%	N	N	--	--
mango	2- 5%	N	N	N	N
pimento	2- 5%	N	N	--	--
forestry	2- 5%	N	N	--	--
natural forest	2- 5%	S2p	--	--	--
banana	2- 5%	N	N	N	N
plantain	2- 5%	N	N	--	--
pineapple	2- 5%	N	N	--	--
unimpr. pasture	2- 5%	S2f	--	--	--
impr. pasture	2- 5%	--	S1	N	N
ginger	2- 5%	N	N	N	N

Climatic data: R75= 1265 ; Rav= 1522 ; PET= 1441 (mm/yr); R75/PET= .87

Table 16.3 Suitability of Brysons variant I soils for selected crops within specific technical and socio-economic settings (MLUs); month of planting/sowing: May.

		agro-ecological suitability class for:			
Crop	slope (%)	MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rain
sugar cane	2- 5%	S3pw	S3pw	S2pw	S2w
maize	2- 5%	N	N	N	S2p
tobacco	2- 5%	N	N	N	S2p
groundnut	2- 5%	N	N	N	S2p
pigeon pea	2- 5%	N	N	--	--
common bean	2- 5%	N	N	N	S2p
red pea	2- 5%	N	N	N	S2p
onion	2- 5%	N	N	N	S2p
cassava	2- 5%	N	N	--	--
yam	2- 5%	N	N	--	--
cocoyam	2- 5%	S3fr	S3pr	--	--
sweet potato	2- 5%	N	N	N	S2p
calaloo	2- 5%	N	N	N	S2p
cabbage	2- 5%	N	N	N	S2p
tomato	2- 5%	N	N	N	S2p
cucumber	2- 5%	N	N	N	S2p
pumpkin	2- 5%	N	N	N	S2p
coconut	2- 5%	N	N	N	S3pt
cocoa	2- 5%	N	N	N	--
coffee (arab.)	2- 5%	N	N	N	--
coffee (cane.)	2- 5%	N	N	N	--
breadfruit	2- 5%	N	N	--	--
citrus	2- 5%	N	N	N	S3pw
ackee	2- 5%	N	N	--	--
mango	2- 5%	N	N	N	S3pw
pimento	2- 5%	N	N	--	--
forestry	2- 5%	N	N	--	--
natural forest	2- 5%	S2p	--	--	--
banana	2- 5%	N	N	N	S3p
plantain	2- 5%	N	N	--	--
pineapple	2- 5%	N	N	--	--
unimpr. pasture	2- 5%	S2f	--	--	--
impr. pasture	2- 5%	--	S1	S1	S1
ginger	2- 5%	N	N	N	S3p

Climatic data: R75= 1265 ; Rav= 1522 ; PET= 1441 (mm/yr); R75/PET= .87

Table 16.4 Suitability of Lluidas variant I soils for selected crops within specific technical and socio-economic settings (MLUs); month of planting/sowing: May.

Crop	slope (%)	agro-ecological suitability class for: MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rain
sugar cane	0- 2%	S3pw	S2pw	S2w	S2w
	2- 5%	S3pw	S2pw	S2w	S2w
maize	0- 2%	S3pr	S3pr	S2p	S1
	2- 5%	S3pr	S3pr	S2p	S1
tobacco	0- 2%	S3pr	S3pr	S2p	S1
	2- 5%	S3pr	S3pr	S2p	S1
groundnut	0- 2%	S3pr	S3pr	S2p	S1
	2- 5%	S3pr	S3pr	S2p	S1
pigeon pea	0- 2%	S3pw	S3pw	--	--
	2- 5%	S3pw	S3pw	--	--
common bean	0- 2%	S3pr	S3pr	S2p	S1
	2- 5%	S3pr	S3pr	S2p	S1
red pea	0- 2%	S3pr	S3pr	S2p	S1
	2- 5%	S3pr	S3pr	S2p	S1
onion	0- 2%	S3p	S3p	S2p	S1
	2- 5%	S3p	S3p	S2p	S1
cassava	0- 2%	S3pw	S3pw	--	--
	2- 5%	S3pw	S3pw	--	--
yam	0- 2%	S3p	S3p	--	--
	2- 5%	S3p	S3p	--	--
cocoyam	0- 2%	S3pr	S2pr	--	--
	2- 5%	S3pr	S2pr	--	--
sweet potato	0- 2%	S3pr	S3pr	S2p	S1
	2- 5%	S3pr	S3pr	S2p	S1
calaloo	0- 2%	S3pr	S3pr	S2p	S1
	2- 5%	S3pr	S3pr	S2p	S1
cabbage	0- 2%	S3pr	S3pr	S2p	S1
	2- 5%	S3pr	S3pr	S2p	S1
tomato	0- 2%	S3pr	S3pr	S2p	S1
	2- 5%	S3pr	S3pr	S2p	S1
cucumber	0- 2%	S3pr	S3pr	S2p	S1
	2- 5%	S3pr	S3pr	S2p	S1
pumpkin	0- 2%	S3p	S3p	S2p	S1
	2- 5%	S3p	S3p	S2p	S1
coconut	0- 2%	S2pt	S2pt	S2pt	S2t
	2- 5%	S2pt	S2pt	S2pt	S2t
cocoa	0- 2%	S3pr	S2pr	S2p	--
	2- 5%	S3pr	S2pr	S2p	--
coffee (arab.)	0- 2%	S3ptr	S3ptr	S2pt	--
	2- 5%	S3ptr	S3ptr	S2pt	--
coffee (cane.)	0- 2%	S3pr	S2pr	S2p	--

Climatic data: R75= 1265 ; Rav= 1522 ; PET= 1441 (mm/yr); R75/PET= .87

[Table continues overleaf]

Crop	slope (%)	agro-ecological suitability class for: MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rain)
coffee (cane.)	2- 5%	S3pr	S2pr	S2p	--
breadfruit	0- 2%	S2p	S2p	--	--
	2- 5%	S2p	S2p	--	--
citrus	0- 2%	S2pw	S2pw	S2pw	S2w
	2- 5%	S2pw	S2pw	S2pw	S2w
ackee	0- 2%	S2pw	S2pw	--	--
	2- 5%	S2pw	S2pw	--	--
mango	0- 2%	S2pw	S2pw	S2pw	S2w
	2- 5%	S2pw	S2pw	S2pw	S2w
pimento	0- 2%	S2pr	S2pr	--	--
	2- 5%	S2pr	S2pr	--	--
forestry	0- 2%	S2p	S2p	--	--
	2- 5%	S2p	S2p	--	--
natural forest	0- 2%	S1	--	--	--
	2- 5%	S1	--	--	--
banana	0- 2%	S3pr	S3pr	S2p	S1
	2- 5%	S3pr	S3pr	S2p	S1
plantain	0- 2%	S3pr	S3pr	--	--
	2- 5%	S3pr	S3pr	--	--
pineapple	0- 2%	S3pw	S3pw	--	--
	2- 5%	S3pw	S3pw	--	--
unimpr. pasture	0- 2%	S1	--	--	--
	2- 5%	S1	--	--	--
impr. pasture	0- 2%	--	S1	S1	S1
	2- 5%	--	S1	S1	S1
ginger	0- 2%	N	N	S2p	S1
	2- 5%	N	N	S2p	S1

Climatic data: R75= 1265 ; Rav= 1522 ; PET= 1441 (mm/yr); R75/PET= .87

Table 16.5 Suitability of Rose Hall variant I soils for selected crops within specific technical and socio-economic settings (MLUs); month of planting/sowing: May.

Crop	slope (%)	agro-ecological suitability class for: MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rain
sugar cane	2- 5%	N	N	S1	S1
maize	2- 5%	S3pr	S2pr	S2p	S1
tobacco	2- 5%	S3pr	S2pr	S2p	S1
groundnut	2- 5%	S3pr	S2pr	S2p	S1
pigeon pea	2- 5%	S2p	S2p	--	--
common bean	2- 5%	S3pr	S2pr	S2p	S1
red pea	2- 5%	S3pr	S2pr	S2p	S1
onion	2- 5%	S3p	S2p	S2p	S1
cassava	2- 5%	S2p	S2p	--	--
yam	2- 5%	S3pr	S2pr	--	--
cocoyam	2- 5%	N	N	--	--
sweet potato	2- 5%	S3pr	S2pr	S2p	S1
calaloo	2- 5%	S3pr	S2pr	S2p	S1
cabbage	2- 5%	S3ptr	S3ptr	S2pt	S2t
tomato	2- 5%	S3pr	S2pr	S2p	S1
cucumber	2- 5%	S3pr	S2pr	S2p	S1
pumpkin	2- 5%	S3p	S2p	S2p	S1
coconut	2- 5%	S2pr	S2pr	S2p	S1
cocoa	2- 5%	N	N	S2p	--
coffee (arab.)	2- 5%	S3ptr	S3ptr	S2pt	--
coffee (cane.)	2- 5%	S3pr	S2pr	S2p	--
breadfruit	2- 5%	S2pr	S2pr	--	--
citrus	2- 5%	S2p	S2p	S2p	S1
ackee	2- 5%	S2p	S2p	--	--
mango	2- 5%	S2p	S2p	S2p	S1
pimento	2- 5%	N	N	--	--
forestry	2- 5%	S2pr	S2pr	--	--
natural forest	2- 5%	S1	--	--	--
banana	2- 5%	N	N	S2p	S1
plantain	2- 5%	N	N	--	--
pineapple	2- 5%	S3p	S2p	--	--
unimpr. pasture	2- 5%	S1	--	--	--
impr. pasture	2- 5%	--	S2r	S1	S1
ginger	2- 5%	N	N	S2p	S1

Climatic data: R75= 1136 ; Rav= 1366 ; PET= 1486 (mm/yr); R75/PET= .76

Table 16.6 Suitability of Prospect variant I soils for selected crops within specific technical and socio-economic settings (MLUs); month of planting/sowing: May.

Crop	slope (%)	agro-ecological suitability class for: MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rain)
sugar cane	2- 5%	N	N	S1	S1
maize	2- 5%	S3fr	S2r	S1	S1
tobacco	2- 5%	S2fr	S2r	S1	S1
groundnut	2- 5%	S2fr	S2r	S1	S1
pigeon pea	2- 5%	S1	S1	--	--
common bean	2- 5%	S3fr	S2r	S1	S1
red pea	2- 5%	S2fr	S2r	S1	S1
onion	2- 5%	S2f	S1	S1	S1
cassava	2- 5%	S1	S1	--	--
yam	2- 5%	S2fr	S2r	--	--
cocoyam	2- 5%	N	N	--	--
sweet potato	2- 5%	S3fr	S2r	S1	S1
calaloo	2- 5%	S2fr	S2r	S1	S1
cabbage	2- 5%	S3ftr	S2tr	S2t	S2t
tomato	2- 5%	S3fr	S2r	S1	S1
cucumber	2- 5%	S3fr	S2r	S1	S1
pumpkin	2- 5%	S2f	S1	S1	S1
coconut	2- 5%	S2r	S2r	S1	S1
cocoa	2- 5%	N	N	S1	--
coffee (arab.)	2- 5%	S3ftr	S2tr	S2t	--
coffee (cane.)	2- 5%	S3fr	S2r	S1	--
breadfruit	2- 5%	S2r	S2r	--	--
citrus	2- 5%	S1	S1	S1	S1
ackee	2- 5%	S1	S1	--	--
mango	2- 5%	S1	S1	S1	S1
pimento	2- 5%	N	N	--	--
forestry	2- 5%	S2r	S2r	--	--
natural forest	2- 5%	S1	--	--	--
banana	2- 5%	N	N	S1	S1
plantain	2- 5%	N	N	--	--
pineapple	2- 5%	S2f	S1	--	--
unimpr. pasture	2- 5%	S1	--	--	--
impr. pasture	2- 5%	--	S2r	S1	S1
ginger	2- 5%	N	N	S1	S1

Climatic data: R75= 1136 ; Rav= 1366 ; PET= 1486 (mm/yr); R75/PET= .76

Table 16.7 Suitability of St. Ann variant I soils for selected crops within specific technical and socio-economic settings (MLUs); month of planting/sowing: May.

Crop	slope (%)	agro-ecological suitability class for: MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rain
sugar cane	5- 8%	S3ftw	S2tw	S2ptw	S2ptw
	8-16%	S3ftw	S2tw	S2ptw	S2ptw
maize	5- 8%	S3f	S1	S2p	S2p
	8-16%	S3f	S1	S2p	N
tobacco	5- 8%	S2ft	S2t	S2pt	S2pt
	8-16%	S2ft	S2t	S2pt	N
groundnut	5- 8%	S2ft	S2t	S2pt	S2pt
	8-16%	S2ft	S2t	S2pt	N
pigeon pea	5- 8%	S2w	S2w	--	--
	8-16%	S2w	S2w	--	--
common bean	5- 8%	S3f	S1	S2p	S2p
	8-16%	S3f	S1	S2p	N
red pea	5- 8%	S2f	S1	S2p	S2p
	8-16%	S2f	S1	S2p	N
onion	5- 8%	S2f	S1	S2p	S2p
	8-16%	S2f	S1	S2p	N
cassava	5- 8%	S2w	S2w	--	--
	8-16%	S2w	S2w	--	--
yam	5- 8%	S2f	S1	--	--
	8-16%	S2f	S1	--	--
cocoyam	5- 8%	S3ft	S2t	--	--
	8-16%	S3ft	S2t	--	--
sweet potato	5- 8%	S3f	S1	S2p	S2p
	8-16%	S3f	S1	S2p	N
calaloo	5- 8%	S2f	S1	S2p	S2p
	8-16%	S2f	S1	S2p	N
cabbage	5- 8%	S3f	S1	S2p	S2p
	8-16%	S3f	S1	S2p	N
tomato	5- 8%	S3f	S1	S2p	S2p
	8-16%	S3f	S1	S2p	N
cucumber	5- 8%	S3f	S1	S2p	S2p
	8-16%	S3f	S1	S2p	N
pumpkin	5- 8%	S2f	S1	S2p	S2p
	8-16%	S2f	S1	S2p	N
coconut	5- 8%	S2t	S2t	S2t	S2t
	8-16%	S2t	S2t	S2t	S2t
cocoa	5- 8%	S3ft	S2t	S2t	--
	8-16%	S3ft	S2t	S2t	--
coffee (arab.)	5- 8%	N	S2ft	S2t	--
	8-16%	N	S2ft	S2t	--
coffee (cane.)	5- 8%	N	S2ft	S2t	--

Climatic data: R75= 1563 ; Rav= 1833 ; PET= 1356 (mm/yr); R75/PET= 1.15

[Table continues overleaf]

Crop	slope (%)	agro-ecological suitability class for: MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rain)
coffee (cane.)	8-16%	N	S2ft	S2t	--
breadfruit	5- 8%	S1	S1	--	--
	8-16%	S1	S1	--	--
citrus	5- 8%	S2fw	S2w	S2w	S2w
	8-16%	S2fw	S2w	S2w	S2w
ackee	5- 8%	S2w	S2w	--	--
	8-16%	S2w	S2w	--	--
mango	5- 8%	S2w	S2w	S2w	S2w
	8-16%	S2w	S2w	S2w	S2w
pimento	5- 8%	S2fw	S2w	--	--
	8-16%	S2fw	S2w	--	--
forestry	5- 8%	S2f	S1	--	--
	8-16%	S2f	S1	--	--
natural forest	5- 8%	S1	--	--	--
	8-16%	S1	--	--	--
banana	5- 8%	S3ft	S2t	S2pt	S2pt
	8-16%	S3ft	S2t	S2pt	S2pt
plantain	5- 8%	S2f	S1	--	--
	8-16%	S2f	S1	--	--
pineapple	5- 8%	S2ftw	S2tw	--	--
	8-16%	S2ftw	S2tw	--	--
unimpr. pasture	5- 8%	S1	--	--	--
	8-16%	S1	--	--	--
impr. pasture	5- 8%	--	S1	S1	S1
	8-16%	--	S1	S1	S1
ginger	5- 8%	S3fw	S2w	S2pw	S2pw
	8-16%	S3fw	S2w	S2pw	S2pw

Climatic data: R75= 1563 ; Rav= 1833 ; PET= 1356 (mm/yr); R75/PET= 1.15

Table 16.8 Suitability of soils like St. Ann variant I (inclusion) for selected crops within specific technical and socio-economic settings (MLUs); month of planting/sowing: May.

Crop	slope (%)	agro-ecological suitability class for: MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rain
sugar cane	5- 8%	S2ftw	S2ftw	S2ftw	S2ftw
	8-16%	S2ftw	S2ftw	S2ftw	S2ftw
maize	5- 8%	S3f	S2f	S2f	S2f
	8-16%	S3f	S2f	S2f	S3p
tobacco	5- 8%	S2ft	S2ft	S2ft	S2ft
	8-16%	S2ft	S2ft	S2ft	S3pt
groundnut	5- 8%	S2ft	S2t	S2t	S2t
	8-16%	S2ft	S2t	S2t	S2pt
pigeon pea	5- 8%	S2w	S2w	--	--
	8-16%	S2w	S2w	--	--
common bean	5- 8%	S3f	S2f	S2f	S2f
	8-16%	S3f	S2f	S2f	S3p
red pea	5- 8%	S2f	S1	S1	S1
	8-16%	S2f	S1	S1	S2p
onion	5- 8%	S2f	S1	S1	S1
	8-16%	S2f	S1	S1	S2p
cassava	5- 8%	S2w	S2w	--	--
	8-16%	S2w	S2w	--	--
yam	5- 8%	S2f	S1	--	--
	8-16%	S2f	S1	--	--
cocoyam	5- 8%	S2ft	S2ft	--	--
	8-16%	S2ft	S2ft	--	--
sweet potato	5- 8%	S3f	S2f	S2f	S2f
	8-16%	S3f	S2f	S2f	S3p
calaloo	5- 8%	S2f	S1	S1	S1
	8-16%	S2f	S1	S1	S2p
cabbage	5- 8%	S3f	S2f	S2f	S2f
	8-16%	S3f	S2f	S2f	S3p
tomato	5- 8%	S3f	S2f	S2f	S2f
	8-16%	S3f	S2f	S2f	S3p
cucumber	5- 8%	S3f	S2f	S2f	S2f
	8-16%	S3f	S2f	S2f	S3p
pumpkin	5- 8%	S2f	S1	S1	S1
	8-16%	S2f	S1	S1	S2p
coconut	5- 8%	S2t	S2t	S2t	S2t
	8-16%	S2t	S2t	S2t	S2t
cocoa	5- 8%	S2ft	S2ft	S2ft	--
	8-16%	S2ft	S2ft	S2ft	--
coffee (arab.)	5- 8%	S2ft	S2ft	S2ft	--
	8-16%	S2ft	S2ft	S2ft	--
coffee (cane.)	5- 8%	S2ft	S2ft	S2ft	--

Climatic data: R75= 1563 ; Rav= 1833 ; PET= 1356 (mm/yr); R75/PET= 1.15
[Table continues overleaf]

Crop	slope (%)	agro-ecological suitability class for: MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rain)
coffee (cane.)	8-16%	S2ft	S2ft	S2ft	--
breadfruit	5- 8%	S1	S1	--	--
	8-16%	S1	S1	--	--
citrus	5- 8%	S2w	S2w	S2w	S2w
	8-16%	S2w	S2w	S2w	S2w
ackee	5- 8%	S2w	S2w	--	--
	8-16%	S2w	S2w	--	--
mango	5- 8%	S2w	S2w	S2w	S2w
	8-16%	S2w	S2w	S2w	S2w
pimento	5- 8%	S2fw	S2w	--	--
	8-16%	S2fw	S2w	--	--
forestry	5- 8%	S1	S1	--	--
	8-16%	S1	S1	--	--
natural forest	5- 8%	S1	--	--	--
	8-16%	S1	--	--	--
banana	5- 8%	S3ft	S2ft	S2ft	S2ft
	8-16%	S3ft	S2ft	S2ft	S2ft
plantain	5- 8%	S2f	S1	--	--
	8-16%	S2f	S1	--	--
pineapple	5- 8%	S2tw	S2tw	--	--
	8-16%	S2tw	S2tw	--	--
unimpr. pasture	5- 8%	S1	--	--	--
	8-16%	S1	--	--	--
impr. pasture	5- 8%	--	S1	S1	S1
	8-16%	--	S1	S1	S1
ginger	5- 8%	S2fw	S2fw	S2fw	S2fw
	8-16%	S2fw	S2fw	S2fw	S2fw

Climatic data: R75= 1563 ; Rav= 1833 ; PET= 1356 (mm/yr); R75/PET= 1.15

Table 16.9 Suitability of soils like Swansea (inclusion) for selected crops within specific technical and socio-economic settings (MLUs); month of planting/sowing: May.

Crop	slope (%)	MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rain)
		agro-ecological suitability class for:			
sugar cane	8-16%	S3ptw	S3ptw	N	N
	16-30%	S3ptwe	N	N	N
maize	8-16%	S3p	S3p	N	N
	16-30%	N	N	N	N
tobacco	8-16%	S3pt	S3pt	N	N
	16-30%	N	N	N	N
groundnut	8-16%	S3pt	S3pt	N	N
	16-30%	N	N	N	N
pigeon pea	8-16%	S2pw	S2pw	--	--
	16-30%	N	N	--	--
common bean	8-16%	S3p	S3p	N	N
	16-30%	N	N	N	N
red pea	8-16%	S3p	S3p	N	N
	16-30%	N	N	N	N
onion	8-16%	S3p	S3p	N	N
	16-30%	N	N	N	N
cassava	8-16%	S3pw	S3pw	--	--
	16-30%	N	N	--	--
yam	8-16%	N	N	--	--
	16-30%	N	N	--	--
cocoyam	8-16%	S3pt	S3pt	--	--
	16-30%	N	N	--	--
sweet potato	8-16%	S3p	S3p	N	N
	16-30%	N	N	N	N
calaloo	8-16%	S3p	S3p	N	N
	16-30%	N	N	N	N
cabbage	8-16%	S3p	S3p	N	N
	16-30%	N	N	N	N
tomato	8-16%	S3p	S3p	N	N
	16-30%	N	N	N	N
cucumber	8-16%	S3p	S3p	N	N
	16-30%	N	N	N	N
pumpkin	8-16%	S3p	S3p	N	N
	16-30%	N	N	N	N
coconut	8-16%	N	N	N	N
	16-30%	N	N	N	N
cocoa	8-16%	N	N	N	--
	16-30%	N	N	N	--
coffee (arab.)	8-16%	N	N	N	--
	16-30%	N	N	N	--
coffee (cane.)	8-16%	N	N	N	--

Climatic data: R75= 1563 ; Rav= 1833 ; PET= 1356 (mm/yr); R75/PET= 1.15

[Table continues overleaf]

Crop	slope (%)	agro-ecological suitability class for: MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rain)
coffee (cane.)	16-30%	N	N	N	--
breadfruit	8-16%	N	N	--	--
	16-30%	N	N	--	--
citrus	8-16%	N	N	N	N
	16-30%	N	N	N	N
ackee	8-16%	N	N	--	--
	16-30%	N	N	--	--
mango	8-16%	N	N	N	N
	16-30%	N	N	N	N
pimento	8-16%	N	N	--	--
	16-30%	N	N	--	--
forestry	8-16%	N	N	--	--
	16-30%	N	N	--	--
natural forest	8-16%	S1	--	--	--
	16-30%	S1	--	--	--
banana	8-16%	N	N	N	N
	16-30%	N	N	N	N
plantain	8-16%	S3p	S3p	--	--
	16-30%	S3pe	N	--	--
pineapple	8-16%	S3ptw	S3ptw	--	--
	16-30%	N	N	--	--
unimpr. pasture	8-16%	S1	--	--	--
	16-30%	S1	--	--	--
impr. pasture	8-16%	--	S1	S1	S1
	16-30%	--	S2p	N	N
ginger	8-16%	S3pw	S3pw	N	N
	16-30%	N	N	N	N

Climatic data: R75= 1563 ; Rav= 1833 ; PET= 1356 (mm/yr); R75/PET= 1.15

Table 16.10 Suitability of Swansea soils for selected crops within specific technical and socio-economic settings (MLUs); month of planting/sowing: May.

		agro-ecological suitability class for:			
Crop	slope (%)	MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rain
sugar cane	8-16%	S3ptw	S3ptw	N	N
	16-30%	S3ptwe	N	N	N
maize	8-16%	S3p	S3p	N	N
	16-30%	N	N	N	N
tobacco	8-16%	S3pt	S3pt	N	N
	16-30%	N	N	N	N
groundnut	8-16%	S3pt	S3pt	N	N
	16-30%	N	N	N	N
pigeon pea	8-16%	S2pw	S2pw	--	--
	16-30%	N	N	--	--
common bean	8-16%	S3p	S3p	N	N
	16-30%	N	N	N	N
red pea	8-16%	S3p	S3p	N	N
	16-30%	N	N	N	N
onion	8-16%	S3p	S3p	N	N
	16-30%	N	N	N	N
cassava	8-16%	S3pw	S3pw	--	--
	16-30%	N	N	--	--
yam	8-16%	N	N	--	--
	16-30%	N	N	--	--
cocoyam	8-16%	S3pt	S3pt	--	--
	16-30%	N	N	--	--
sweet potato	8-16%	S3p	S3p	N	N
	16-30%	N	N	N	N
calaloo	8-16%	S3p	S3p	N	N
	16-30%	N	N	N	N
cabbage	8-16%	S3p	S3p	N	N
	16-30%	N	N	N	N
tomato	8-16%	S3p	S3p	N	N
	16-30%	N	N	N	N
cucumber	8-16%	S3p	S3p	N	N
	16-30%	N	N	N	N
pumpkin	8-16%	S3p	S3p	N	N
	16-30%	N	N	N	N
coconut	8-16%	N	N	N	N
	16-30%	N	N	N	N
cocoa	8-16%	N	N	N	--
	16-30%	N	N	N	--
coffee (arab.)	8-16%	N	N	N	--
	16-30%	N	N	N	--
coffee (cane.)	8-16%	N	N	N	--

Climatic data: R75= 1563 ; Rav= 1833 ; PET= 1356 (mm/yr); R75/PET= 1.15

[Table continues overleaf]

Crop	slope (%)	agro-ecological suitability class for: MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rain
coffee (cane.)	16-30%	N	N	N	--
breadfruit	8-16%	N	N	--	--
	16-30%	N	N	--	--
citrus	8-16%	N	N	N	N
	16-30%	N	N	N	N
ackee	8-16%	N	N	--	--
	16-30%	N	N	--	--
mango	8-16%	N	N	N	N
	16-30%	N	N	N	N
pimento	8-16%	N	N	--	--
	16-30%	N	N	--	--
forestry	8-16%	N	N	--	--
	16-30%	N	N	--	--
natural forest	8-16%	S1	--	--	--
	16-30%	S1	--	--	--
banana	8-16%	N	N	N	N
	16-30%	N	N	N	N
plantain	8-16%	S3p	S3p	--	--
	16-30%	N	N	--	--
pineapple	8-16%	S3ptw	S3ptw	--	--
	16-30%	N	N	--	--
unimpr. pasture	8-16%	S1	--	--	--
	16-30%	S1	--	--	--
impr. pasture	8-16%	--	S1	S1	S1
	16-30%	--	S2p	N	N
ginger	8-16%	S3pw	S3pw	N	N
	16-30%	N	N	N	N

Climatic data: R75= 1563 ; Rav= 1833 ; PET= 1356 (mm/yr); R75/PET= 1.15

Table 16.11 Suitability of Linstead variant I soils for selected crops within specific technical and socio-economic settings (MLUs); month of planting/sowing: May.

Crop	slope (%)	agro-ecological suitability class for: MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rain
sugar cane	2- 5%	N	N	S2p	S1
	5- 8%	N	N	S2p	S1
maize	2- 5%	N	N	N	S2p
	5- 8%	N	N	N	S2p
tobacco	2- 5%	N	N	N	S2p
	5- 8%	N	N	N	S2p
groundnut	2- 5%	N	N	N	S2p
	5- 8%	N	N	N	S2p
pigeon pea	2- 5%	N	N	--	--
	5- 8%	N	N	--	--
common bean	2- 5%	N	N	N	S2p
	5- 8%	N	N	N	S2p
red pea	2- 5%	N	N	N	S2p
	5- 8%	N	N	N	S2p
onion	2- 5%	N	N	N	S2p
	5- 8%	N	N	N	S2p
cassava	2- 5%	N	N	--	--
	5- 8%	N	N	--	--
yam	2- 5%	N	N	--	--
	5- 8%	N	N	--	--
cocoyam	2- 5%	N	N	--	--
	5- 8%	N	N	--	--
sweet potato	2- 5%	N	N	N	S2p
	5- 8%	N	N	N	S2p
calaloo	2- 5%	N	N	N	S2p
	5- 8%	N	N	N	S2p
cabbage	2- 5%	N	N	N	S2pt
	5- 8%	N	N	N	S2pt
tomato	2- 5%	N	N	N	S2p
	5- 8%	N	N	N	S2p
cucumber	2- 5%	N	N	N	S2p
	5- 8%	N	N	N	S2p
pumpkin	2- 5%	N	N	N	S2p
	5- 8%	N	N	N	S2p
coconut	2- 5%	N	N	N	S2p
	5- 8%	N	N	N	S2p
cocoa	2- 5%	N	N	N	--
	5- 8%	N	N	N	--
coffee (arab.)	2- 5%	N	N	N	--
	5- 8%	N	N	N	--
coffee (cane.)	2- 5%	N	N	N	--

Climatic data: R75= 1136 ; Rav= 1366 ; PET= 1486 (mm/yr); R75/PET= .76
[Table continues overleaf]

Crop	slope (%)	agro-ecological suitability class for: MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rain)
coffee (cane.)	5- 8%	N	N	N	--
breadfruit	2- 5%	N	N	--	--
	5- 8%	N	N	--	--
citrus	2- 5%	N	N	N	S2p
	5- 8%	N	N	N	S2p
ackee	2- 5%	N	N	--	--
	5- 8%	N	N	--	--
mango	2- 5%	N	N	N	S2p
	5- 8%	N	N	N	S2p
pimento	2- 5%	N	N	--	--
	5- 8%	N	N	--	--
forestry	2- 5%	N	N	--	--
	5- 8%	N	N	--	--
natural forest	2- 5%	S2p	--	--	--
	5- 8%	S2p	--	--	--
banana	2- 5%	N	N	N	S2p
	5- 8%	N	N	N	S2p
plantain	2- 5%	N	N	--	--
	5- 8%	N	N	--	--
pineapple	2- 5%	N	N	--	--
	5- 8%	N	N	--	--
unimpr. pasture	2- 5%	S2f	--	--	--
	5- 8%	S2f	--	--	--
impr. pasture	2- 5%	--	S2r	S1	S1
	5- 8%	--	S2r	S1	S1
ginger	2- 5%	N	N	N	S2p
	5- 8%	N	N	N	S2p

Climatic data: R75= 1136 ; Rav= 1366 ; PET= 1486 (mm/yr); R75/PET= .76

Table 16.12 Suitability of Mount Rosser soils for selected crops within specific technical and socio economic settings (MLUs); month of planting/sowing: May.

Mount Rosser soils are not suitable for the land utilization types as considered in this land evaluation exercise, except for:

- natural forest at MLU-A level: S1 for slopes of 16-30%, 30-50% and slopes over 50%;
- unimproved pasture at MLU-A level: S3p for slopes of 16-30% and S3pe for slopes of 30-50%, and
- improved pasture at MLU-B level: S3p for slopes of 16-30%.

Table 16.13 Suitability of Rosemere variant I soils for selected crops within specific technical and socio-economic settings (MLUs); month of planting/sowing: May.

Crop	slope (%)	agro-ecological suitability class for: MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rain
sugar cane	2- 5%	N	N	S2f	S2f
	5- 8%	N	N	S2f	S2f
maize	2- 5%	N	S3pr	S3p	S2f
	5- 8%	N	S3pr	S3p	S2f
tobacco	2- 5%	N	S3pr	S3p	S2f
	5- 8%	N	S3pr	S3p	S2f
groundnut	2- 5%	N	S3pr	S3p	S2f
	5- 8%	N	S3pr	S3p	S2f
pigeon pea	2- 5%	N	S3p	--	--
	5- 8%	N	S3p	--	--
common bean	2- 5%	N	S3pr	S3p	S2f
	5- 8%	N	S3pr	S3p	S2f
red pea	2- 5%	N	S3pr	S3p	S2f
	5- 8%	N	S3pr	S3p	S2f
onion	2- 5%	N	S3p	S3p	S2f
	5- 8%	N	S3p	S3p	S2f
cassava	2- 5%	N	S3p	--	--
	5- 8%	N	S3p	--	--
yam	2- 5%	N	S3pr	--	--
	5- 8%	N	S3pr	--	--
cocoyam	2- 5%	N	N	--	--
	5- 8%	N	N	--	--
sweet potato	2- 5%	N	S3pr	S3p	S2f
	5- 8%	N	S3pr	S3p	S2f
calaloo	2- 5%	N	S3pr	S3p	S2f
	5- 8%	N	S3pr	S3p	S2f
cabbage	2- 5%	N	S3ptr	S3pt	S2ft
	5- 8%	N	S3ptr	S3pt	S2ft
tomato	2- 5%	N	S3pr	S3p	S2f
	5- 8%	N	S3pr	S3p	S2f
cucumber	2- 5%	N	S3pr	S3p	S2f
	5- 8%	N	S3pr	S3p	S2f
pumpkin	2- 5%	N	S3p	S3p	S2f
	5- 8%	N	S3p	S3p	S2f
coconut	2- 5%	N	S3pr	S3p	S3p
	5- 8%	N	S3pr	S3p	S3p
cocoa	2- 5%	N	N	S3p	--
	5- 8%	N	N	S3p	--
coffee (arab.)	2- 5%	N	S3ptr	S3pt	--
	5- 8%	N	S3ptr	S3pt	--
coffee (cane.)	2- 5%	N	S3pr	S3p	--

Climatic data: R75= 1136 ; Rav= 1366 ; PET= 1486 (mm/yr); R75/PET= .76

[Table continues overleaf]

Crop	slope (%)	agro-ecological suitability class for: MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rain
coffee (cane.)	5- 8%	N	S3pr	S3p	--
breadfruit	2- 5%	N	S3pr	--	--
	5- 8%	N	S3pr	--	--
citrus	2- 5%	N	S3p	S3p	S3p
	5- 8%	N	S3p	S3p	S3p
ackee	2- 5%	N	S3p	--	--
	5- 8%	N	S3p	--	--
mango	2- 5%	N	S3p	S3p	S3p
	5- 8%	N	S3p	S3p	S3p
pimento.	2- 5%	N	N	--	--
	5- 8%	N	N	--	--
forestry	2- 5%	N	S3pr	--	--
	5- 8%	N	S3pr	--	--
natural forest	2- 5%	S2f	--	--	--
	5- 8%	S2f	--	--	--
banana	2- 5%	N	N	S3p	S3p
	5- 8%	N	N	S3p	S3p
plantain	2- 5%	N	N	--	--
	5- 8%	N	N	--	--
pineapple	2- 5%	N	S3p	--	--
	5- 8%	N	S3p	--	--
unimpr. pasture	2- 5%	N	--	--	--
	5- 8%	N	--	--	--
impr. pasture	2- 5%	--	S2fr	S2f	S2f
	5- 8%	--	S2fr	S2f	S2f
ginger	2- 5%	N	N	S3p	S2f
	5- 8%	N	N	S3p	S2f

Climatic data: R75= 1136 ; Rav= 1366 ; PET= 1486 (mm/yr); R75/PET= .76

Table 16.14 Suitability of Riverhead soils for selected crops within specific technical and socio-economic settings (MLUs); month of planting/sowing: May.

Crop	slope (%)	agro-ecological suitability class for: MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rain)
sugar cane	2- 5%	N	N	S1	S1
	5- 8%	N	N	S1	S1
maize	2- 5%	S3pr	S3pr	S2p	S1
	5- 8%	S3pr	S3pr	S2p	S1
tobacco	2- 5%	S3pr	S3pr	S2p	S1
	5- 8%	S3pr	S3pr	S2p	S1
groundnut	2- 5%	S3pr	S3pr	S2p	S1
	5- 8%	S3pr	S3pr	S2p	S1
pigeon pea	2- 5%	S3p	S3p	--	--
	5- 8%	S3p	S3p	--	--
common bean	2- 5%	S3pr	S3pr	S2p	S1
	5- 8%	S3pr	S3pr	S2p	S1
red pea	2- 5%	S3pr	S3pr	S2p	S1
	5- 8%	S3pr	S3pr	S2p	S1
onion	2- 5%	S3p	S3p	S2p	S1
	5- 8%	S3p	S3p	S2p	S1
cassava	2- 5%	S3p	S3p	--	--
	5- 8%	S3p	S3p	--	--
yam	2- 5%	S3pr	S3pr	--	--
	5- 8%	S3pr	S3pr	--	--
cocoyam	2- 5%	N	N	--	--
	5- 8%	N	N	--	--
sweet potato	2- 5%	S3pr	S3pr	S2p	S1
	5- 8%	S3pr	S3pr	S2p	S1
calaloo	2- 5%	S3pr	S3pr	S2p	S1
	5- 8%	S3pr	S3pr	S2p	S1
cabbage	2- 5%	S3ptr	S3ptr	S2pt	S2t
	5- 8%	S3ptr	S3ptr	S2pt	S2t
tomato	2- 5%	S3pr	S3pr	S2p	S1
	5- 8%	S3pr	S3pr	S2p	S1
cucumber	2- 5%	S3pr	S3pr	S2p	S1
	5- 8%	S3pr	S3pr	S2p	S1
pumpkin	2- 5%	S3p	S3p	S2p	S1
	5- 8%	S3p	S3p	S2p	S1
coconut	2- 5%	S2pr	S2pr	S2p	S1
	5- 8%	S2pr	S2pr	S2p	S1
cocoa	2- 5%	N	N	S2p	--
	5- 8%	N	N	S2p	--
coffee (arab.)	2- 5%	S3ptr	S3ptr	S2pt	--
	5- 8%	S3ptr	S3ptr	S2pt	--
coffee (cane.)	2- 5%	S3pr	S2pr	S2p	--

Climatic data: R75= 1136 ; Rav= 1366 ; PET= 1486 (mm/yr); R75/PET= .76

[Table continues overleaf]

Crop	slope (%)	agro-ecological suitability class for: MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rain
coffee (cane.)	5- 8%	S3pr	S2pr	S2p	--
breadfruit	2- 5%	S2pr	S2pr	--	--
	5- 8%	S2pr	S2pr	--	--
citrus	2- 5%	S2p	S2p	S2p	S1
	5- 8%	S2p	S2p	S2p	S1
ackee	2- 5%	S2p	S2p	--	--
	5- 8%	S2p	S2p	--	--
mango	2- 5%	S2p	S2p	S2p	S1
	5- 8%	S2p	S2p	S2p	S1
pimento	2- 5%	N	N	--	--
	5- 8%	N	N	--	--
forestry	2- 5%	S2pr	S2pr	--	--
	5- 8%	S2pr	S2pr	--	--
natural forest	2- 5%	S1	--	--	--
	5- 8%	S1	--	--	--
banana	2- 5%	N	N	S2p	S1
	5- 8%	N	N	S2p	S1
plantain	2- 5%	N	N	--	--
	5- 8%	N	N	--	--
pineapple	2- 5%	S3p	S3p	--	--
	5- 8%	S3p	S3p	--	--
unimpr. pasture	2- 5%	S1	--	--	--
	5- 8%	S1	--	--	--
impr. pasture	2- 5%	--	S2r	S1	S1
	5- 8%	--	S2r	S1	S1
ginger	2- 5%	N	N	S2p	S1
	5- 8%	N	N	S2p	S1

Climatic data: R75= 1136 ; Rav= 1366 ; PET= 1486 (mm/yr); R75/PET= .76

Table 16.15 Suitability of Union Hill variant I soils for selected crops within specific technical and socio-economic settings (MLUs); month of planting/sowing: May.

Crop	slope (%)	agro-ecological suitability class for: MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rain
sugar cane	5- 8%	N	N	S2p	S2p
	8-16%	N	N	S2p	S2p
	16-30%	N	N	N	N
maize	5- 8%	S3fr	S2r	S2p	S2p
	8-16%	S3fr	S2r	S2p	N
	16-30%	S3fre	S3pre	N	N
tobacco	5- 8%	S2fr	S2r	S2p	S2p
	8-16%	S2fr	S2r	S2p	N
	16-30%	S3fre	S3pre	N	N
groundnut	5- 8%	S2fr	S2r	S2p	S2p
	8-16%	S2fr	S2r	S2p	N
	16-30%	S3fre	S3pre	N	N
pigeon pea	5- 8%	S2f	S1	--	--
	8-16%	S2f	S1	--	--
	16-30%	S2fe	S2pe	--	--
common bean	5- 8%	S3fr	S2r	S2p	S2p
	8-16%	S3fr	S2r	S2p	N
	16-30%	S3fre	S3pre	N	N
red pea	5- 8%	S2fr	S2r	S2p	S2p
	8-16%	S2fr	S2r	S2p	N
	16-30%	S3fre	S3pre	N	N
onion	5- 8%	S2f	S1	S2p	S2p
	8-16%	S2f	S1	S2p	N
	16-30%	S2fe	S2pe	N	N
cassava	5- 8%	S2f	S1	--	--
	8-16%	S2f	S1	--	--
	16-30%	S2fe	S2pe	--	--
yam	5- 8%	S2fr	S2r	--	--
	8-16%	S2fr	S2r	--	--
	16-30%	S3fre	S3pre	--	--
cocoyam	5- 8%	N	N	--	--
	8-16%	N	N	--	--
	16-30%	N	N	--	--
sweet potato	5- 8%	S3fr	S2r	S2p	S2p
	8-16%	S3fr	S2r	S2p	N
	16-30%	S3fre	S3pre	N	N
calaloo	5- 8%	S2fr	S2r	S2p	S2p
	8-16%	S2fr	S2r	S2p	N
	16-30%	S3fre	S3pre	N	N
cabbage	5- 8%	S3ftr	S2tr	S2pt	S2pt
	8-16%	S3ftr	S2tr	S2pt	N

Climatic data: R75= 1136 ; Rav= 1366 ; PET= 1486 (mm/yr); R75/PET= .76

[Table continues overleaf]

Crop	slope (%)	agro-ecological suitability class for: MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rain
cabbage	16-30%	N	S3ptre	N	N
tomato	5- 8%	S3fr	S2r	S2p	S2p
	8-16%	S3fr	S2r	S2p	N
	16-30%	S3fre	S3pre	N	N
cucumber	5- 8%	S3fr	S2r	S2p	S2p
	8-16%	S3fr	S2r	S2p	N
	16-30%	S3fre	S3pre	N	N
pumpkin	5- 8%	S2f	S1	S2p	S2p
	8-16%	S2f	S1	S2p	N
	16-30%	S2fe	S2pe	N	N
coconut	5- 8%	S3ftr	S2tr	S2t	S2t
	8-16%	S3ftr	S2tr	S2t	S2t
	16-30%	S3ftr	S3ptr	N	N
cocoa	5- 8%	N	N	S1	--
	8-16%	N	N	S1	--
	16-30%	N	N	N	--
coffee (arab.)	5- 8%	N	S3ftr	S2t	--
	8-16%	N	S3ftr	S2t	--
	16-30%	N	S3ptr	N	--
coffee (cane.)	5- 8%	N	S2fr	S1	--
	8-16%	N	S2fr	S1	--
	16-30%	N	S3pr	N	--
breadfruit	5- 8%	S2r	S2r	--	--
	8-16%	S2r	S2r	--	--
	16-30%	S2r	S2pr	--	--
citrus	5- 8%	S2f	S1	S1	S1
	8-16%	S2f	S1	S1	S1
	16-30%	S2f	S2p	N	N
ackee	5- 8%	S1	S1	--	--
	8-16%	S1	S1	--	--
	16-30%	S1	S2p	--	--
mango	5- 8%	S2f	S1	S1	S1
	8-16%	S2f	S1	S1	S1
	16-30%	S2f	S2p	N	N
pimento	5- 8%	N	N	--	--
	8-16%	N	N	--	--
	16-30%	N	N	--	--
forestry	5- 8%	S2fr	S2r	--	--
	8-16%	S2fr	S2r	--	--
	16-30%	S2fr	S2pr	--	--
natural forest	5- 8%	S1	--	--	--

Climatic data: R75= 1136 ; Rav= 1366 ; PET= 1486 (mm/yr); R75/PET= .76
[Table continues overleaf]

		agro-ecological suitability class for:			
Crop	slope (%)	MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rain
natural forest	8-16%	S1	--	--	--
	16-30%	S1	--	--	--
banana	5- 8%	N	N	S2p	S2p
	8-16%	N	N	S2p	S2p
	16-30%	N	N	N	N
plantain	5- 8%	N	N	--	--
	8-16%	N	N	--	--
	16-30%	N	N	--	--
pineapple	5- 8%	N	S2f	--	--
	8-16%	N	S2f	--	--
	16-30%	N	S3pe	--	--
unimpr. pasture	5- 8%	S2f	--	--	--
	8-16%	S2f	--	--	--
	16-30%	S2f	--	--	--
impr. pasture	5- 8%	--	S2r	S1	S1
	8-16%	--	S2r	S1	S1
	16-30%	--	S2pr	N	N
ginger	5- 8%	N	N	S2p	S2p
	8-16%	N	N	S2p	S2p
	16-30%	N	N	N	N

Climatic data: R75= 1136 ; Rav= 1366 ; PET= 1486 (mm/yr); R75/PET= .76

Table 16.16 Suitability of Lluidas variant II soils for selected crops within specific technical and socio-economic settings (MLUs); month of planting/sowing: May.

Crop	slope (%)	agro-ecological suitability class for: MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rain)
sugar cane	0- 2%	S2fw	S2w	S2w	S2w
	2- 5%	S2fw	S2w	S2w	S2w
maize	0- 2%	S2fr	S2r	S1	S1
	2- 5%	S2fr	S2r	S1	S1
tobacco	0- 2%	S2r	S2r	S1	S1
	2- 5%	S2r	S2r	S1	S1
groundnut	0- 2%	S2r	S2r	S1	S1
	2- 5%	S2r	S2r	S1	S1
pigeon pea	0- 2%	S2w	S2w	--	--
	2- 5%	S2w	S2w	--	--
common bean	0- 2%	S2fr	S2r	S1	S1
	2- 5%	S2fr	S2r	S1	S1
red pea	0- 2%	S2r	S2r	S1	S1
	2- 5%	S2r	S2r	S1	S1
onion	0- 2%	S1	S1	S1	S1
	2- 5%	S1	S1	S1	S1
cassava	0- 2%	S2w	S2w	--	--
	2- 5%	S2w	S2w	--	--
yam	0- 2%	S1	S1	--	--
	2- 5%	S1	S1	--	--
cocoyam	0- 2%	S3fr	S2r	--	--
	2- 5%	S3fr	S2r	--	--
sweet potato	0- 2%	S2fr	S2r	S1	S1
	2- 5%	S2fr	S2r	S1	S1
calaloo	0- 2%	S2r	S2r	S1	S1
	2- 5%	S2r	S2r	S1	S1
cabbage	0- 2%	S2fr	S2r	S1	S1
	2- 5%	S2fr	S2r	S1	S1
tomato	0- 2%	S2fr	S2r	S1	S1
	2- 5%	S2fr	S2r	S1	S1
cucumber	0- 2%	S2fr	S2r	S1	S1
	2- 5%	S2fr	S2r	S1	S1
pumpkin	0- 2%	S1	S1	S1	S1
	2- 5%	S1	S1	S1	S1
coconut	0- 2%	S2t	S2t	S2t	S2t
	2- 5%	S2t	S2t	S2t	S2t
cocoa	0- 2%	S3fr	S2r	S1	--
	2- 5%	S3fr	S2r	S1	--
coffee (arab.)	0- 2%	S3ftr	S2tr	S2t	--
	2- 5%	S3ftr	S2tr	S2t	--
coffee (cane.)	0- 2%	S3fr	S2r	S1	--

Climatic data: R75= 1265 ; Rav= 1522 ; PET= 1441 (mm/yr); R75/PET= .87
[Table continues overleaf]

Crop	slope (%)	agro-ecological suitability class for: MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rai)
coffee (cane.)	2- 5%	S3fr	S2r	S1	--
breadfruit	0- 2%	S1	S1	--	--
	2- 5%	S1	S1	--	--
citrus	0- 2%	S2w	S2w	S2w	S2w
	2- 5%	S2w	S2w	S2w	S2w
ackee	0- 2%	S2w	S2w	--	--
	2- 5%	S2w	S2w	--	--
mango	0- 2%	S2w	S2w	S2w	S2w
	2- 5%	S2w	S2w	S2w	S2w
pimento	0- 2%	S2r	S2r	--	--
	2- 5%	S2r	S2r	--	--
forestry	0- 2%	S1	S1	--	--
	2- 5%	S1	S1	--	--
natural forest	0- 2%	S1	--	--	--
	2- 5%	S1	--	--	--
banana	0- 2%	S2fr	S2r	S1	S1
	2- 5%	S2fr	S2r	S1	S1
plantain	0- 2%	S2r	S2r	--	--
	2- 5%	S2r	S2r	--	--
pineapple	0- 2%	S2fw	S2w	--	--
	2- 5%	S2fw	S2w	--	--
unimpr. pasture	0- 2%	S1	--	--	--
	2- 5%	S1	--	--	--
impr. pasture	0- 2%	--	S1	S1	S1
	2- 5%	--	S1	S1	S1
ginger	0- 2%	N	N	S1	S1
	2- 5%	N	N	S1	S1

Climatic data: R75= 1265 ; Rav= 1522 ; PET= 1441 (mm/yr); R75/PET= .87

Table 16.17 Suitability of Mountain Hill soils for selected crops within specific technical and socio-economic settings (MLUs); month of planting/sowing: May.

		agro-ecological suitability class for:			
Crop	slope (%)	MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rain)
sugar cane	5- 8%	N	S3fw	S3fw	S3fw
maize	5- 8%	N	S3f	S3f	S3f
tobacco	5- 8%	N	S3f	S3f	S3f
groundnut	5- 8%	N	S3f	S2f	S2f
pigeon pea	5- 8%	N	S3fw	--	--
common bean	5- 8%	N	S3f	S3f	S3f
red pea	5- 8%	N	S3f	S2f	S2f
onion	5- 8%	N	S3f	S2f	S2f
cassava	5- 8%	N	S2fw	--	--
yam	5- 8%	N	S3f	--	--
cocoyam	5- 8%	N	S3f	--	--
sweet potato	5- 8%	N	S3f	S3f	S3f
calaloo	5- 8%	N	S2f	S2f	S2f
cabbage	5- 8%	N	S3f	S3f	S3f
tomato	5- 8%	N	S3f	S3f	S3f
cucumber	5- 8%	N	S3f	S3f	S3f
pumpkin	5- 8%	N	S3f	S2f	S2f
coconut	5- 8%	N	S3ft	S2ft	S2ft
cocoa	5- 8%	N	S3f	S3f	--
coffee (arab.)	5- 8%	N	S3ft	S3ft	--
coffee (cane.)	5- 8%	N	S3f	S3f	--
breadfruit	5- 8%	N	S2f	--	--
citrus	5- 8%	N	S2fw	S2fw	S2fw
ackee	5- 8%	N	S2fw	--	--
mango	5- 8%	N	S2fw	S2fw	S2fw
pimento	5- 8%	N	S3fw	--	--
forestry	5- 8%	N	S2f	--	--
natural forest	5- 8%	N	--	--	--
banana	5- 8%	N	S3f	S3f	S3f
plantain	5- 8%	N	S3f	--	--
pineapple	5- 8%	N	S2fw	--	--
unimpr. pasture	5- 8%	N	--	--	--
impr. pasture	5- 8%	--	S2f	S2f	S2f
ginger	5- 8%	N	S3fw	S3fw	S3fw

Climatic data: R75= 1563 ; Rav= 1833 ; PET= 1356 (mm/yr); R75/PET= 1.15

Table 16.18 Suitability of Pennants variant I soils for selected crops within specific technical and socio-economic settings (MLUs); month of planting/sowing: May.

Crop	slope (%)	agro-ecological suitability class for: MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rain)
sugar cane	2- 5%	N	S3fr	S2f	S2f
	5- 8%	N	S3fr	S2f	S2f
maize	2- 5%	N	S3fr	S3p	S2f
	5- 8%	N	S3fr	S3p	S2f
tobacco	2- 5%	N	S3pr	S3p	S2f
	5- 8%	N	S3pr	S3p	S2f
groundnut	2- 5%	N	S3pr	S3p	S2f
	5- 8%	N	S3pr	S3p	S2f
pigeon pea	2- 5%	N	S3p	--	--
	5- 8%	N	S3p	--	--
common bean	2- 5%	N	S3fr	S3p	S2f
	5- 8%	N	S3fr	S3p	S2f
red pea	2- 5%	N	S3pr	S3p	S2f
	5- 8%	N	S3pr	S3p	S2f
onion	2- 5%	N	S3p	S3p	S2f
	5- 8%	N	S3p	S3p	S2f
cassava	2- 5%	N	S3p	--	--
	5- 8%	N	S3p	--	--
yam	2- 5%	N	S3pr	--	--
	5- 8%	N	S3pr	--	--
cocoyam	2- 5%	N	S3fr	--	--
	5- 8%	N	S3fr	--	--
sweet potato	2- 5%	N	S3fr	S3p	S2f
	5- 8%	N	S3fr	S3p	S2f
calaloo	2- 5%	N	S3pr	S3p	S2f
	5- 8%	N	S3pr	S3p	S2f
cabbage	2- 5%	N	N	S3p	S2f
	5- 8%	N	N	S3p	S2f
tomato	2- 5%	N	S3fr	S3p	S2f
	5- 8%	N	S3fr	S3p	S2f
cucumber	2- 5%	N	S3fr	S3p	S2f
	5- 8%	N	S3fr	S3p	S2f
pumpkin	2- 5%	N	S3p	S3p	S2f
	5- 8%	N	S3p	S3p	S2f
coconut	2- 5%	N	S3ptr	S3pt	S2ft
	5- 8%	N	S3ptr	S3pt	S2ft
cocoa	2- 5%	N	S3pr	S3p	--
	5- 8%	N	S3pr	S3p	--
coffee (arab.)	2- 5%	N	S3ptr	S3pt	--
	5- 8%	N	S3ptr	S3pt	--
coffee (cane.)	2- 5%	N	S3pr	S3p	--

Climatic data: R75= 1206 ; Rav= 1451 ; PET= 1441 (mm/yr); R75/PET= .83
[Table continues overleaf]

Crop	slope (%)	agro-ecological suitability class for: MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rain
coffee (cane.)	5- 8%	N	S3pr	S3p	--
breadfruit	2- 5%	N	S3p	--	--
	5- 8%	N	S3p	--	--
citrus	2- 5%	N	S3p	S3p	S2f
	5- 8%	N	S3p	S3p	S2f
ackee	2- 5%	N	S3p	--	--
	5- 8%	N	S3p	--	--
mango	2- 5%	N	S3p	S3p	S2f
	5- 8%	N	S3p	S3p	S2f
pimento	2- 5%	N	S3pr	--	--
	5- 8%	N	S3pr	--	--
forestry	2- 5%	N	S3p	--	--
	5- 8%	N	S3p	--	--
natural forest	2- 5%	N	--	--	--
	5- 8%	N	--	--	--
banana	2- 5%	N	S3fr	S3p	S2f
	5- 8%	N	S3fr	S3p	S2f
plantain	2- 5%	N	S3pr	--	--
	5- 8%	N	S3pr	--	--
pineapple	2- 5%	N	S3p	--	--
	5- 8%	N	S3p	--	--
unimpr. pasture	2- 5%	N	--	--	--
	5- 8%	N	--	--	--
impr. pasture	2- 5%	--	S2f	S2f	S2f
	5- 8%	--	S2f	S2f	S2f
ginger	2- 5%	N	N	S3p	S2f
	5- 8%	N	N	S3p	S2f

Climatic data: R75= 1206 ; Rav= 1451 ; PET= 1441 (mm/yr); R75/PET= .83

Table 16.19 Suitability of Tydixon soils for selected crops within specific technical and socio-economic settings (MLUs); month of planting/sowing: May.

Crop	slope (%)	agro-ecological suitability class for: MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rai
sugar cane	0- 2%	N	S3fw	S3pw	S3fw
	2- 5%	N	S3fw	S3pw	S3fw
maize	0- 2%	N	N	N	S3p
	2- 5%	N	N	N	S3p
tobacco	0- 2%	N	N	N	S3p
	2- 5%	N	N	N	S3p
groundnut	0- 2%	N	N	N	S3p
	2- 5%	N	N	N	S3p
pigeon pea	0- 2%	N	N	--	--
	2- 5%	N	N	--	--
common bean	0- 2%	N	N	N	S3p
	2- 5%	N	N	N	S3p
red pea	0- 2%	N	N	N	S3p
	2- 5%	N	N	N	S3p
onion	0- 2%	N	N	N	S3p
	2- 5%	N	N	N	S3p
cassava	0- 2%	N	N	--	--
	2- 5%	N	N	--	--
yam	0- 2%	N	N	--	--
	2- 5%	N	N	--	--
cocoyam	0- 2%	N	S3fr	--	--
	2- 5%	N	S3fr	--	--
sweet potato	0- 2%	N	N	N	S3p
	2- 5%	N	N	N	S3p
calaloo	0- 2%	N	N	N	S3p
	2- 5%	N	N	N	S3p
cabbage	0- 2%	N	N	N	S3p
	2- 5%	N	N	N	S3p
tomato	0- 2%	N	N	N	S3p
	2- 5%	N	N	N	S3p
cucumber	0- 2%	N	N	N	S3p
	2- 5%	N	N	N	S3p
pumpkin	0- 2%	N	N	N	S3p
	2- 5%	N	N	N	S3p
coconut	0- 2%	N	N	N	S3pt
	2- 5%	N	N	N	S3pt
cocoa	0- 2%	N	N	N	--
	2- 5%	N	N	N	--
coffee (arab.)	0- 2%	N	N	N	--
	2- 5%	N	N	N	--
coffee (cane.)	0- 2%	N	N	N	--

Climatic data: R75= 1265 ; Rav= 1522 ; PET= 1441 (mm/yr); R75/PET= .87

[Table continues overleaf]

Crop	slope (%)	agro-ecological suitability class for: MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rain
coffee (cane.)	2- 5%	N	N	N	--
breadfruit	0- 2%	N	N	--	--
	2- 5%	N	N	--	--
citrus	0- 2%	N	N	N	S3pw
	2- 5%	N	N	N	S3pw
ackee	0- 2%	N	N	--	--
	2- 5%	N	N	--	--
mango	0- 2%	N	N	N	S3pw
	2- 5%	N	N	N	S3pw
pimento	0- 2%	N	N	--	--
	2- 5%	N	N	--	--
forestry	0- 2%	N	N	--	--
	2- 5%	N	N	--	--
natural forest	0- 2%	N	--	--	--
	2- 5%	N	--	--	--
banana	0- 2%	N	N	N	S3p
	2- 5%	N	N	N	S3p
plantain	0- 2%	N	N	--	--
	2- 5%	N	N	--	--
pineapple	0- 2%	N	N	--	--
	2- 5%	N	N	--	--
unimpr. pasture	0- 2%	N	--	--	--
	2- 5%	N	--	--	--
impr. pasture	0- 2%	--	S2f	S2f	S2f
	2- 5%	--	S2f	S2f	S2f
ginger	0- 2%	N	N	N	S3p
	2- 5%	N	N	N	S3p

Climatic data: R75= 1265 ; Rav= 1522 ; PET= 1441 (mm/yr); R75/PET= .87

Table 16.20 Suitability of Knollis soils for selected crops within specific technical and socio-economic settings (MLUs); month of planting/sowing: May.

Crop	slope (%)	agro-ecological suitability class for: MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rain
sugar cane	0- 2%	N	S3pw	S2pw	S2w
	2- 5%	N	S3pw	S2pw	S2w
maize	0- 2%	N	N	N	S2p
	2- 5%	N	N	N	S2p
tobacco	0- 2%	N	N	N	S2p
	2- 5%	N	N	N	S2p
groundnut	0- 2%	N	N	N	S2p
	2- 5%	N	N	N	S2p
pigeon pea	0- 2%	N	N	--	--
	2- 5%	N	N	--	--
common bean	0- 2%	N	N	N	S2p
	2- 5%	N	N	N	S2p
red pea	0- 2%	N	N	N	S2p
	2- 5%	N	N	N	S2p
onion	0- 2%	N	N	N	S2p
	2- 5%	N	N	N	S2p
cassava	0- 2%	N	N	--	--
	2- 5%	N	N	--	--
yam	0- 2%	N	N	--	--
	2- 5%	N	N	--	--
cocoyam	0- 2%	N	S3pr	--	--
	2- 5%	N	S3pr	--	--
sweet potato	0- 2%	N	N	N	S2p
	2- 5%	N	N	N	S2p
calaloo	0- 2%	N	N	N	S2p
	2- 5%	N	N	N	S2p
cabbage	0- 2%	N	N	N	S2p
	2- 5%	N	N	N	S2p
tomato	0- 2%	N	N	N	S2p
	2- 5%	N	N	N	S2p
cucumber	0- 2%	N	N	N	S2p
	2- 5%	N	N	N	S2p
pumpkin	0- 2%	N	N	N	S2p
	2- 5%	N	N	N	S2p
coconut	0- 2%	N	N	N	S2pt
	2- 5%	N	N	N	S2pt
cocoa	0- 2%	N	N	N	--
	2- 5%	N	N	N	--
coffee (arab.)	0- 2%	N	N	N	--
	2- 5%	N	N	N	--
coffee (cane.)	0- 2%	N	N	N	--

Climatic data: R75= 1265 ; Rav= 1522 ; PET= 1441 (mm/yr); R75/PET= .87
[Table continues overleaf]

Crop	slope (%)	agro-ecological suitability class for: MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rain
coffee (cane.)	2- 5%	N	N	N	--
breadfruit	0- 2%	N	N	--	--
	2- 5%	N	N	--	--
citrus	0- 2%	N	N	N	S2pw
	2- 5%	N	N	N	S2pw
ackee	0- 2%	N	N	--	--
	2- 5%	N	N	--	--
mango	0- 2%	N	N	N	S2pw
	2- 5%	N	N	N	S2pw
pimento	0- 2%	N	N	--	--
	2- 5%	N	N	--	--
forestry	0- 2%	N	N	--	--
	2- 5%	N	N	--	--
natural forest	0- 2%	S2p	--	--	--
	2- 5%	S2p	--	--	--
banana	0- 2%	N	N	N	S2p
	2- 5%	N	N	N	S2p
plantain	0- 2%	N	N	--	--
	2- 5%	N	N	--	--
pineapple	0- 2%	N	N	--	--
	2- 5%	N	N	--	--
unimpr. pasture	0- 2%	S2f	--	--	--
	2- 5%	S2f	--	--	--
impr. pasture	0- 2%	--	S1	S1	S1
	2- 5%	--	S1	S1	S1
ginger	0- 2%	N	N	N	S2p
	2- 5%	N	N	N	S2p

Climatic data: R75= 1265 ; Rav= 1522 ; PET= 1441 (mm/yr); R75/PET= .87

Table 16.21 Suitability of Lluidas soils for selected crops within specific technical and socio-economic settings (MLUs); month of planting/sowing: May.

Crop	slope (%)	agro-ecological suitability class for: MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rain
sugar cane	0- 2%	S2pw	S2pw	S2w	S2w
	2- 5%	S2pw	S2pw	S2w	S2w
maize	0- 2%	S3p	S2p	S1	S1
	2- 5%	S3p	S2p	S1	S1
tobacco	0- 2%	S3p	S2p	S1	S1
	2- 5%	S3p	S2p	S1	S1
groundnut	0- 2%	S3p	S2p	S1	S1
	2- 5%	S3p	S2p	S1	S1
pigeon pea	0- 2%	S2pw	S2pw	--	--
	2- 5%	S2pw	S2pw	--	--
common bean	0- 2%	S3p	S2p	S1	S1
	2- 5%	S3p	S2p	S1	S1
red pea	0- 2%	S3p	S2p	S1	S1
	2- 5%	S3p	S2p	S1	S1
onion	0- 2%	S3p	S2p	S1	S1
	2- 5%	S3p	S2p	S1	S1
cassava	0- 2%	S2pw	S2pw	--	--
	2- 5%	S2pw	S2pw	--	--
yam	0- 2%	S3p	S2p	--	--
	2- 5%	S3p	S2p	--	--
cocoyam	0- 2%	S3pr	S2pr	--	--
	2- 5%	S3pr	S2pr	--	--
sweet potato	0- 2%	S3p	S2p	S1	S1
	2- 5%	S3p	S2p	S1	S1
calaloo	0- 2%	S3pr	S2pr	S1	S1
	2- 5%	S3pr	S2pr	S1	S1
cabbage	0- 2%	S3pr	S2pr	S1	S1
	2- 5%	S3pr	S2pr	S1	S1
tomato	0- 2%	S3p	S2p	S1	S1
	2- 5%	S3p	S2p	S1	S1
cucumber	0- 2%	S3p	S2p	S1	S1
	2- 5%	S3p	S2p	S1	S1
pumpkin	0- 2%	S3p	S2p	S1	S1
	2- 5%	S3p	S2p	S1	S1
coconut	0- 2%	S2t	S2t	S2t	S2t
	2- 5%	S2t	S2t	S2t	S2t
cocoa	0- 2%	S2fr	S2r	S1	--
	2- 5%	S2fr	S2r	S1	--
coffee (arab.)	0- 2%	S2ft	S2t	S2t	--
	2- 5%	S2ft	S2t	S2t	--
coffee (cane.)	0- 2%	S2f	S1	S1	--

Climatic data: R75= 1328 ; Rav= 1551 ; PET= 1447 (mm/yr); R75/PET= .9099999

[Table continues overleaf]

Crop	slope (%)	agro-ecological suitability class for: MLU-A (rainfed)	MLU-B (rainfed)	MLU-C (rain/irr.)	MLU-D (irr./rain)
coffee (cane.)	2- 5%	S2f	S1	S1	--
breadfruit	0- 2%	S1	S1	--	--
	2- 5%	S1	S1	--	--
citrus	0- 2%	S2w	S2w	S2w	S2w
	2- 5%	S2w	S2w	S2w	S2w
ackee	0- 2%	S2w	S2w	--	--
	2- 5%	S2w	S2w	--	--
mango	0- 2%	S2w	S2w	S2w	S2w
	2- 5%	S2w	S2w	S2w	S2w
pimento	0- 2%	S2fw	S2w	--	--
	2- 5%	S2fw	S2w	--	--
forestry	0- 2%	S1	S1	--	--
	2- 5%	S1	S1	--	--
natural forest	0- 2%	S1	--	--	--
	2- 5%	S1	--	--	--
banana	0- 2%	S3pr	S2pr	S1	S1
	2- 5%	S3pr	S2pr	S1	S1
plantain	0- 2%	S3pr	S2pr	--	--
	2- 5%	S3pr	S2pr	--	--
pineapple	0- 2%	S3pw	S2pw	--	--
	2- 5%	S3pw	S2pw	--	--
unimpr. pasture	0- 2%	S1	--	--	--
	2- 5%	S1	--	--	--
impr. pasture	0- 2%	--	S1	S1	S1
	2- 5%	--	S1	S1	S1
ginger	0- 2%	S3pw	S2pw	S2w	S2w
	2- 5%	S3pw	S2pw	S2w	S2w

Climatic data: R75= 1328 ; Rav= 1551 ; PET= 1447 (mm/yr); R75/PET= .9099999

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7. GLOSSARY

(adapted from FAO 1976 and Soil Survey Staff 1984)

Alluvium: Material, such as sand, silt or clay, deposited on land by streams.

Association, soil: A map unit of two or more kinds of soils occurring in a clear but intricate geographical pattern so that it is not practical to map them separately at the selected map scale. The soils of an association can be mapped separately on a larger map scale.

Available water capacity (available moisture capacity): The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as mm of water per meter of soil. The capacity in a 100 mm profile or to a limiting layer is expressed as: very low: 50-100 mm; low: 50-100 mm; moderate: 100-150 mm; high:150-200 mm; very high: more than 200 mm.

Base Saturation: The degree to which material, having cation exchange properties, is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity

Bedrock (rock): Solid rock that underlies the soil and other unconsolidated material, or that is exposed at the surface.

Bench terrace: A raised, level, or nearly level strip of earth constructed on or nearly on the contour, supported by a barrier of rock or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Boulders: Rock fragments larger than 25 cm in diameter.

Calcareous soil: A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, diluted hydrochloric acid.

Cation: An ion carrying a positive charge of electricity. The common cations in soils are calcium, potassium, magnesium, sodium, hydrogen and aluminium.

Cation exchange capacity (CEC): The total amount of exchangeable cations that can be held by the soil, expressed in terms of milli-equivalents per 100 grams of soil at neutrality (pH 7, NH4OAc method). The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Clay: As a soil separate, the mineral soil particles less than 0.002 millimeters (2 microns) in diameter. As a soil textural class, soil that has 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay skin: A thin coating of oriented clay on the surface of a soil aggregate or lining of pores or root channels. Synonym: clay coating.

Coarse textured soil: Sand or loamy sand.

Colluvium: Soil material, rock fragments or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex, soil: A map unit of two or more kinds of soils occurring in such an intricate pattern, that they cannot be mapped separately.

Concretions: Grains, pellets or nodules of various sizes, shapes and colours consisting of concentrated or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate, and iron and manganese oxides are common compounds in concretions.

Conservation tillage: A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil: The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe the consistence are:

> Loose: non coherent when dry or moist; does not hold together in a mass.
>
> Friable: when moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together in a lump.
>
> Firm: when moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.
>
> Plastic: when wet, rapidly deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.
>
> Sticky: when wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.
>
> Hard: when dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.
>
> Soft: when dry, breaks into powder or individual grains under very slight pressure.
>
> Cemented: hard; little affected by moistening.

Consociation: A map unit with 75 percent of one kind of soil (major series) and 25 percent inclusions of other (minor) soils.

Contour, strip-cropping: Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean tilled crops or summer fallow.

Control section: The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 25 and 100/200 cm.

Diversion, terrace: A ridge of earth, generally a terrace, built to protect down slope areas by diverting run-off from its natural course.

Doline: A depression in the landscape where limestone has been dissolved (synonym: sinkhole).

Effective cation exchange capacity (ECEC): The total amount of exchangeable cations that is held by the soil (Ca, Mg, Na, K, H and Al), expressed in terms of milli-equivalents per 100 grams of soil at the pH value of the soil. Except for calcareous soils, the ECEC is lower than the CEC value determined with the NH4OAc method at pH 7.

Erosion: The wearing away of the land surface by water, wind, ice or other geological agents and by such processes as gravitational creep (synonym: natural erosion).

Erosion, accelerated: Erosion much more rapid than geologic erosion, mainly as a result of the activities of man, animals or a catastrophe in nature, for example, fire that exposes the surface.

Fertility, soil: The quality that enables a soil to provide nutrients, in adequate amounts and in proper balance, for the growth of the specified plants when light, moisture, temperature, tilth and other growth factors are favourable. Inherent fertility is the fertility of the soil in its natural situation, without applied manure or mineral fertilizers.

Fine textured soil: Sandy clay, silty clay and clay.

Grassed waterway: A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel: Rounded or angular fragments of rock from 2 mm up to 7.5 cm.

Gravelly soil material: Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 7.5 cm in diameter.

Ground water: Water, filling all the unblocked pores and underlying material below the water table.

Horizon, soil: A layer of soil approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons in the survey area are as follows:

> A horizon: The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with mineral material. Also, any ploughed or disturbed surface layer.
>
> B horizon: The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon may have distinctive characteristics, such as:
> a) accumulation of clay, sesquioxides, humus or a combination of these,
> b) granular, prismatic or blocky structure;
> c) redder or more brown colours than those of the A horizon; or
> d) a combination of these.

C horizon: The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a '2', precedes the letter C.

R layer: Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Inclusion/Included soil: A soil that comprises less than 25 % of a mapping unit.

Infiltration: The downward entry of water into the immediate surface of the soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Krotovinas: Old burrows that are filled with humus rich materials from the A horizon.

Land characteristics: An attribute of land that can be measured or estimated, and which can be employed as a means of describing land qualities or distinguishing between land units of differing suitabilities for use.

Land evaluation: The process of assessment of land performance when used for specified purposes in order to identify and make a comparison of promising kinds of land use.

Land improvement: An alteration in the qualities of land which improves its potential for use.

Land qualities: A complex attribute of land which acts in a manner distinct from the actions of other land qualities in its influence on the suitability of land for a specified kind of use.

Land suitability: The fitness of a given type of land for a specified kind of land use.

Land suitability classification: An appraisal and grouping of specific types of land in terms of their absolute or relative suitability for a specified kind of use.

Land use requirement: The conditions of land necessary or desirable for the successful and sustained practice of a given land utilization type (subdivided in crop requirements and management requirements).

Land utilization type (LUT): A kind of land use described or defined in a degree of detail greater than that of a major kind of land use. In the context of rainfed agriculture, a land utilization type refers to a crop, crop combination or cropping system within a specified technical and socio-economic setting.

Loam: Mineral soil material that consists of 7 to 27 percent clay particles, 28 to 50 percent silt particles and less than 52 percent sand particles.

Major kind of land use (MLU): A major subdivision of rural land use, such as low technology rainfed farming or high technology rainfed farming with supplementary irrigation. In JAMPLES, MLUs are defined as crop/management systems: a particular crop is grown within a well defined technological and socio-economical setting.

Medium textured soil: Very fine sandy loam, silt loam or loam.

Mineral soil: Soil that is mainly mineral material and low in organic material. Its bulk density (kg per cubic m) is more than that of organic material.

Moderately coarse textured soil: Coarse sandy loam, sandy loam and fine sandy loam.

Moderately fine textured soil: Clay loam, sandy clay loam and silty clay loam.

Moisture Availability Zone: zone of similar rainfall (rainfall exceeded in 3 out of 4 years, R75) and potential evapo-transpiration (PET), as delineated on the agro-ecological zones map. These zones are defined by the annual R75/PET value as follows: Dry zone: R75/PET < 0.5; Intermediate zone: 0.5 <= R75/PET < 1.0; Wet zone: 1.0 <= R75/PET < 1.5; Very wet zone: R75/PET => 1.5. The zones are described in terms of the number of Dry months (0.3 < R75/PET), Rainy months (0.3 <= R75/PET < 0.5), Moist months (0.5 <= R75/PET < 1.0) and Humid months (R75/PET >= 1.0).

Mottling: Irregular spots of different colours that vary in number and size. Mottling generally indicates poor aeration and impeded drainage.

Munsell notation: A designation of colour by degrees of the three simple variables hue, value and chroma. For example, a notation of 5 YR 5/4 is a colour hue of 5 YR, a value of 5 and a chroma of 4. Each code corresponds with a specific name for the colour (5 YR 5/4 is reddish brown).

Parent material: The unconsolidated organic and mineral material in which soil forms.

Particle size class: Classes which refer to the grain size distribution of the whole soil, not only the fine earth. These classes are: fragmental, sandy-skeletal, loamy-skeletal, clayey-skeletal, sandy, loamy and clayey. The latter three classes can be read from a particle size triangle.

Permeability: The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of centimeters per hour that water moves downward through the saturated soil. (Terms describing permeability are: very slow = less than 1.5 mm/hr; slow = 1. 5-15 mm/hr; moderate = 15-50 mm/hr; moderately rapid = 50-150 mm/hr; rapid =150-500 mm/hr; very rapid = more than 500 mm/hr.)

Phase, soil: A subdivision of a soil series based on features that affect its use and management. For example slope, stoniness and rockiness.

Profile, soil: A vertical section of the soil extending through all its horizons and into the parent material. The profile is described from a soil pit.

Reaction, soil: A measure of acidity or alkalinity, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as: extremely acid (pH < 4.5), very strongly acid (4.5 < pH < 5.0), strongly acid (5.1 < pH < 5.5), medium acid (5.6 < pH < 6.0) slightly acid (6.1 < pH < 6.5), neutral (6.6 < pH < 7.3), mildly alkaline (7.4 < pH < 7.8), moderately alkaline (7.9 < pH < 8.4), strongly alkaline (8.5 < pH < 9.0) and very strongly alkaline (pH > 9.0).

Relief: The collectively considered elevations or inequalities of a land surface.

Relief, intensity: The range between the average lowest and average highest point in a specific landscape as seen in relation to the horizontal distance (synonym: amplitude).

Rock fragments: Rock or mineral fragments having a diameter of 2 mm or more.

Root zone: The part of the soil that can be penetrated by plant roots.

Run-off: The water that flows off the surface without sinking into the soil.

Sand: As a soil separate, individual rock or mineral fragments from 0.05 mm to 2.0 mm in diameter. As a soil textural class, soil that has 85% or more sand and not more than 10% clay.

Sedimentary rock: Rock made up of particles deposited from suspensions in water which have been hardened. The major kinds of sedimentary rocks are conglomerate formed from gravel, shale formed from clay, and limestone formed from soft masses of calcium carbonate. There are many intermediate types.

Series, soil: A group of soils that has profiles that are almost alike, except for differences in texture of the surface layer or the underlying material. All soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shrink-swell: The shrinking of usually montmorillonitic soils when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt: As a soil separate, individual mineral particles that range in diameter from 0.002 mm to 0.05 mm. As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slope: The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, multiplied by 100%. Thus a slope of 30 percent is a drop of 30 meters in 100 meters of horizontal distance.

Soil: A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting of the integrated effect of climate and living matter on earthy parent material, as conditioned by relief over periods of time.

Solum: The upper part of a soil profile, above the C horizon, in which the process of soil formation is active. The solum generally consists of the A, E, and B horizons. The living roots and plant and animal activities are largely confined to the solum.

Stones: Rock fragments 7.5-25 cm in diameter.

Stony: Refers to a soil containing stones in numbers that interfere with/prevent tillage.

Structure, soil: The arrangement of primary soil particles into compound particles or aggregates.

Subsoil: Technically the B horizon; roughly the part of the solum below the plough layer.

Substratum: The part of the soil below the solum (C horizon and R layer).

Subsurface layer: Any surface soil horizon (A, AE, AB or EB) below the surface layer.

Surface layer: The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 10-25 cm. Frequently designated as plough layer or "Ap horizon".

Texture: The relative proportion of sand, silt and clay particles in a mass of soil. The textural class can be read from a textural triangle.

Textural group: (USDA) indication for a group of textural classes of part of the pedon (the control section, usually 25-100 cm) and comprises only the fine earth fraction. The groups are: fine -, moderately fine -, medium -, moderately course - and course textured and strongly contrasting.

Textural group: (FAO/UNESCO) indication for a group of textural classes of the upper 30 cm of the profile. The classes are: coarse -, medium - and fine textured.

Variant, soil series: A soil largely similar to existing soil series, yet significantly different from it in some minor properties.

APPENDIX I

Agro-climatic analyses

Agro-climatic analyses for Charming Hole, Corn Ground, Ewarton, Grass Piece, Point Hill, Swansea and Worthy Park and analysis of seasonal rainfall and PET variability for Worthy Park.

Explanation of the tables:

N	number of records for the month/year shown
R mean	mean rainfall (mm) for the month/year shown
CV (%)	coefficient of variation, a measure for the variability of the rainfall for the period under study
R min	lowest amount of rainfall (mm) recorded for the period shown
R90	amount of rainfall (mm) that will be reached or exceeded in 90% of the years
R75	amount of rainfall (mm) that will be reached or exceeded in 75% of the years
R50	amount of rainfall (mm) that will be reached or exceeded in 50% of the years
R25	amount of rainfall (mm) that will be reached or exceeded in 25% of the years
R10	amount of rainfall (mm) that will be reached or exceeded in 10% of the years
Rmax	highest amount of rainfall (mm) recorded for the period shown
PET	potential evapo-transpiration (calculated with linear regression after IICA,1983)

DGP-75%	dependable growing period in 75% of the years (- M+H+u)
p	0.3 PET <- R75 < 0.5 PET
M	0.5 PET <- R75 < 1.0 PET
H	R75 >- 1.0 PET
u	use of soil moisture reserve at the end of the rainy season

Tmin	mean minimum daily air temperature calculated with linear regression (SSU 1988a)
Tmean	mean daily air temperature calculated with linear regression (SSU 1988a)
Tmax	mean maximum daily air temperature calculated with linear regression (SSU 1988a)

P(R > x mm) probability of receiving more than x mm of rainfall in the specified month(s)

CHARMING HOLE

Table 1 : Extremes and variability of monthly and annual rainfall totals, mean potential evapo-transpiration, and mean air temperature for CHARMING HOLE (in mm/month and degrees Celsius respectively) [data base: 1951 - 1989]

PERIOD	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
N	36	36	36	34	34	35	36	36	36	34	34	32	28
Mean	72	60	59	101	183	169	126	146	193	256	108	87	1551
CV (%)	87	65	63	63	57	72	44	42	57	51	61	76	20
Minim.	11	2	5	3	5	6	37	51	58	68	1	21	854
R90	18	7	9	21	40	40	50	62	89	97	19	21	1124
R75	33	32	33	55	109	85	86	102	125	163	62	42	1328
R50	57	60	59	96	183	150	126	146	176	246	108	75	1551
R25	95	87	84	142	258	235	165	190	242	339	155	119	1774
R10	144	112	108	187	326	329	202	230	319	431	197	171	1979
Maxim.	324	165	141	279	460	580	239	329	659	602	280	308	2159
PET	98	102	128	131	140	137	146	137	118	116	98	97	1447
R75/PET	0.33	0.31	0.25	0.41	0.77	0.61	0.59	0.74	1.05	1.41	0.63	0.43	0.91
75%DGP	p	p	-	p	M	M	M	M	H	H	M	u	
Tmin	17.3	16.8	17.3	18.2	19.5	20.2	20.1	20.2	20.2	19.9	19.3	18.3	19.0
Tmean	22.0	21.9	22.3	23.2	24.0	24.6	24.9	25.2	24.8	24.5	23.8	22.8	23.6
Tmax	26.8	26.9	27.5	28.2	28.5	28.9	29.5	29.8	29.4	28.8	28.1	27.3	28.4

Table 2 : Probability of surpassing preselected monthly rainfall totals at CHARMING HOLE [in %; data base: 1951 - 1989 , elev.= 365 m]

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
P(Xi<0.3)	23	24	38	13	8	7	7	1	2	1	10	13
P(.3<=X<.5)	22	25	27	17	5	11	13	8	2	0	8	25
P(.5<=Xi<1)	36	38	30	50	23	28	47	36	19	5	35	28
P(1<=Xi)	19	13	5	20	64	54	33	55	77	94	47	34
P(2<=Xi)	5	0	0	5	17	14	0	2	19	50	11	6
P(R> 25mm)	83	77	77	88	94	97	100	100	100	100	94	93
P(R> 50mm)	52	52	52	88	91	94	94	100	100	100	82	62
P(R> 75mm)	27	30	30	64	88	82	80	88	97	97	61	46
P(R>100mm)	19	13	16	35	76	68	61	66	91	94	47	31
P(R>150mm)	11	2	0	20	61	45	33	55	61	76	26	15
P(R>200mm)	5	0	0	5	35	28	16	16	33	61	11	6
P(R>300mm)	2	0	0	0	14	11	0	2	5	26	0	3
P(R>400mm)	0	0	0	0	5	5	0	0	5	11	0	0
P(R>500mm)	0	0	0	0	0	5	0	0	5	8	0	0

Note: frequency analysis of non-transformed data (for N see table 1)
Xi is the abbreviation for R/PET

CORN GROUND

Table 1 : Extremes and variability of monthly and annual rainfall totals, mean potential evapo-transpiration, and mean air temperature for CORN GROUND (in mm/month and degrees Celsius respectively) [data base: 1951 - 1989]

PERIOD	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
N	34	34	34	33	32	31	33	32	32	31	32	29	24
Mean	58	67	63	105	204	171	124	164	177	269	119	89	1662
CV (%)	97	92	64	86	60	73	45	67	48	47	55	91	25
Minim.	5	3	0	8	30	0	3	20	74	96	29	17	789
R90	11	11	8	12	45	38	47	56	83	95	30	21	1084
R75	24	27	34	43	117	83	84	91	119	179	73	39	1362
R50	46	55	63	92	201	151	124	144	167	269	119	69	1662
R25	79	95	91	155	288	240	164	216	224	360	166	116	1961
R10	120	143	117	223	371	339	200	301	287	443	208	179	2239
Maxim.	310	295	161	439	466	545	219	536	501	592	294	367	2577
PET	98	102	128	131	140	137	146	137	118	116	98	97	1447
R75/PET	0.24	0.26	0.26	0.32	0.83	0.60	0.57	0.66	1.00	1.54	0.74	0.39	0.94
75%DGP	-	-	-	p	M	M	M	M	H	H	M	u	
Tmin	17.3	16.8	17.3	18.2	19.5	20.2	20.1	20.2	20.2	19.9	19.3	18.3	19.0
Tmean	22.0	21.9	22.3	23.2	24.0	24.6	24.9	25.2	24.8	24.5	23.8	22.8	23.6
Tmax	26.8	26.9	27.5	28.2	28.5	28.9	29.5	29.8	29.4	28.8	28.1	27.3	28.4

Table 2 : Probability of surpassing preselected monthly rainfall totals at CORN GROUND [in %; data base: 1951 - 1989 , elev.= 365 m]

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
P(Xi<0.3)	28	34	31	31	4	5	13	5	1	1	4	12
P(.3<=X<.5)	32	20	29	6	3	9	9	3	0	0	9	27
P(.5<=Xi<1)	29	26	35	39	31	45	39	46	28	16	37	41
P(1<=Xi)	11	20	5	24	62	41	39	46	71	83	50	20
P(2<=Xi)	2	5	0	9	25	16	0	12	15	54	12	13
P(R> 25mm)	76	73	79	84	100	96	96	96	100	100	100	93
P(R> 50mm)	41	47	61	66	96	96	84	96	100	100	87	58
P(R> 75mm)	17	32	38	60	93	83	75	90	96	100	68	41
P(R>100mm)	11	20	14	45	87	64	69	71	84	93	50	17
P(R>150mm)	5	8	2	21	59	38	36	40	53	80	31	13
P(R>200mm)	2	5	0	9	34	25	6	18	43	64	12	13
P(R>300mm)	2	0	0	3	25	16	0	12	6	38	0	3
P(R>400mm)	0	0	0	3	15	6	0	6	3	12	0	0
P(R>500mm)	0	0	0	0	0	6	0	3	3	6	0	0

Note: frequency analysis of non-transformed data (for N see table 1)
Xi is the abbreviation for R/PET

EWARTON

Table 1 : Extremes and variability of monthly and annual rainfall totals, mean potential evapo-transpiration, and mean air temperature for EWARTON (in mm/month and degrees Celsius respectively) [data base: 1950 - 1989]

PERIOD	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
N	33	32	30	29	28	28	30	31	29	25	26	21	14
Mean	58	57	56	96	148	177	120	145	139	187	103	71	1366
CV (%)	88	81	59	74	71	69	40	45	58	39	71	85	22
Minim.	8	9	3	1	33	29	36	41	32	94	24	6	857
R90	11	5	11	5	37	55	54	61	52	91	29	15	925
R75	25	24	32	45	75	96	85	98	83	134	54	31	1136
R50	48	52	56	93	132	157	120	142	127	184	90	58	1366
R25	80	85	79	144	205	238	154	188	182	237	139	97	1596
R10	120	119	101	192	286	330	185	233	244	289	196	148	1807
Maxim.	224	189	133	295	490	679	221	357	443	388	371	226	1846
PET	100	105	132	136	144	140	149	140	121	119	101	100	1487
R75/PET	0.24	0.23	0.24	0.33	0.52	0.68	0.57	0.70	0.68	1.13	0.53	0.30	0.76
75%DGP	-	-	-	p	M	M	M	M	M	H	M	u	
Tmin	17.8	17.4	17.8	18.8	20.1	20.7	20.7	20.8	20.8	20.5	19.8	18.8	19.5
Tmean	22.5	22.5	22.8	23.7	24.6	25.1	25.4	25.8	25.4	25.1	24.4	23.4	24.2
Tmax	27.4	27.5	28.1	28.7	29.0	29.5	30.1	30.3	29.9	29.5	28.7	27.9	28.9

Table 2 : Probability of surpassing preselected monthly rainfall totals at EWARTON [in %; data base: 1950 - 1989 , elev.= 258 m]

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
P(Xi<0.3)	31	39	35	22	9	5	7	4	5	0	9	25
P(.3<=X<.5)	27	21	36	24	17	10	10	3	6	0	15	28
P(.5<=Xi<1)	30	25	26	27	42	35	60	45	34	24	34	28
P(1<=Xi)	12	15	3	27	32	50	23	48	55	76	42	19
P(2<=Xi)	6	0	0	3	14	14	0	3	6	20	7	9
P(R> 25mm)	72	65	86	86	100	100	100	100	100	100	96	90
P(R> 50mm)	42	40	50	68	89	92	90	96	96	100	76	47
P(R> 75mm)	21	31	20	48	75	85	83	87	79	100	53	19
P(R>100mm)	12	15	13	34	60	82	56	67	58	92	42	19
P(R>150mm)	9	6	0	20	32	50	23	41	34	68	15	14
P(R>200mm)	6	0	0	10	21	32	10	16	17	36	7	9
P(R>300mm)	0	0	0	0	14	7	0	3	3	8	3	0
P(R>400mm)	0	0	0	0	3	3	0	0	3	0	0	0
P(R>500mm)	0	0	0	0	0	3	0	0	0	0	0	0

Note: frequency analysis of non-transformed data (for N see table 1)
Xi is the abbreviation for R/PET

GRASS PIECE

Table 1 : Extremes and variability of monthly and annual rainfall totals, mean potential evapo-transpiration, and mean air temperature for GRASS PIECE (in mm/month and degrees Celsius respectively) [data base: 1970 - 1989]

PERIOD	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
N	15	16	16	14	14	14	15	15	15	13	13	14	9
Mean	82	79	59	128	208	144	128	206	243	259	107	89	1794
CV (%)	77	59	61	73	69	71	40	58	71	54	70	79	27
Minim.	21	17	4	5	33	45	33	56	93	55	32	20	922
R90	12	12	7	15	39	49	54	56	75	51	31	24	1049
R75	36	44	32	58	101	78	90	118	126	153	55	43	1411
R50	73	79	59	118	190	124	128	197	206	259	93	73	1794
R25	120	114	85	189	300	189	166	287	323	366	146	119	2177
R10	171	147	110	265	421	273	202	380	475	467	212	182	2538
Maxim.	260	185	132	337	628	471	201	530	692	572	319	300	2503
PET	98	101	127	131	139	136	145	136	118	115	97	97	1441
R75/PET	0.37	0.43	0.25	0.44	0.72	0.57	0.61	0.86	1.06	1.32	0.57	0.43	0.97
75%DGP	p	p	-	p	M	M	M	M	H	H	M	u	
Tmin	17.3	16.8	17.3	18.2	19.5	20.2	20.1	20.2	20.2	19.9	19.3	18.3	19.0
Tmean	22.0	21.9	22.3	23.2	24.0	24.6	24.9	25.2	24.8	24.5	23.8	22.8	23.6
Tmax	26.8	26.9	27.5	28.2	28.5	28.9	29.5	29.8	29.4	28.8	28.1	27.3	28.4

Table 2 : Probability of surpassing preselected monthly rainfall totals at GRASS PIECE [in %; data base: 1970 - 1989 , elev.= 365 m]

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
P(Xi<0.3)	34	20	33	9	8	1	8	1	0	2	1	9
P(.3<=X<.5)	0	18	18	14	14	14	6	6	0	7	23	28
P(.5<=Xi<1)	40	31	43	42	7	57	53	40	20	7	46	35
P(1<=Xi)	26	31	6	35	71	28	33	53	80	84	30	28
P(2<=Xi)	6	0	0	14	21	7	0	20	26	46	15	7
P(R> 25mm)	80	81	75	92	100	100	100	100	100	100	100	92
P(R> 50mm)	66	62	56	92	85	92	86	100	100	100	76	64
P(R> 75mm)	40	56	37	64	78	78	86	93	100	92	69	42
P(R>100mm)	26	31	12	42	78	64	66	86	93	92	30	28
P(R>150mm)	6	12	0	28	64	21	33	53	46	84	15	14
P(R>200mm)	6	0	0	21	42	21	6	40	33	53	7	7
P(R>300mm)	0	0	0	14	21	7	0	20	26	30	7	0
P(R>400mm)	0	0	0	0	7	7	0	6	20	23	0	0
P(R>500mm)	0	0	0	0	7	0	0	6	13	7	0	0

Note: frequency analysis of non-transformed data (for N see table 1)
Xi is the abbreviation for R/PET

POINT HILL

Table 1 : Extremes and variability of monthly and annual rainfall totals, mean potential evapo-transpiration, and mean air temperature for POINT HILL (in mm/month and degrees Celsius respectively) [data base: 1951 - 1979]

PERIOD	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
N	25	26	25	28	27	28	28	28	27	27	27	28	22
Mean	84	67	95	109	242	211	142	198	208	312	148	88	1834
CV (%)	70	80	72	68	62	93	46	49	54	47	69	71	20
Minim.	0	7	9	4	20	11	7	36	11	115	5	4	959
R90	3	3	6	13	34	33	53	70	74	144	7	15	1313
R75	42	28	45	55	134	82	96	129	127	209	75	43	1563
R50	84	63	92	106	242	170	142	196	197	294	148	82	1834
R25	127	101	142	159	350	298	189	266	277	397	221	127	2104
R10	166	140	189	210	450	453	232	331	362	510	289	174	2354
Maxim.	210	210	249	347	555	848	249	510	657	757	352	265	2640
PET	93	95	118	121	129	129	137	130	112	109	91	92	1357
R75/PET	0.45	0.29	0.38	0.45	1.03	0.63	0.69	0.99	1.13	1.90	0.82	0.47	1.15
75%DGP	p	-	p	p	H	M	M	M	H	H	M	u	
Tmin	16.0	15.6	16.0	17.0	18.3	18.9	18.8	18.9	18.9	18.6	18.0	17.0	17.7
Tmean	20.7	20.5	21.0	21.9	22.7	23.2	23.6	23.9	23.5	23.1	22.4	21.4	22.3
Tmax	25.3	25.5	26.2	26.9	27.2	27.6	28.2	28.6	28.0	27.4	26.7	25.9	27.1

Table 2 : Probability of surpassing preselected monthly rainfall totals at POINT HILL [in %; data base: 1951 - 1979 , elev.= 609 m]

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
P(Xi<0.3)	12	25	24	23	5	8	9	5	5	0	13	9
P(.3<=X<.5)	20	26	12	10	0	7	3	3	0	0	7	28
P(.5<=Xi<1)	28	23	36	28	25	28	42	17	7	0	14	21
P(1<=Xi)	40	26	28	39	70	57	46	75	88	100	66	42
P(2<=Xi)	12	3	8	3	37	21	0	25	29	66	33	7
P(R> 25mm)	88	80	88	89	96	96	96	100	96	100	88	92
P(R> 50mm)	64	42	72	75	96	92	89	96	96	100	81	64
P(R> 75mm)	48	34	48	67	88	78	85	92	96	100	74	53
P(R>100mm)	40	23	36	50	81	67	71	82	88	100	59	28
P(R>150mm)	16	7	20	25	62	46	42	71	70	88	40	14
P(R>200mm)	12	3	12	3	51	32	25	42	51	88	33	7
P(R>300mm)	0	0	0	3	25	21	0	10	11	37	7	0
P(R>400mm)	0	0	0	0	25	14	0	3	3	25	0	0
P(R>500mm)	0	0	0	0	11	10	0	3	3	11	0	0

Note: frequency analysis of non-transformed data (for N see table 1)
Xi is the abbreviation for R/PET

SWANSEA

Table 1 : Extremes and variability of monthly and annual rainfall totals, mean potential evapo-transpiration, and mean air temperature for SWANSEA (in mm/month and degrees Celsius respectively) [data base: 1948 - 1989]

PERIOD	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
N	40	40	41	40	39	39	40	39	40	38	37	35	31
Mean	57	53	53	92	187	154	110	139	174	260	113	70	1452
CV (%)	91	70	58	83	64	74	48	59	60	52	65	81	23
Minim.	8	0	3	5	4	16	2	38	46	58	32	13	624
R90	15	3	12	14	26	41	38	56	69	91	36	17	980
R75	26	27	31	39	103	78	73	85	105	164	62	33	1206
R50	46	53	53	79	187	134	110	126	157	253	101	58	1452
R25	75	79	74	132	271	209	148	179	225	348	150	94	1697
R10	113	103	94	192	349	297	182	239	303	441	207	138	1923
Maxim.	302	145	139	367	467	551	238	454	566	610	343	242	2314
PET	98	101	127	131	139	136	145	136	118	115	97	97	1441
R75/PET	0.26	0.26	0.24	0.29	0.74	0.56	0.49	0.62	0.89	1.42	0.64	0.33	0.83
75%DGP	-	-	-	-	M	M	u	M	M	H	M	u	
Tmin	17.2	16.8	17.2	18.2	19.5	20.1	20.1	20.1	20.1	19.8	19.2	18.2	18.9
Tmean	21.9	21.8	22.2	23.1	23.9	24.5	24.8	25.1	24.7	24.4	23.7	22.7	23.6
Tmax	26.7	26.8	27.4	28.1	28.4	28.8	29.4	29.7	29.3	28.8	28.0	27.2	28.3

Table 2 : Probability of surpassing preselected monthly rainfall totals a SWANSEA [in %; data base: 1948 - 1989 , elev.= 380 m]

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
P(Xi<0.3)	36	36	33	26	7	7	16	4	0	1	1	24
P(.3<=X<.5)	22	22	31	22	7	12	7	7	5	0	16	22
P(.5<=Xi<1)	30	27	34	30	33	43	50	48	25	10	35	34
P(1<=Xi)	12	15	2	22	53	38	27	41	70	89	48	20
P(2<=Xi)	2	0	0	5	25	12	0	5	12	50	10	8
P(R> 25mm)	77	72	75	87	94	97	95	100	100	100	100	88
P(R> 50mm)	37	42	46	70	89	89	85	94	97	100	78	54
P(R> 75mm)	15	25	21	40	84	79	75	84	95	97	62	28
P(R>100mm)	12	15	9	35	74	64	60	64	75	89	45	17
P(R>150mm)	2	0	0	15	48	33	20	33	55	84	18	8
P(R>200mm)	2	0	0	12	35	17	5	12	27	63	10	5
P(R>300mm)	2	0	0	2	23	10	0	5	7	28	5	0
P(R>400mm)	0	0	0	0	7	5	0	5	5	15	0	0
P(R>500mm)	0	0	0	0	0	5	0	0	5	10	0	0

Note: frequency analysis of non-transformed data (for N see table 1)
Xi is the abbreviation for R/PET

WORTHY PARK

Table 1 : Extremes and variability of monthly and annual rainfall totals, mean potential evapo-transpiration, and mean air temperature for WORTHY PARK (in mm/month and degrees Celsius respectively) [data base: 1901 - 1989]

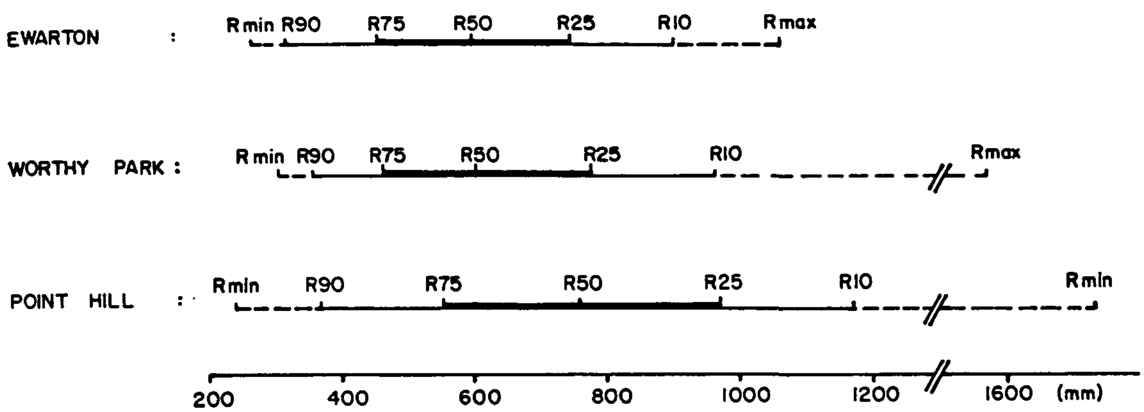
PERIOD	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
N	86	84	84	85	85	85	85	84	84	83	85	80	72
Mean	61	52	61	88	185	181	113	161	177	244	140	67	1522
CV (%)	82	77	70	77	69	87	45	59	65	58	89	73	24
Minim.	8	4	3	2	17	24	35	19	41	41	9	0	771
R90	18	10	12	13	47	49	55	50	64	92	34	12	1031
R75	31	25	31	41	98	85	78	95	102	149	64	33	1266
R50	51	47	56	81	170	145	108	153	157	227	115	62	1522
R25	80	74	86	127	256	236	143	219	231	321	187	96	1779
R10	114	103	116	175	347	353	179	285	317	421	277	131	2013
Maxim.	379	254	224	298	838	1091	360	465	700	938	751	241	2379
PET	98	101	127	131	139	136	145	136	118	115	97	97	1441
R75/PET	0.31	0.24	0.24	0.31	0.70	0.62	0.53	0.69	0.86	1.29	0.66	0.34	0.87
75%DGP	p	-	-	p	M	M	M	M	M	H	M	u	
Tmin	17.2	16.8	17.2	18.2	19.5	20.1	20.1	20.1	20.1	19.8	19.2	18.2	18.9
Tmean	21.9	21.8	22.2	23.1	23.9	24.5	24.8	25.1	24.7	24.4	23.7	22.7	23.6
Tmax	26.7	26.8	27.4	28.1	28.4	28.8	29.4	29.7	29.3	28.8	28.0	27.2	28.3

Table 2 : Probability of surpassing preselected monthly rainfall totals at WORTHY PARK [in %; data base: 1901 - 1989 , elev.= 380 m]

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
P(Xi<0.3)	21	39	32	27	5	3	2	4	1	1	6	22
P(.3<=X<.5)	30	16	33	23	15	16	20	11	7	2	12	25
P(.5<=Xi<1)	34	36	28	32	22	32	58	33	27	8	25	32
P(1<=Xi)	15	9	7	18	58	49	20	52	65	89	57	21
P(2<=Xi)	2	1	0	2	20	18	1	8	17	43	17	2
P(R> 25mm)	86	72	80	87	98	98	100	98	100	100	98	82
P(R> 50mm)	47	46	51	70	90	90	94	96	96	98	83	53
P(R> 75mm)	22	20	25	43	78	78	76	82	89	95	70	31
P(R>100mm)	12	10	14	30	71	65	55	71	71	92	57	20
P(R>150mm)	4	2	3	16	54	41	20	47	52	74	25	7
P(R>200mm)	1	1	2	9	38	25	3	30	30	61	17	2
P(R>300mm)	1	0	0	0	17	18	1	7	10	21	7	0
P(R>400mm)	0	0	0	0	4	10	0	5	5	12	4	0
P(R>500mm)	0	0	0	0	2	2	0	0	2	8	3	0

Note: frequency analysis of non-transformed data (for N see table 1)
Xi is the abbreviation for R/PET

Rainfall statistics for 4 monthly periods, following the month of May, at Ewarton, Worthy Park and Point Hill. The figure is based on the rainfall and PET data as presented in the tables below (L: length of growing season, expressed in the number of months)



Analvsis of seasonal rainfall and PET variabilitv for the Ewarton area [data base: 1950 - 1988].

Time period	L	PETm	N	Min	R90	R75	R50	R25	R10	Max	CV%	RP75
Mav -June	(2)	283	25	81	126	200	304	435	582	983	57	0.70
Mav -Julv	(3)	432	24	125	181	301	443	594	741	1019	46	0.69
Mav -Auo.	(4)	571	24	274	320	454	599	744	879	1126	33	0.79
Mav -Sep.	(5)	691	24	351	440	584	739	895	1039	1205	29	0.84
Mav -Oct.	(6)	809	21	561	621	768	928	1088	1236	1343	23	0.94

Analvsis of seasonal rainfall and PET variabilitv for the Worthv Park area [data base: 1901 - 1988].

Time period	L	PETm	N	Min	R90	R75	R50	R25	R10	Max	CV%	RP75
Mav -June	(2)	274	85	86	146	222	330	469	634	1435	61	0.81
Mav -Julv	(3)	419	84	150	234	326	449	601	774	1480	49	0.77
Mav -Auo.	(4)	555	82	305	352	463	605	776	964	1573	41	0.83
Mav -Seo.	(5)	672	81	362	444	608	800	1006	1211	1730	37	0.90
Mav -Oct.	(6)	787	80	496	640	825	1043	1281	1521	2663	33	1.04

Analvsis of seasonal rainfall and PET variabilitv for the Point Hill area [data base: 1951 - 1978].

Time period	L	PETm	N	Min	R90	R75	R50	R25	R10	Max	CV%	RP75
Mav -June	(2)	258	25	111	148	239	375	557	773	1362	64	0.92
Mav -Julv	(3)	395	25	156	232	362	534	740	960	1498	51	0.91
Mav -Auo.	(4)	524	25	241	369	552	758	969	1168	1534	38	1.05
Mav -Sep.	(5)	636	24	404	558	753	963	1173	1367	1717	30	1.18
Mav -Oct.	(6)	745	24	552	826	1028	1246	1464	1666	1919	24	1.37

Table 1 : Analysis of seasonal rainfall and PET variability for the Worthy Park area [data base: 1901 - 1988].

Time period	L	PETm	N	Min	R90	R75	R50	R25	R10	Max	CV%	RP75
Jan.-Mar.	(3)	325	81	52	83	123	171	223	275	459	43	0.37
Jan.-Apr.	(4)	455	79	101	136	199	265	332	395	576	37	0.43
Jan.-May	(5)	593	79	169	240	337	447	563	676	1053	37	0.56
Jan.-June	(6)	729	79	258	336	454	603	779	969	1851	42	0.62
Feb.-Apr.	(3)	358	79	54	91	143	202	261	319	506	43	0.40
Feb.-May	(4)	496	79	141	185	281	388	497	602	986	41	0.56
Feb.-June	(5)	632	79	224	287	398	541	710	895	1717	45	0.62
Feb.-July	(6)	777	78	297	377	504	660	838	1023	1762	38	0.64
Mar.-May	(3)	395	80	113	145	230	329	435	538	960	45	0.58
Mar.-June	(4)	531	80	164	243	348	487	654	838	1658	49	0.65
Mar.-July	(5)	676	79	250	330	455	610	788	975	1703	42	0.67
Mar.-Aug.	(6)	812	78	355	454	596	769	963	1165	1796	36	0.73
Apr.-June	(3)	404	83	128	189	287	419	582	764	1584	55	0.71
Apr.-July	(4)	549	82	192	277	395	544	717	900	1629	45	0.71
Apr.-Aug.	(5)	685	81	340	401	537	705	896	1095	1722	39	0.78
Apr.-Sep.	(6)	802	80	394	502	688	898	1119	1334	1879	35	0.85
May -July	(3)	419	84	150	234	326	449	601	774	1480	49	0.77
May -Aug.	(4)	555	82	305	352	463	605	776	964	1573	41	0.83
May -Sep.	(5)	672	81	362	444	608	800	1006	1211	1730	37	0.90
May -Oct.	(6)	787	80	496	640	825	1043	1281	1521	2663	33	1.04
June-Aug.	(3)	417	82	184	236	321	431	561	701	1229	43	0.77
June-Sep.	(4)	534	81	242	323	458	616	787	959	1586	40	0.85
June-Oct.	(5)	649	80	372	512	667	854	1064	1282	2523	35	1.02
June-Nov.	(6)	746	80	473	606	787	999	1232	1467	2707	33	1.05
July-Sep.	(3)	398	82	181	228	330	447	570	691	1156	39	0.82
July-Oct.	(4)	513	81	261	403	528	680	851	1028	2094	36	1.02
July-Nov.	(5)	610	81	352	490	638	817	1019	1228	2277	35	1.04
July-Dec.	(6)	707	77	372	557	706	885	1083	1288	2345	32	0.99

[Continues overleaf]

Table 1 : Analysis of seasonal rainfall and PET variability for the Worthy Park area [data base: 1901 - 1988].

Time period L	PETm	N	Min	R90	R75	R50	R25	R10	Max	CV%	RP75
Aug.-Oct. (3)	368	82	188	306	424	566	725	887	1734	40	1.15
Aug.-Nov. (4)	465	82	250	391	534	706	896	1090	1917	38	1.14
Aug.-Dec. (5)	562	78	299	458	607	778	961	1143	1986	34	1.07
Aug.-Jan. (6)	659	76	395	507	663	842	1033	1223	2056	33	1.00
Sep.-Nov. (3)	329	83	166	289	401	541	701	870	1488	42	1.21
Sep.-Dec. (4)	426	79	279	355	474	616	772	930	1556	36	1.11
Sep.-Jan. (5)	523	77	331	398	526	678	845	1015	1626	35	1.00
Sep.-Feb. (6)	624	76	368	454	576	725	894	1074	1880	34	0.92
Oct.-Dec. (3)	309	79	173	221	320	438	566	694	1189	42	1.03
Oct.-Jan. (4)	406	77	232	269	373	498	638	780	1259	40	0.91
Oct.-Feb. (5)	507	76	269	325	423	545	686	836	1513	37	0.83
Oct.-Mar. (6)	634	74	276	379	474	593	731	880	1551	34	0.74
Nov.-Jan. (3)	291	78	114	124	178	249	335	429	699	49	0.61
Nov.-Feb. (4)	392	77	140	161	228	310	402	496	745	42	0.58
Nov.-Mar. (5)	519	75	159	194	280	373	466	552	763	36	0.54
Nov.-Apr. (6)	649	75	211	261	359	464	569	667	877	33	0.55
Dec.-Feb. (3)	295	77	43	86	128	179	234	290	464	44	0.43
Dec.-Mar. (4)	422	75	100	123	179	241	305	366	535	38	0.42
Dec.-Apr. (5)	552	75	156	182	255	334	412	486	644	34	0.46
Dec.-May (6)	690	74	236	289	398	518	641	758	1092	34	0.57

* Ri is the minimum amount of rainfall exceeded in i percent - 90%, 75%, 50%, 25% and 10% respectively - of the years during the time period under review. PET is the mean seasonal potential evapotranspiration. RPi is the abbreviation for Ri/PET ratio. N is the total number of observations for each analysis and CV the coefficient of variation.
L stands for length of growing cycle (planting to harvesting).

APPENDIX II
Rock analyses

Results of rock analyses, as carried out by the Geological Survey Department, Kingston, are listed below. Locations of sampling sites are indicated on the soil map by◆ and number, as the bold printed number below.

Analyses (Lab. No.	89/84A/**067** 2826	89/84A/**068** 2827	89/84A/**072** 2828	89/84A/**075A** 2829)
LOI	43.77	43.70	43.80	43.78
SiO2	0.30	0.13	0.15	0.19
CaO	54.43	55.26	55.34	55.56
MgO	0.76	0.39	0.33	0.37
Fe2O3	0.17	0.13	0.10	0.05
TiO2	0.02	0.03	0.03	0.02
MnO	0.004	0.007	0.001	0.003
Al2O3	0.34	0.21	0.13	0.09
Na2O	0.01	0.02	0.02	0.02
K2O	0.01	0.02	0.02	0.01
CaCO3	97.15	98.63	98.77	99.16
Total carb.	98.74	99.45	99.46	99.93

Notes: AAS determinations except for Loss on Ignition (LOI) and CaCO3 (wet chemistry); CaCO3 = CaO * 1.78477; MgCO3 = MgO * 2.09176; total carbonates = CaCO3 + MgCO3.

Sample 89/84A/067: Troy-Claremont Formation: tough, compact microspar with patches of coarser, sparry crystals; scattered vuggy patches of relict coralline (?) fossils; off-white/limestone cream colour.

Sample 89/84A/068: Troy-Claremont Formation: tough, compact micrite, coarser microspar and sparry limestone; off white/cream colour with patches of grey; includes in-filled veins/cavities of clear orange brown "dog tooth" spar calcite.

Sample 89/84A/072: Somerset Formation: moderately consolidated, chalky fine grained biofragmental/foraminifera limestone; scattered dissolution porosity of small, often flat, thin fossil voids.

Sample 89/84A/075A: Troy-Claremont Formation: smooth, compact micrite with patch of cavity filling sugary calcite crystals; limestone cream-pinkish colour; sub-parallel stress jointing visible.

APPENDIX III
Land use in the Lluidas Vale area

A. Land use by farmers of the survey area in 17 villages and at Worthy Park Estate. Data from August 1988 Agricultural Census.

Villages:

1. Charlton
2. Charlton Drive
3. Coolshade
4. Dodds Valley
5. Ewarton
6. Grass Piece
7. Ivy
8. Lluidas Vale
9. Mt. Diablo
10. Mt. Rosser
11. Mt. Success
12. Polly Ground
13. Retirement
14. Riverhead
15. Top Hill
16. Tydixon
17. Tydixon Park
18. Worthy Park

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	M*
total # farmers	53	12	91	22	25	8	35	67	25	43	3	44	25	17	48	69	5	1	592
% male	83	92	79	100	88	50	57	81	88	77	100	73	76	88	73	71	100	100	81
% female	17	8	21	0	12	50	43	19	12	23	0	27	24	12	27	29	0	0	19
total # ha	127	6	218	33	25	6	32	60	40	34	9	31	50	15	86	131	28	740	991
# ha/farmer	2.4	0.5	2.4	1.5	1.0	0.8	0.9	0.9	1.6	0.8	3.1	0.7	2.0	0.9	1.8	1.9	5.6	740	1.7
% farms 0-0.4 ha	51	67	19	27	60	0	46	48	32	35	0	57	36	47	27	28	0	0	34
-do- 0.4-2 ha	28	33	46	64	28	100	46	45	52	65	33	36	48	47	54	46	20	0	47
-do- 2-4 ha	8	0	20	5	4	0	9	3	12	0	33	7	4	0	13	14	40	0	10
-do- 4-10 ha	8	0	11	0	8	0	0	4	0	0	33	0	8	6	4	9	0	0	5
-do- >10 ha	6	0	4	5	0	0	0	0	4	0	0	0	4	0	2	3	40	100	4
% farmers with crops/livestock:																			
bananas	38	33	80	27	56	75	83	25	68	74	100	34	47	76	77	41	20	0	58
sugar cane	6	0	54	55	4	13	0	54	0	0	33	0	58	29	58	16	80	100	27
coffee	26	8	62	36	32	50	54	10	60	47	100	45	37	35	65	39	0	0	38
cocoa	6	8	13	0	12	63	26	4	36	16	33	16	0	53	48	10	0	0	20
other	68	50	92	41	60	13	83	49	84	42	100	61	95	82	54	62	6	0	60
domestic crops	64	8	87	36	48	75	49	40	92	51	100	48	58	76	56	43	0	0	55
poultry (po.)	30	25	37	50	24	25	11	55	40	14	67	16	8	6	48	30	40	0	28
other livestock	68	25	57	73	52	25	26	60	40	26	67	45	56	65	71	61	100	100	54
#po./ all farm.	36	*	5	6	*	12	1	9	22	4	20	6	4	1	10	10	6	0	10
#po./po. farm.	119	*	14	12	*	48	10	16	55	30	31	38	45	10	21	31	15	0	33
# o. l./all farm.	4.8	1.8	2.8	1.9	4.6	0.6	0.8	2.2	2.6	1.1	2.7	2.0	3.3	3.7	3.8	3.3	8.4	1225	3.0
# o. l./o. l. farm.	7.1	7.2	4.8	2.6	8.9	1.5	3.1	3.7	6.5	4.4	4.0	4.4	4.5	5.7	5.4	5.5	8.4	1225	5.2

Data provided by Databank, Ministry of Agriculture; data sorted by Mr. Berrice Evans.

M*: mean values, leaving out Worthy Park Estate for all data and Charlton Drive and Ewarton for poultry/all farmers and poultry/poultry farmers.

* Charlton Drive has two farms with 10,000 heads of poultry each; Ewarton has one farm of 6,000 and one of 15,000 heads of poultry plus 1 resp. 4 small poultry farmers.

B. Acreage grown per crop (at the end of the specified month) by subsistence (subs.) farmers as well as by farmers of land lease projects (PLL). Information as provided by extension officers from the Land Authority Office in Linstead.

	Lluidas district			Ewarton district				
subs. or PLL	subs	subs	subs	subs	PLL	subs+PLL	subs	PLL
month	07	03	10	06		02	10	
year	89	89	88	89		89	88	
PULSES								
broad bean	6	6.5	2	3		1.5	1.5	
sugar bean	7.25	7.75	2.75	4.25		1.5	0.75	
cow peas	5	5		5	1.75		2	0.25
gungo peas	109	21	30	27	6.5	2.75	4	1.75
red peas	9	11	5	5.5	2.5	10	1	0.5
peanut	2	2.5		3		1.25	1	
Total	138.25	53.75	39.75	47.75	10.75	17.00	10.25	2.50
VEGETABLES								
cabbage	5.5	10	2	6.5		4	1.5	
calaloo	3.75	2.25	0.75	8.75		5.75	1.25	
carrot	14.5	14	7	0.50		0.5	1	
cho-cho	11.5	10	3	11.5		9	1	
cucumber				4.75		9	1	
lettuce				1.5		0.25		
okra	5.25	4.25	1	4.25		2		
pumpkin	14	12	6.25	26.5	23.75	41.5	3	1.5
string bean				0.75		0.75		
tomato	5.5	5.5	0.5	4.75	1	5.75	0.5	
turnip	9.25	2		0.75				
others						1.75		
Total	69.25	60.00	20.50	70.50	24.75	80.25	9.25	1.5
CONDIMENTS								
onion				2				
sweet pepper				1.75		1		
hot pepper	5.75		2	5.5		4.75	2	
thyme		4.5						
Total	5.75	4.5	2	9.25		5.75	2	

FRUITS								
pawpaw				7.75				
pineapple				23	3.25	21.75	20	1.75
Total				30.75	3.25	21.75	20	1.75
CEREALS								
corn	21	9	2	18	4.5	4.5	1	1.5
h. plantain	43	37	27	24.25	8.5	24.25	8.5	1.5
o. plantain	18	15.5	12	7.75		7.75	2	
Total	82	61.5	41	50.00	13	36.50	11.5	3
GROUND PROVISION								
irish potato		1.5						
sweet potato	31	34	30	9	2.75	11.25	10.5	5.25
lucea yam				3				
negro yam	85	44.5	44.5	12		2	6	
renta yam	98	48	30	55	17	15.5	18	9.5
st. vincent yam	59	79	25	75	16	4.25	15	3
tau yam	82	26	20					
yellow yam	84	19	24	13	2.25	3.5	5	
sweet yam				5				
white yam	14.5	7	7					
b. cassava	76	13	11	14	8.5	16.25	11	3
s. cassava	20.25	27.75	24.25	21	7	24.25	14	8.5
coco	24.25	24.75	23.5	3.25		0.75	8	2
dasheen	33	75	23	5.75	2	2.75	6	0.75
sorrel			4				16	
Total	607	399.5	266.25	216	55.5	80.5	109.5	32

APPENDIX IV

Soil profile descriptions and analytical data sheets

When reading the results of chemical and physical analyses, it should be kept in mind that these depend on the analyzing method and the way the analyses are performed. Compared to many other laboratories worldwide (LABEX 1989) results from the RPPD laboratory are relatively high for clay, exchangeable Mg and Na and relatively low for sand and CEC. $CaCO_3$, pH-H_2O, pH-KCl, organic carbon, exchangeable K and Ca and silt are within the acceptable range of deviation. Other analyses were not tested within this LABEX round.

The profile descriptions in Appendix IV are listed according to pit number as indicated on the map. The full number indicates the year of observation, the 1:12,500 toposheet and the number of observation during the survey. The presented profiles are considered representative for the following "Jamaican Series":

Pit no:	Series represented by the profile:
89/84C/**001**	Donnington variant II clay loam
88/84C/**003**	Brysons variant II clay
86/84C/**004**	Brysons variant I clay
86/84C/**010**	Lluidas variant I clay
90/84C/**014**	Bonnygate clay
89/84A/**046**	Rose Hall variant I silty clay
89/84A/**047**	Prospect variant I clay loam
89/84A/**054**	St. Ann variant I silty clay
89/84A/**066**	inclusion (like St. Ann variant I)
89/84A/**067**	inclusion (like Swansea)
89/84A/**068**	Swansea silty clay
89/84A/**084**	Linstead variant I clay loam
89/84A/**090**	Mount Rosser clay
88/84C/**098**	Rosemere variant I clay
88/84C/**099**	Riverhead clay
88/84C/**105**	Union Hill variant I clay
88/84C/**107**	Lluidas variant II loam
88/84C/**108**	Mountain Hill clay
88/84C/**109**	Pennants variant I clay loam
88/84C/**110**	Tydixon sandy loam
88/84C/**111**	Knollis clay loam
88/84C/**112**	Lluidas loam - silty loam

Profile no.	**89/84C/001**
Map unit	BF1
USDA (1987)	Typic Eutropept
Family	loamy-skeletal, mixed, isohyperthermic
Series	**Donnington variant II**
FAO/UNESCO (1988)	Eutric Regosol, medium textured
Location	Worthy Park Estate, St. Catherine toposheet 84C, 450329 N, 503092 E
Parent material/rock	fluvio-colluvial deposition (conglomerate) of original Central Inlier material
Physiographic position	hilly outcrop in inland basin, bordering the limestone hills
Topography	hilly (around 30% slope)
Elevation	about 380 m above MSL
Land use	citrus plantation
Drainage class	well drained
Moisture condition	dry throughout
Surface stoniness/ rock outcrop	some protruding limestone outcrops
Described by	L.L.T. Dawkins and P. van Gent
Date	05-04-89
Remarks	-

(All colours are for dry conditions)

Ah *0-24/36 cm* (dark) brown (10YR 4/3) gravelly clay loam; weak very fine to coarse granular structure; slightly sticky and plastic when wet, slightly hard when dry; common very fine and few fine and medium pores; common very fine and fine and few medium and coarse roots; some ant activity; weathered remnants of stone sized weathering conglomerates; slightly calcareous; clear wavy boundary to

CB *24/36-80 cm* mixed strong brown (7.5YR 5/8), yellow (10YR 7/6), reddish brown (5YR 4/4) and reddish grey (5YR 5/2) gravelly loam with gravel and stone sized light yellowish brown (10YR 6/4) and brownish yellow (10YR 6/8) pockets of weathering conglomerates; structureless; common very fine pores; very few very fine roots; slightly calcareous; gradual smooth boundary to

C *80-138 cm* reddish grey (5YR 5/2) gravelly loam with big brownish yellow (10YR 6/8) pockets and few smaller grey (10YR 6/1) and dark reddish brown (5YR 2.5/2) pockets; structureless; no pores, roots or other biologic activity; slightly calcareous

Profile no: 89/84C/001
Soil series: Donnington variant II
Lab no: 67/89

depth (cm)	particle size sand (%)	silt (%)	clay (%)	texture	natural clay (%)	dispersion-ratio* (%)	org. C (%)	N (%)	C/N
0 -24/30	26	45	29	CL	-	-	1.7	0.15	11
24/30-80	30	45	25	L	-	-	0.2	0.01	20

depth (cm)	CaCO3 (%)	pH H2O 1:2.5	pH KCl 1:2.5	EC2.5 mS/cm	ESP* (%)	SAR*	av. P2O5 (ppm)	av. K2O (ppm)
0 -24/30	-	4.8	3.4	0.14	3	-	36	>400
24/30-80	-	5.3	3.3	0.08	4	-	7	60

depth (cm)	exchangeable bases Ca2+ (me/100 g)	Mg2+	Na+	K+	sum	exchangeable acidity (me/100 g)	Al3+	CEC (NH4OAc) soil (me/100 g)	clay*	base sat.* (%)
0 -24/30	6.3	11.19	0.64	1.19	19.3	7.19	7.19	22.6	78	85
24/30-80	3.1	17.07	0.93	0.19	21.3	11.51	11.51	23.5	94	91

depth (cm)	ECEC soil (%)	clay*	Al. sat.* (%)	bulk density (g/cubic cm)	pF 1.0 (vol. %)	2.0	4.2	available moisture* (vol. %)
0 -24/30	26.5	91	27	-	-	-	-	-
24/30-80	32.8	134	35	-	-	-	-	-

\- not determined
* derived value
(about 7 kg organic carbon per cubic meter)

Profile no.	**88/84C/003**
Map unit	BFy1
USDA (1987)	Aquentic Chromudert
Family	very fine, mixed, isohyperthermic
Series	**Brysons variant II**
FAO/UNESCO (1988)	Eutric Vertisol, fine textured
Location	Worthy Park Estate, St. Catherine; toposheet 84C, 450720 N, 492830 E
Parent material/rock	fine textured lacustrine deposits
Physiographic position	margin of inland basin protruding into limestone hills
Topography	almost flat (0-2% slope)
Elevation	about 370 m above MSL
Land use	unimproved pasture
Drainage class	imperfectly drained
Moisture condition	moist below topsoil
Surface stoniness/rock outcrop	nil
Described by	M. Ahmed, D. Buckley, L.L.T. Dawkins, G. Ford, D. Phillips, H. Smith and P.White
Date	15-06-88
Remarks	notably high Mg2+ contents

(All colours are for moist conditions,unless otherwise stated)

Ah *0-17 cm* dark brown (10YR 3/3), (dark) brown (10YR 4/3) when dry, clay; moderately strong coarse and medium subangular blocky structure; sticky and plastic when wet, very firm when moist, very hard when dry; few medium and fine pores; common fine roots; few worm casts; many round hard Fe-concretions; field pH 6; non calcareous; clear smooth boundary to

CA *17-40 cm* mixed yellowish brown (10YR 5/8) and dark brown (10YR 3/3) heavy clay; moderate medium subangular blocky structure; sticky and plastic when wet, very firm when moist; presence of slickensides; common medium and fine pores; few fine roots; few worm casts; many round hard Fe-concretions; field pH 6; non calcareous; clear smooth boundary to

Cg *40-125 cm* mixed yellowish brown (10YR 5/6) and light grey (10YR 7/2) heavy clay with many coarse distinct red (2.5YR 4/8) mottles; moderate medium subangular blocky structure; sticky and plastic when wet, firm when moist; presence of intersecting slickensides; common fine pores; few fine roots, few worm casts; few small Fe-Mn-concretions; field pH 4; non calcareous

Profile no: 88/84C/003
Soil series: Brysons variant II
Lab no: 120/88

depth (cm)	particle size: sand (%)	silt (%)	clay (%)	texture	natural clay (%)	dispersion-ratio* (%)	org. C (%)	N (%)	C/N
0- 17	8	13	78	C	-	-	3.2	0.35	9
17- 40	7	1	92	C	-	-	0.9	0.12	8
40-125	5	5	90	C	-	-	0.3	0.04	8

depth (cm)	CaCO3 (%)	pH H2O 1:2.5	pH KCl 1:2.5	EC2.5 mS/cm	ESP* (%)	SAR*	av. P2O5 (ppm)	av. K2O (ppm)
0- 17	-	6.7	5.3	0.08	1	-	21	92
17- 40	<0.50	7.4	5.4	0.06	1	-	19	55
40-125	-	4.9	3.5	0.19	2	-	16	55

depth (cm)	exchangeable bases (me/100 g): Ca2+	Mg2+	Na+	K+	sum	exchangeable (me/100 g): acidity	Al3+	CEC (NH4OAc) (me/100 g): soil	clay	base sat.* (%)
0- 17	19.5*	11.58	0.26	0.24	31.6*	-	-	31.6	41	100
17- 40	16.2*	10.92	0.31	0.18	27.6*	-	-	27.6	30	100
40-125	12.4	10.92	0.66	0.22	24.2	8.47	7.93	28.6	32	85

depth (cm)	ECEC* (me/100 g): soil	clay	Al. sat.* (%)	bulk density (g/cubic cm)	pF (vol. %): 1.0	2.0	4.2	available moisture* (vol. %)
0- 17	-	-	-	-	-	-	-	-
17- 40	-	-	-	-	-	-	-	-
40-125	32.7	36	24	-	-	-	-	-

- not determined
* derived value
(about 13 kg organic carbon per cubic meter)

Profile no.	**86/84C/004**
Map unit	BFy1
USDA (1987)	Entic Chromudert
Family	very fine, montmorillonitic, isohyperthermic
Series	**Brysons variant I**
FAO/UNESCO (1988)	Eutric Vertisol, fine textured
Location	Tydixon Park, St. Catherine; toposheet 84C , 456776 N, 461316 E
Parent material/rock	fine textured lacustrine deposits, influenced by surrounding limestone
Physiographic position	inland basin
Topography	almost flat (<2 % slope)
Elevation	about 360 m above MSL
Land use	citrus
Drainage class	imperfectly drained
Moisture condition	dry throughout
Surface stoniness/rock outcrop	nil
Described by	M. Ahmed, L. Dawkins, G. Ford and M. Gray
Date	28-08-86
Remarks	cracks, about 1 cm wide, to a depth of 50 cm; slickensides are likely to intersect; remarkable high Mg and K levels

(All colours are for moist conditions, unless otherwise stated)

Ap *0-22 cm* very dark greyish brown (10YR 3/2), dark greyish brown (10YR 4/2) when dry, clay; moderate medium (sub)angular blocky parting into strong fine angular blocky structure; sticky and plastic when wet, firm when moist, very hard when dry; many cutans (slickensides?); common medium and coarse pores; common fine and medium roots; common worm casts; field pH 6.5; calcareous; abrupt broken boundary to

CA *22-40 cm* yellowish brown (10YR 5/6) clay; strong coarse angular blocky structure; sticky and plastic when wet, firm when moist; common to many pressure faces and slickensides; common medium to coarse pores; few fine and medium roots; common worm casts; common hard rounded brown and black Fe-Mn concretions; calcareous limestones; field pH 8; calcareous; gradual broken boundary to

Cu1 *40-90 cm* brownish yellow (10YR 6/6) clay; strong coarse angular blocky structure; sticky and plastic when wet, firm when moist; common to many pressure faces and slickensides; few pores; few fine and medium roots; field pH 8.5; strongly calcareous; gradual smooth boundary to

Cu2 *90-140 cm* brownish yellow (10YR 6/8) clay; moderate fine and medium subangular blocky structure; sticky and plastic when wet, firm when moist; common hard rounded black Fe-Mn concretions; strongly calcareous

Profile no: 86/84C/004
Soil series: Brysons variant I
Lab no: 203/86

depth (cm)	particle size sand (%)	silt (%)	clay (%)	texture	natural clay (%)	dispersion-ratio* (%)	org. C (%)	N (%)	C/N
0-22	6	33	61	C	-	-	3.4	0.26	13
22-40	8	32	60	C	-	-	0.5	0.05	10
40-90	9	35	56	C	-	-	0.3	0.03	10
90-140	5	30	65	C	-	-	0.1	0.01	10

depth (cm)	CaCO3 (%)	pH H20 1:2.5	KCl 1:2.5	EC2.5 mS/cm	ESP* (%)	SAR*	av. P205 (ppm)	av. K20 (ppm)
0-22	<0.5	6.8	5.9	0.19	<1	-	18	198
22-40	9.2	8.2	7.2	0.12	1	-	6	136
40-90	2.3	8.2	7.2	0.17	1	-	4	132
90-140	7.0	8.2	7.2	0.28	2	-	4	104

depth (cm)	exchangeable bases (me/100 g) Ca2+	Mg2+	Na+	K+	sum	exchangeable (me/100 g) acidity	Al3+	CEC (NH4OAc) (me/100 g) soil	clay	base sat.* (%)
0-22	34.4	11.02	0.11	0.43	46.0	-	-	47.2	77	97
22-40	24.7*	13.09	0.26	0.36	38.4*	-	-	38.4	64	100
40-90	16.8*	19.98	0.52	0.34	37.6*	-	-	37.6	67	100
90-140	14.6*	24.98	0.87	0.37	40.8*	-	-	40.8	63	100

depth (cm)	ECEC* (me/100 g) soil	clay	Al. sat.* (%)	bulk density (g/cubic cm)	pF (vol. %) 1.0	2.0	4.2	available moisture* (vol. %)
0-22	-	-	-	-	-	-	-	
22-40	-	-	-	-	-	-	-	-
40-90	-	-	-	-	-	-	-	-
90-140	-	-	-	-	-	-	-	-

- not determined
* derived value
(about 14 kg organic carbon per cubic meter)

Profile no.	**86/84C/010**
Map unit	PRx1
USDA (1987)	Typic Hapludoll
Family	(very) fine, mixed, isohyperthermic
Series	**Lluidas variant I**
FAO/UNESCO (1988)	Haplic Phaozem, fine textured
Location	Worthy Park Estate, St. Catherine; toposheet 84C, 452340 N, 503460 E
Parent material/rock	recent alluvial deposits of the Rio Cobre, originating from different sources
Physiographic position	river plain in inland basin
Topography	almost flat (0-2% slope)
Elevation	about 355 m above MSL
Land use	citrus plantation
Drainage class	moderately well drained
Moisture condition	moist throughout
Surface stoniness/rock outcrop	not gravelly in this place, gravelly in other places
Described by	G. Ford, M. Gray and M. Sharif
Date	26-11-86
Remarks	area is prone to flooding after heavy showers

(All colours are for moist conditions)

Ah *0-20 cm* dark brown (7.5YR 3/2) clay; weak coarse subangular blocky, parting into medium subangular blocky structure; sticky and plastic when wet, firm when moist, very hard when dry; few fine and very fine tubular pores; common fine roots; few worms and worm casts; clear smooth boundary to

Bw *20-45 cm* dark brown to brown (7.5YR 4/2); weak coarse subangular blocky structure; sticky and plastic when wet, firm when moist; patchy very thin cutans; few fine and very fine pores; few fine and very fine roots; common worm casts; gradual smooth boundary to

Cg1 *45-81 cm* dark brown to brown (7.5YR 4/2) silty clay with few fine faint dark yellowish brown (10YR 5/6) mottles; structureless (massive); sticky and plastic when wet, firm when moist; few very fine pores; few very fine roots; many small (1-3 mm) soft Fe-Mn-nodules and common black Mn-stains; clear wavy boundary to

Cg2 *81-120 cm* mixed strong brown (7.5YR 5/6) and brown (7.5YR 5/2) (sandy) clay loam; structureless (massive); slightly sticky and plastic when wet, friable when moist; common fine and very fine pores; clear smooth boundary to

2Cg *120-150 cm* mixed dark brown to brown (10YR 4/3) and little brownish yellow (10YR 6/8) and strong brown (7.5YR 4/6), crushed (10YR 4/3), sandy clay loam; structureless (massive); non sticky and non plastic when wet, friable when moist, soft when dry; few fine pores

Profile no: 86/84C/010
Soil series: Lluidas variant I
Lab no: 254/86

depth (cm)	particle size sand (%)	silt (%)	clay (%)	texture	natural clay (%)	dispersion-ratio* (%)	org. C (%)	N (%)	C/N
0-20	2	35	63	C	-	-	1.5	0.16	9
20-45	1	32	67	C	-	-	0.6	0.08	8
45-81	12	43	45	SiC	-	-	0.1	0.04	3
81-120	39	30	31	CL	-	-	0.1	0.03	3
120-150	55	22	23	SCL	-	-	0.1	0.03	3

depth (cm)	CaCO3 (%)	pH H2O 1:2.5	pH KCl 1:2.5	EC2.5 mS/cm	ESP* (%)	SAR*	av. P2O5 (ppm)	av. K2O (ppm)
0-20	-	6.3	6.0	-	1	-	23	118
20-45	-	7.0	5.0	-	2	-	19	99
45-81	0.70	7.3	4.9	-	3	-	33	72
81-120	0.57	7.2	4.7	-	3	-	184	45
120-150	0.68	7.2	4.5	-	3	-	74	33

depth (cm)	exchangeable bases (me/100 g) Ca2+	Mg2+	Na+	K+	sum	exchangeable (me/100 g) acidity	Al3+	CEC (NH4OAc) (me/100 g) soil	clay	base sat.* (%)
0-20	21.5*	9.0	0.32	0.34	31.2*	-	-	31.2	50	100
20-45	21.0*	10.6	0.49	0.33	32.4*	-	-	32.4	48	100
45-81	16.6*	9.9	0.70	0.24	27.4*	-	-	27.4	61	100
81-120	14.0*	8.0	0.66	0.14	22.8*	-	-	22.8	74	100
120-150	12.6*	7.1	0.63	0.10	20.4*	-	-	20.4	89	100

depth (cm)	ECEC* (me/100 g) soil	clay	Al. sat.* (%)	bulk density (g/cubic cm)	pF (vol. %) 1.0	2.0	4.2	available moisture* (vol. %)
0-20	-	-	-	-	-	-	-	-
20-45	-	-	-	-	-	-	-	-
45-81	-	-	-	-	-	-	-	-
81-120	-	-	-	-	-	-	-	-
120-150	-	-	-	-	-	-	-	-

- not determined
* derived value
(about 7 kg organic carbon per cubic meter)

Profile no.	**90/84C/014**
Map unit	HLx1-3, HLx5-7
USDA (1987)	Lithic Oxic Eutropept
Family	clayey-skeletal, mixed, isohyperthermic.
Series	**Bonnygate**
FAO/UNESCO (1988)	Eutric Leptosol, fine textured
Location	Thetford Mountains, St. Catherine; toposheet 84C, 457942 N, 511152 E
Parent material/rock	On top of White limestone (Troy-Claremont) and colluvium thereof
Physiographic position	complex midslope on faultline
Topography	steep (> 50% slope)
Elevation	about 350 m above MSL
Land use	very few mixed cropping plots in between secondary forest
Drainage class	excessively drained
Moisture condition	moist throughout
Surface stoniness/rock outcrop	rocky and stony
Described by	B. Evans and P. van Gent
Date	28-03-90
Remarks	due to late availability of the laboratory data, no land evaluation has been carried out for this soil.

(All colours are for moist conditions)

Ah *0-8 cm* dark yellowish brown (10YR 4/4) stony clay with some blackish mottles; moderate very fine subangular blocky structure; sticky and slightly plastic when wet, friable when moist; common fine and medium pores; abundant very fine and fine roots; high fauna activity; field pH 8.0; strongly calcareous; gradual wavy boundary to

Bw *8-25 cm* dark yellowish brown (10YR 4/4) clay; moderately fine angular blocky structure; sticky and plastic when wet, friable when moist; common fine pores; many very fine and fine roots and few coarse roots; high fauna activity; field pH 8.0; strongly calcareous

R hard limestone with extension of the Bw horizon in wide crevices to 40-50 cm

Profile no: 90/84C/014
Soil series: Bonnygate
Lab no: 36/90

depth (cm)	particle size sand (%)	silt (%)	clay (%)	texture	natural clay (%)	dispersion-ratio* (%)	org. C (%)	N (%)	C/N
0-8	16	29	55	C	-	-	0.9	0.46	2
8-25	10	27	63	C	-	-	0.8	0.45	2

depth (cm)	CaCO3 (%)	pH H2O 1:2.5	KCl 1:2.5	EC2.5 mS/cm	ESP* (%)	SAR*	av. P2O5 (ppm)	av. K2O (ppm)
0-8	8.67	8.4	7.5	0.09	2.61	-	9	284
8-25	9.13	8.3	7.5	0.09	1.65	-	5	217

depth (cm)	exchangeable bases (me/100 g) Ca2+	Mg2+	Na+	K+	sum	exchangeable (me/100 g) acidity	Al3+	CEC (NH4OAc) (me/100 g) soil	clay	base sat.* (%)
0-8	5.5*	8.73	0.40	0.64	15.3*	-	-	15.3	28	100
8-25	9.1*	6.45	0.27	0.49	16.3*	-	-	16.3	26	100

depth (cm)	ECEC* (me/100 g) soil	clay	Al. sat.* (%)	bulk density (g/cubic cm)	pF (vol. %) 1.0	2.0	4.2	available moisture* (vol. %)
0-8	-	-	-	-	-	-	-	-
8-25	-	-	-	-	-	-	-	-

- not determined
* derived value
(very low in organic carbon per cubic meter)

Profile no.	**89/84A/046**
Map unit	PFy1
USDA (1987)	Vertic Eutropept
Family	fine, mixed, isohyperthermic
Series	**Rose Hall variant I**
FAO/UNESCO (1988)	Eutric Fluvisol, fine textured
Location	Ewarton Nursery Ltd., St. Catherine toposheet 84A, 462303 N, 515789 E
Parent material/rock	mixed recent alluvium with admixtures of limestone colluvium
Physiographic position	inland basin
Topography	almost flat (2% slope)
Elevation	about 255 m above MSL
Land use	citrus plantation
Drainage class	moderately well drained
Moisture condition	moist throughout
Surface stoniness/rock outcrop	-
Described by	L.L.T. Dawkins and P. van Gent
Date	16-03-89
Remarks	cracks to a depth of 25 cm, not wider than 1 cm; profile shows original stratification in subsoil, with several sandy layers

(All colours are for moist conditions; auger hole description from 150 cm onwards)

Ah *0-32/44 cm* (may extend to 58 cm) dark greyish brown (10YR 4/2) silty clay (field: clay loam to clay); weak coarse subangular blocky structure; slightly sticky and slightly plastic when wet, very firm when moist; few pressure faces; common very fine and fine and few medium pores; frequent very fine to medium roots; few worms and some ant-activity; few small hard round black Mn-concretions; non calcareous; clear irregular boundary to

AC *32/44-61 cm* yellowish red (5YR 5/6) silty clay with common coarse distinct (dark) brown (10YR 4/3) coatings of topsoil on peds; weak medium to coarse subangular blocky structure; slightly sticky and slightly plastic when wet, very firm when moist; some black-red coated worm channels; few pressure faces; many very fine and fine, few medium and very few coarse pores; common very fine and fine roots; few worm casts; non calcareous; clear smooth boundary to

C *61-73 cm* yellowish red (5YR 5/6, colour of the rubbed soil) loam with small quartz and blackish grains; weak very fine to coarse granular structure; slightly sticky and slightly plastic when wet, very friable when moist; many very fine and fine pores as well as some former root channels; few worm casts; slightly calcareous; clear smooth boundary to

Cg1 *73-91 cm* yellowish red (5YR 5/6) silty clay loam with few fine to medium faint very pale brown (10YR 7/3) mottles and few fine distinct Mn-stains; weak medium to coarse subangular blocky structure; slightly sticky and slightly plastic to plastic when wet, very firm when moist; few coated worm channels; few pressure faces; many very fine and fine and few medium and coarse pores; slightly calcareous; clear smooth boundary to

Cg2 *91-112 cm* yellowish red (5YR 5/6) silty clay with common medium distinct light yellowish brown (10YR 6/4) mottles; weak medium and fine subangular blocky structure; slightly sticky to sticky and slightly plastic when wet, very firm when moist; few pressure faces; many micro to fine and few medium pores; slightly calcareous; clear smooth boundary to (see page A60)

Profile no: 89/84A/046
Soil series: Rose Hall variant I
Lab no: 51/89

depth (cm)	particle size sand (%)	silt (%)	clay (%)	texture	natural clay (%)	dispersion-ratio* (%)	org. C (%)	N (%)	C/N
0-32/44	4	45	52	SiC	27	60	1.6	0.14	11
32/44-61	1	44	55	SiC	30	55	0.4	0.03	13
61- 73	47	29	24	L	10	42	0.2	0.01	20
73- 91	14	48	38	SiCL	15	39	0.2	0.01	20
91-112	4	48	48	SiC	21	44	0.2	0.01	20
112-129	57	26	17	SL	8	47	0.1	0.01	10
129-150	8	53	39	SiCL	17	44	0.1	0.01	10

depth (cm)	CaCO3 (%)	pH H20 1:2.5	pH KCl 1:2.5	EC2.5 mS/cm	ESP* (%)	SAR*	av. P205 (ppm)	av. K20 (ppm)
0-32/44	-	7.2	5.9	0.07	1	-	21	298
32/44-61	-	5.8	3.7	0.02	1	-	20	179
61- 73	-	5.9	3.9	0.03	1	-	34	96
73- 91	<0.5	5.9	3.7	0.02	1	-	35	128
91-112	-	6.2	4.7	0.11	1	-	49	143
112-129	<0.5	6.9	5.3	0.05	1	-	105	58
129-150	-	6.2	4.0	0.03	1	-	103	109

depth (cm)	exchangeable bases Ca2+ (me/100 g)	Mg2+	Na+	K+	sum	exchangeable acidity (me/100 g)	Al3+	CEC (NH4OAc) soil (me/100 g)	clay*	base sat. (%)
0-32/44	41.6*	13.45	0.65	1.05	56.7*	-	-	56.7	109	100
32/44-61	45.6*	17.38	0.96	0.74	64.7*	-	-	64.7	118	100
61- 73	-	11.79	0.33	0.29	-	1.53	1.37	33.1	138	-
73- 91	-	13.65	0.59	0.47	-	0.74	0.62	48.1	127	-
91-112	-	18.07	0.71	0.65	-	1.54	1.52	64.9	135	-
112-129	21.7*	7.27	0.31	0.18	29.5*	-	-	29.5	174	100
129-150	44.6*	13.80	0.65	0.43	59.5*	-	-	59.5	153	100

depth (cm)	ECEC soil (me/100 g)	clay*	Al sat.* (%)	bulk density (g/cubic cm)	pF 1.0 (vol. %)	2.0	4.2	available moisture* (vol. %)
0-32/4	-	-	-	1.3	-	-	-	-
32/44-61	-	-	-	-	-	-	-	-
61- 73	-	-	-	1.5	-	-	-	-
73- 91	-	-	-	-	-	-	-	-
91-112	-	-	-	1.3	-	-	-	-
112-129	-	-	-	-	-	-	-	-
129-150	-	-	-	-	-	-	-	-

- not determined
* derived value
(about 10 kg organic carbon per cubic meter)

Profile no.	**89/84A/047**
Map unit	PFy1
USDA (1987)	Typic Hapludoll
Family	fine loamy, mixed, isohyperthermic
Series	**Prospect variant I**
FAO/UNESCO (1988)	Eutric Fluvisol, medium textured
Location	Ewarton Nursery Ltd, St. Catherine toposheet 84A, 463421 N, 515329 E
Parent material/rock	mixed recent alluvium and some Limestone colluvium
Physiographic position	inland basin, bordering the limestone hills
Topography	almost flat (1 % slope)
Elevation	about 265 m above MSL
Land use	citrus plantation
Drainage class	well drained
Moisture condition	moist throughout
Surface stoniness/rock outcrop	-
Described by	L.L.T. Dawkins and P. van Gent
Date	16-03-89
Remarks	profile shows stratification in subsoil; no cracks

(All colours are for moist conditions)

Ah *0-22 cm* very dark brown (10YR 2/2) clay loam; weak fine to coarse subangular blocky structure; slightly sticky and slightly plastic when wet, friable when moist; few cutans around concretions and in root channels; common very fine to medium pores; few very fine to medium roots; common worm and ant activity; very few small hard round black Mn-concretions; few limestone gravels; non calcareous; gradual irregular boundary to

AC *22-44 cm* yellowish red (5YR 5/6) clay loam with many medium distinct very dark greyish brown (10YR 3/2) mottles; weak medium and coarse subangular blocky structure; slightly sticky and slightly plastic when wet, friable when moist; black-grey cutans of topsoil in root channels and on ped surfaces; common very fine to medium pores; common very fine to coarse roots; common worm casts; few limestone gravels; slightly calcareous matrix; clear smooth boundary to

C1 *44-63 cm* strong brown (7.5YR 4/6, colour of rubbed soil) sandy loam; moderately weak fine to coarse subangular blocky structure; slightly sticky and slightly plastic when wet, very friable when moist; grey cutans on ped surfaces; some Mn-stains; common very fine to medium pores; common very fine and fine roots; few worm casts; few limestone gravels; slightly calcareous matrix; clear smooth boundary to

C2 *63-90 cm* reddish brown to yellowish red (5YR 5/5) clay loam (field: clay); moderately weak medium to very coarse subangular blocky structure; slightly sticky to sticky and plastic when wet, very firm when moist; cutans in pores (former root channels); some Mn-stains; many micro and very fine, common fine and few medium pores; common fine to coarse roots; slightly calcareous matrix; clear smooth boundary to

C3 *90-138 cm* strong brown (7.5YR 4/6, colour of rubbed soil) sandy loam; weak fine and coarse subangular blocky structure; slightly sticky and slightly plastic when wet, very friable when moist; cutans (hardly visible) in former root channels; many micro to fine pores; common limestone gravels and grains; slightly calcareous matrix; abrupt smooth boundary to (see page A60)

Profile no: 89/84A/047
Soil series: Prospect variant I
Lab no: 52/89

depth (cm)	particle size sand (%)	silt (%)	clay (%)	texture	natural clay (%)	dispersion-ratio* (%)	org. C (%)	N (%)	C/N
0-22	42	29	29	CL	15	52	1.8	0.14	13
22-44	41	28	31	CL	14	45	0.6	0.05	12
44-63	66	18	16	SL	8	50	0.2	0.02	10
63-90	28	35	37	CL	16	43	0.2	0.01	20
90-138	68	16	16	SL	6	40	0.1	0.01	10
138-150	45	34	21	C	6	29	0.1	0.01	10

depth (cm)	CaCO3 (%)	pH H2O 1:2.5	pH KCl 1:2.5	EC2.5 mS/cm	ESP* (%)	SAR*	av. P2O5 (ppm)	av. K2O (ppm)
0-22	<0.5	6.8	5.6	0.06	1	-	25	101
22-44	-	5.9	3.8	0.05	1	-	10	104
44-63	<0.5	6.3	4.1	0.17	1	-	75	67
63-90	<0.5	5.9	3.8	0.25	1	-	42	103
90-138	-	6.9	5.1	0.06	1	-	148	44
138-150	13.3	8.9	7.0	0.07	1	-	57	61

depth (cm)	exchangeable bases (me/100 g) Ca2+	Mg2+	Na+	K+	sum	exchangeable (me/100 g) acidity	Al3+	CEC (NH4OAc) (me/100 g) soil	clay*	base sat.* (%)
0-22	24.0*	7.15	0.33	0.28	31.8*	-	-	31.8	110	100
22-44	-	8.20	0.42	0.29	-	0.78	0.68	34.7	112	-
44-63	15.6*	4.71	0.29	0.19	20.8*	-	-	20.8	130	100
63-90	-	8.65	0.56	0.35	-	1.10	1.05	42.5	115	-
90-138	15.3*	3.14	0.24	0.11	18.8*	-	-	18.8	125	100
138-150	28.8*	2.36	0.36	0.18	31.7*	-	-	31.7	151	100

depth (cm)	ECEC (me/ 100 g) soil	clay*	Al sat.* (%)	bulk density (g/cubic cm)	pF (vol. %) 1.0	2.0	4.2	available moisture* (vol. %)
0-22	-	-	-	1.4	-	-	-	-
22-44	-	-	2	-	-	-	-	-
44-63	-	-	-	1.6	-	-	-	-
63-90	-	-	2	1.5	-	-	-	-
90-138	-	-	-	-	-	-	-	-
138-150	-	-	-	-	-	-	-	-

- not determined
* derived value
(about 10 kg organic carbon per cubic meter)

Profile no.	**89/84A/054**
Map unit	HLx1-3, HLx7
USDA (1987)	Kandiudalfic Rhodic Eutrudox
Family	clayey, gibbsitic, isohyperthermic
Series	**St. Ann variant I**
FAO/UNESCO (1988)	Rhodic Ferralsol, fine textured
Location	Tydixon (Swansea), St. Catherine toposheet 84A, 468553 N, 497830 E
Parent material/rock	on top of White Limestone (Troy-Claremont Fm) and colluvium thereof
Physiographic position	just half way at escarpment of Lluidas Vale fault
Topography	very steep (> 50% slope)
Elevation	about 485 m above MSL
Land use	sugar cane and mixed tree crops
Drainage class	well drained
Moisture condition	moist to about 1 m; dry below 1 m
Surface stoniness/rock outcrop	rocky
Described by	L.L.T. Dawkins and P. van Gent
Date	04-04-89
Remarks	road cut along the road from Worthy Park to Camperdown; laboratory texture more clayey than field texture.

(All colours are for moist conditions, unless otherwise stated)

Ah *0-25 cm* dark reddish brown (2.5YR 3/4), red (2.5YR 4/8) when dry, silty clay loam (field: clay loam) weak very fine to medium granular structure; slightly sticky and slightly plastic when wet, loose when dry; many very fine and fine pores; very frequent very fine and few medium and coarse roots; (very) stony (50%); slightly calcareous; abrupt wavy boundary to

BA *25-45 cm* dark red (2.5 YR 3/6), red (2.5 YR 4/6) when dry, clay; moderate fine to coarse subangular blocky structure; slightly sticky and slightly plastic when wet, slightly hard when dry; no cutans on structure elements, only some coated wormholes; common very fine and fine and very few medium pores (former root channels); frequent very fine roots; slightly calcareous; clear wavy boundary to

Bs1 *45-110 cm* dark red (2.5YR 3/4), red (2.5YR 4/6) when dry, clay; moderately weak medium to very coarse (>15 cm) subangular blocky structure; slightly sticky and slightly plastic when wet, hard when dry; no cutans on the ped surfaces,only some coated worm holes; very few medium and common very fine and fine pores (former root channels); common very fine roots; slightly calcareous; diffuse wavy boundary to

Bs2 *110-160 cm* dark red (2.5YR 3/4), red (2.5YR 4/6) when dry, clay; massive; slightly sticky and slightly plastic when wet, hard when dry; few very fine and fine pores and few medium pores of biologic origin (worm activity?); slightly calcareous

Profile no: 89/84A/054
Soil series: St. Ann variant I
Lab no: 66/89

depth (cm)	particle size sand (%)	silt (%)	clay (%)	texture	natural clay (%)	dispersion-ratio* (%)	org. C (%)	N (%)	C/N
0 - 25	1	54	45	SiC	3	7	3.1	0.25	12
25- 45	1	35	64	C	4	6	1.0	0.10	10
45-110	1	36	63	C	6	10	0.4	0.04	10
110-160	1	27	72	C	2	3	0.3	0.03	10

depth (cm)	CaCO3 (%)	pH H20 1:2.5	KCl 1:2.5	EC2.5 mS/cm	ESP* (%)	SAR*	av. P205 (ppm)	av. K20 (ppm)
0 - 25	<0.5	7.5	6.6	0.06	1	-	4	66
25- 45	<0.5	7.6	6.8	0.04	2	-	6	23
45-110	<0.5	8.0	7.2	0.04	2	-	12	10
110-160	<0.5	7.3	6.7	0.05	3	-	13	25

depth (cm)	exchangeable bases (me/100 g) Ca2+	Mg2+	Na+	K+	sum	exchangeable (me/100 g) acidity	Al3+	CEC (NH4OAc) (me/100 g) soil	clay*	base sat.* (%)
0 - 25	12.4*	1.66	0.12	0.14	14.3*	-	-	14.3	32	100
25- 45	4.3*	0.21	0.07	0.07	4.6*	-	-	4.6	7	100
45-110	3.0*	0.10	0.05	0.03	3.2*	-	-	3.2	5	100
110-160	3.2*	0.31	0.12	0.06	3.7*	-	-	3.7	4	100

depth (cm)	ECEC soil (%)	clay*	Al. sat.* (%)	bulk density (g/cubic cm)	pF 1.0 (vol. %)	2.0	4.2	available moisture* (vol. %)
0 - 25	-	-	-	-	-	-	-	-
25- 45	-	-	-	-	-	-	-	-
45-110	-	-	-	-	-	-	-	-
110-160	-	-	-	-	-	-	-	-

- not determined
* derived value
(about 14 kg organic carbon per cubic meter)

Profile no.	**89/84A/066**
Map unit	HLx1, HLx3
USDA (1987)	Kandiudalfic Eutrudox
Family	clayey, gibbsitic, isohyperthermic
Series	**inclusion**
FAO/UNESCO (1988)	Haplic Ferralsol, fine textured
Location	between Worthy Park and Tydixon, St Catherine toposheet 84A , 466711 N, 498092 E
Parent material/rock	on top of White Limestone (Troy-Claremont Fm) and colluvium thereof
Physiographic position	very small valley-bottom
Topography	almost flat (2% slope)
Elevation	about 450 m above MSL
Land use	small farmers' bananas and sugar cane
Drainage class	well drained
Moisture condition	moist throughout
Surface stoniness/rock outcrop	rocky at the surrounding slopes
Described by	L.L.T. Dawkins and P. van Gent
Date	11-04-1989
Remarks	laboratory textures are more clayey than field textures; soil is closely related to St. Ann variant I soils

(All colours are for moist conditions, unless otherwise stated)

Ah *0-21 cm* reddish brown (5YR 4/4), yellowish red (5YR 4/6) when dry, clay loam; weak very fine to medium subangular blocky and granular structure; slightly sticky and slightly plastic when wet, friable when moist; some cutans, but difficult to see because of granular structure; many very fine and fine and few medium pores; abundant fine and common coarse roots; some ants and few worm channels; non calcareous; abrupt to clear smooth boundary to

Bs1 *21-92 cm* reddish brown (2.5YR 4/4), red (2.5YR 4/6) when dry, clay; weak very fine to medium subangular blocky structure; sticky and slightly plastic when wet, firm when moist; black and topsoil coloured patchy thin clay-humus cutans in former root channels; many very fine and fine and few medium pores; common very fine and fine roots; few worm casts; non calcareous; diffuse wavy boundary to

Bs2 *92-165 cm* reddish brown (2.5YR 3.5/4), red (2.5YR 4.5/6) when dry, clay; weak fine to coarse subangular blocky structure; sticky and slightly plastic when wet, firm when moist; few very fine and fine pores; very few very fine roots; slightly calcareous

Profile no: 89/84A/066
Soil series: inclusion
Lab no: 83/89

depth (cm)	particle size sand (%)	silt (%)	clay (%)	texture	natural clay (%)	dispersion-ratio* (%)	org. C (%)	N (%)	C/N
0 - 21	5	46	49	SiC	40	82	2.7	0.26	10
21 - 65	5	13	82	C	0.4	1	0.6	0.09	7
65 - 92	5	10	85	C	0.5	1	0.4	0.06	7
92-165	6	6	88	C	0	0	0.6	0.07	9

depth (cm)	CaCO3 (%)	pH H20 1:2.5	KCl 1:2.5	EC2.5 mS/cm	ESP* (%)	SAR*	av. P2O5 (ppm)	av. K2O (ppm)
0 - 21	-	5.8	4.9	0.08	2	-	6	94
21 - 65	-	6.2	5.4	0.02	3	-	7	16
65 - 92	-	6.8	6.1	0.02	1	-	5	11
92-165	<0.5	6.8	6.1	0.02	2	-	5	12

depth (cm)	exchangeable bases (me/100 g) Ca2+	Mg2+	Na+	K+	sum	exchangeable (me/100 g) acidity	Al3+	CEC (NH4OAc) (me/100 g) soil	clay*	base sat.* (%)
0 - 21	5.7	2.08	0.21	0.21	8.2	-	-	10.1	21	81
21 - 65	2.2	0.68	0.11	0.03	3.0	-	-	4.3	5	70
65 - 92	2.8	0.75	0.03	0.02	3.6	-	-	3.8	4	95
92-165	2.8	1.04	0.02	0.02	3.9	-	-	5.3	6	73

depth (cm)	ECEC soil (%)	clay*	Al. sat.* (%)	bulk density (g/cubic cm)	pF 1.0 (vol. %)	2.0	4.2	available moisture* (vol. %)
0 - 21	-	-	-	1.0	60	42	26	16
21 - 65	-	-	-	1.1	55	49	32	17
65 - 92	-	-	-	1.3	52	50	37	13
92-165	-	-	-	-	-	-	-	-

\- not determined
* derived value
(about 11 kg organic carbon per cubic meter)

Profile no.	**89/84/067**
Map unit	HLx2
USDA (1987)	Humic Kandiudalfic Ruptic-Lithic Eutrudox
Family	clayey, gibbsitic, isohyperthermic
Series	**inclusion**
FAO/UNESCO (1988)	Haplic Ferralsol, fine textured
Location	Tydixon, St. Catherine toposheet 84A, 496118 N, 472632 E
Parent material/rock	on top of White limestone (Troy Claremont Formation)
Physiographic position	midslope, at the lower part of escarpment (Lluidas Vale fault)
Topography	moderately steep (23 % slope)
Elevation	about 535 m above MSL
Land use	unimproved pasture land
Drainage class	well drained
Moisture condition	moist throughout
Surface stoniness/ rock outcrop	rock outcrops in the area
Described by	L.L.T. Dawkins and P. van Gent
Date	12-04-89
Remarks	soils are closely related to Swansea soils

(All colours are for moist conditions, unless otherwise stated)

Ah ***0-8 cm*** **dark yellowish brown (10YR 4/4), dark brown (7.5YR 4/4) when dry, silty clay; weak very fine to coarse subangular blocky and granular structure; slightly sticky to sticky and slightly plastic to plastic when wet, very friable when moist; many very fine and fine pores; very frequent very fine and fine roots; very little biological activity; field pH 7; slightly calcareous; abrupt smooth boundary to**

BA ***8-34 cm*** **mixed yellowish red (5YR 4/6) clay; weak to moderate fine to coarse subangular blocky structure; slightly sticky to sticky and slightly plastic to plastic when wet, friable when moist; soil-coloured patchy thin cutans on root channels; frequent very fine and fine and very few coarse roots; no biological activity; field pH 7; slightly calcareous; clear smooth boundary to**

Bs1 ***34-68 cm*** **yellowish red (5YR 4.5/6) clay; weak fine to coarse subangular blocky structure; slightly sticky and slightly plastic when wet, friable when moist; few very fine and fine pores; frequent very fine and fine roots; very few small hard round blackish Mn concretions; field pH 8; slightly calcareous; gradual smooth to wavy boundary to**

Bs2 ***68-100 cm*** **red (2.5YR 4/6) clay; weak fine to coarse subangular blocky structure; sticky and plastic when wet, firm to very firm when moist; few thin clay-humus skins on ped surfaces; few very fine pores; common very fine roots; field pH 8; slightly calcareous**

R hard limestone incoming at irregular depths, starting from about 34 cm

Profile no: 89/84A/067
Soil series: inclusion
Lab no: 82/89

depth (cm)	particle size sand (%)	silt (%)	clay (%)	texture	natural clay (%)	dispersion-ratio* (%)	org. C (%)	N (%)	C/N
0- 8	2	56	42	SiC	37	88	6.2	0.52	12
8- 34	2	27	71	C	45	63	2.0	0.23	9
34- 68	3	14	84	C	30	36	0.7	0.11	6
68-100	2	15	83	C	3	4	0.4	0.07	6

depth (cm)	CaCO3 (%)	pH H2O 1:2.5	pH KCl 1:2.5	EC2.5 mS/cm	ESP* (%)	SAR*	av. P2O5 (ppm)	av. K2O (ppm)
0- 8	<0.5	6.8	5.8	0.15	1	-	7	112
8- 34	<0.5	7.2	6.1	0.04	2	-	1	33
34- 68	<0.5	7.9	6.6	0.02	2	-	1	12
68-100	<0.5	7.9	7.0	0.04	2	-	1	6

depth (cm)	exchangeable bases Ca2+ (me/100 g)	Mg2+	Na+	K+	sum	exchangeable acidity (me/100 g)	Al3+	CEC (NH4OAc) soil (me/100 g)	clay*	base sat.* (%)
0- 8	17.3	2.93	0.26	0.23	20.7	-	-	21.1	50	98
8- 34	7.1	0.18	0.15	0.02	7.5	-	-	8.4	12	89
34- 68	5.4	0.06	0.11	0.02	5.6	-	-	5.6	7	80
68-100	4.6*	0.20	0.08	0.01	4.9*	-	-	4.9	6	100

depth (cm)	ECEC soil (%)	clay*	Al. sat.* (%)	bulk density (g/cubic cm)	pF 1.0 (vol. %)	2.0	4.2	available moisture* (vol. %)
0- 8	-	-	-	1.0	58	53	32	21
8- 34	-	-	-	1.4	48	39	30	9
34- 68	-	-	-	1.2	43	38	30	8
68-100	-	-	-	-	-	-	-	-

- not determined
* derived value
(about 17 kg organic carbon per cubic meter)

Profile no.	**89/84A/068**
Map unit	HLx2
USDA (1987)	Kandiudalfic Ruptic-Lithic Eutrudox
Family	clayey, gibbsitic, isohyperthermic
Series	**Swansea**
FAO/UNESCO (1988)	Rhodic Ferralsol, fine textured
Location	Tydixon
	toposheet 84A; 483816 N, 474605 E
Parent material/rock	on top of White Limestone (Troy-Claremont Formation)
Physiographic position	saddle
Topography	hilly (16-30% slopes)
Elevation	about 535 m above MSL
Land use	unimproved pasture
Drainage class	well drained
Moisture condition	moist throughout
Surface stoniness/rock outcrop	fair amount of rock outcrops
Described by	L.L.T. Dawkins and P. van Gent
Date	18-04-89
Remarks	some bananas in nearby fields

(All colours are for moist conditions, unless otherwise stated; auger hole sampling from 78 cm)

Ah *0-7 cm* reddish brown (5YR 4/4) to yellowish red (5YR 4/6) silty clay; weak very fine to medium granular structure; slightly sticky and slightly plastic when wet, friable when moist; common very fine and fine pores; frequent very fine and fine roots; little worm activity; field pH 6.5; non calcareous; abrupt smooth boundary to

AB *7-22 cm* mixed red (2.5YR 4/8) and strong brown (7.5YR 4/6), yellowish red (5YR 4/6) when dry and rubbed, clay; weak fine to coarse subangular blocky structure; slightly sticky to sticky and plastic when wet, firm when moist; common very fine and fine pores; frequent very fine and fine roots; field pH 6.5; slightly calcareous; clear smooth boundary to

Bs1 *22-39 cm* yellowish red (5YR 4/6), red (2.5YR 4/8) when dry, clay; moderately weak very fine to coarse subangular blocky structure; slightly sticky to sticky and plastic when wet, firm when moist; few very fine and fine roots; field pH 7; slightly calcareous; gradual smooth boundary to

Bs2 *39-78 cm* red (2.5YR 4/6), red (2.5YR 4/8) when dry, clay; moderately weak very fine to coarse subangular blocky structure; slightly sticky and slightly plastic to plastic when wet, firm when moist; common very fine roots; field pH 8; slightly calcareous. Auger boring from 78-150 cm red (2.5YR 4/6) clay; sticky and plastic, continuation of Bs2

R hard limestone incoming at irregular depths, starting from about 40 cm

Profile no: 89/84A/068
Soil series: Swansea
Lab no: 81/89

depth (cm)	particle size sand (%)	silt (%)	clay (%)	texture	natural clay (%)	dispersion-ratio* (%)	org. C (%)	N (%)	C/N
0 - 7	2	50	48	SiC	38	79	3.0	0.31	10
7 - 22	2	37	61	C	45	74	2.2	0.19	12
22 - 39	1	18	81	C	25	31	1.0	0.10	10
39 - 78	1	12	87	C	0	0	0.5	0.07	7
78-150	1	13	86	C	0	0	0.2	0.03	7

depth (cm)	CaCO3 (%)	pH H2O 1:2.5	pH KCl 1:2.5	EC2.5 mS/cm	ESP* (%)	SAR*	av. P2O5 (ppm)	av. K2O (ppm)
0 - 7	-	6.7	5.7	0.11	2	-	2	177
7 - 22	-	6.9	6.0	0.06	3	-	1	73
22 - 39	<0.5	7.2	6.3	0.03	3	-	1	26
39 - 78	<0.5	7.3	6.7	0.03	1	-	1	6
78-150	<0.5	7.5	6.8	0.05	5	-	0	6

depth (cm)	exchangeable bases Ca2+ (me/100 g)	Mg2+	Na+	K+	sum	exchangeable acidity (me/100 g)	Al3+	CEC (NH4OAc) soil (me/100 g)	clay**	base sat.* (%)
0 - 7	7.6*	2.16	0.21	0.36	10.3*	-	-	10.3	22	100
7 - 22	5.3*	1.31	0.22	0.14	7.0*	-	-	7.0	12	100
22 - 39	2.8	0.64	0.12	0.05	3.6	-	-	3.6	4	100
39 - 78	1.5*	0.65	0.16	0.01	2.3*	-	-	2.3	3	100
78-150	2.4	0.83	0.17	0.01	3.4	-	-	3.6	4	94

depth (cm)	ECEC soil (%)	clay *	Al. sat.* (%)	bulk density (g/cubic cm)	pF 1.0 (vol. %)	2.0	4.2	available moisture* (vol. %)
0 - 7	-	-	-	-	-	-	-	-
7 - 22	-	-	-	1.1	-	-	-	-
22 - 39	-	-	-	1.2	-	-	-	-
39 - 78	-	-	-	1.2	-	-	-	-
78-150	-	-	-	-	-	-	-	-

\- not determined
* derived value
(about 11 kg organic carbon per cubic meter)

Profile no.	**89/84A/084**
Map unit	B04
USDA (1987)	Aquic Kandiudalf
Family	fine, mixed, isohyperthermic
Series	**Linstead variant I**
FAO/UNESCO (1988)	Gleyic Lixisol, medium textured
Location	Ewarton land-lease project; St. Catherine toposheet 84A, 467039 N, 520000 E
Parent material/rock	Old alluvium of St. Thomas in the Vale basin
Physiographic position	side slope
Topography	gently undulating (4% slope)
Elevation	about 220 m above MSL
Land use	presently not in use; previously under vegetables
Drainage class	imperfectly drained
Moisture condition	moist throughout
Surface stoniness/rock outcrop	-
Described by	L.L.T. Dawkins and students from College of Agriculture
Date	21-06-89
Remarks	-

(All colours are for moist conditions, unless otherwise stated)

Ap *0-22 cm* reddish brown (5YR4/4) loam (field: clay loam); weak very fine to medium granular structure; slightly sticky and slightly plastic when wet, friable when moist; many very fine and fine and few medium pores; frequent very fine and common fine roots; many termite channels; common small, hard round black Fe-Mn nodules; field pH 7; slightly calcareous; abrupt wavy boundary to

Bt *22-45 cm* red (2.5 YR 4/6) clay; weak very fine to medium subangular blocky structure; sticky and plastic when wet, firm when moist; common broken reddish brown top soil material along former root channels; few pressure faces; many very fine and fine pores; very few fine roots; very few fine small hard round black Fe-Mn nodules; common termite activity; field pH 7; slightly calcareous; gradual wavy boundary to

Btg1 *45-58 cm* red (2.5 YR 4/6) clay with common medium distinct brownish yellow (10YR 6/8) mottles; weak fine and medium subangular blocky structure; very sticky and plastic when wet, friable when moist; few pressure faces; many very fine and fine pores; few very fine roots; very few medium hard round black Fe-Mn nodules; field pH 6.5; slightly calcareous; clear irregular boundary to

Btg2 *58-150 cm* mixed red (2.5 YR 4/6) and brownish yellow (10 YR 6/8) clay (field: silty clay) with common medium distinct to prominent light grey (10YR 7/2) and red (10R 4/6 and 2.5YR 4/6) mottles; weak, very fine to medium subangular blocky structure; sticky and plastic when wet, friable when moist; common pressure faces; many very fine and few fine pores; very few very fine roots; very few small round black Fe-Mn nodules; field pH 7.5; slightly calcareous

Profile no: 89/84A/084
Soil series: Linstead variant I
Lab no: 117/89

depth (cm)	particle size sand (%)	silt (%)	clay (%)	texture	natural clay (%)	dispersion-ratio* (%)	org. C (%)	N (%)	C/N
0 - 22	45	29	26	L	-	-	2.1	0.26	8
22- 45	27	17	56	C	-	-	0.6	0.11	5
45- 58	25	25	50	C	-	-	0.5	0.09	6
58-150	11	11	78	C	-	-	0.2	0.07	3

depth (cm)	CaCO3 (%)	pH H20 1:2.5	KCl 1:2.5	EC2.5 mS/cm	ESP* (%)	SAR*	av. P205 (ppm)	av. K20 (ppm)
0 - 22	-	6.6	5.6	0.04	1	-	7	54
22- 45	-	6.7	5.7	0.02	2	-	2	14
45- 58	-	6.3	5.5	0.02	3	-	0	12
58-150	<0.5	7.0	6.2	0.03	4	-	2	10

depth (cm)	exchangeable bases Ca2+ (me/100 g)	Mg2+	Na+	K+	sum	exchangeable acidity (me/100 g)	Al3+	CEC (NH4OAc) soil (me/100 g)	clay*	base sat.* (%)
0 - 22	9.3*	1.25	0.16	0.10	10.7*	-	-	10.7	41	100
22- 45	4.5*	0.57	0.11	0.06	5.2*	-	-	5.2	9	100
45- 58	3.7	0.51	0.13	0.12	4.5	-	-	5.0	10	90
58-150	2.4	0.57	0.14	0.04	3.2	-	-	3.2	4	100

depth (cm)	ECEC soil (%)	clay*	Al. sat.* (%)	bulk density (g/cubic cm)	pF 1.0 (vol. %)	2.0	4.2	available moisture* (vol. %)
0 - 22	-	-	-	-	-	-	-	-
22- 45	-	-	-	-	-	-	-	-
45- 58	-	-	-	-	-	-	-	-
58-150	-	-	-	-	-	-	-	-

\- not determined
* derived value
(about 9 kg organic carbon per cubic meter)

Profile no.	**89/84A/090**
Map unit	HJ2
USDA (1987)	Paralithic Hapludoll
Family	fine, mixed, isohyperthermic
Series	**Mount Rosser**
FAO/UNESCO (1988)	Mollic Leptosol, fine textured
Location	Mount Rosser, St. Catherine toposheet 84A, 469013 N, 518026 E
Parent material/rock	land slide of Tertiary Limestone
Physiographic position	complex midslope on fault
Topography	very steep (> 50% slope)
Elevation	about 410 m above MSL
Land use	few mixed cropping plots in between food/secondary forest
Drainage class	well drained
Moisture condition	moist throughout (0-80 cm)
Surface stoniness/rock outcrop	rocky and stony/gravelly
Described by	L.L.T. Dawkins and P. van Gent
Date	01-08-89
Remarks	road cut is located at fault line

(All colours are for moist conditions, unless otherwise stated)

Ah *0-23 cm* dark greyish brown (10YR 4/2), the same colour when dry, gravelly clay with few medium faint reddish brown (5YR 4/4) mottles; moderate to strong course granular structure; slightly sticky and slightly plastic when wet, friable when moist; common very fine and few fine pores; abundant very fine and fine roots; ants and termite activity; field pH 8.0; calcareous; abrupt wavy boundary to

Bw *23-44 cm* strong brown (7.5YR 5/6) gravelly and stony loam (field: clay); weak medium subangular blocky structure; sticky and slightly plastic to plastic when wet; friable when moist; dark greyish brown patchy thin humus cutans found in worm channels; few very fine pores; frequent very fine and few course roots; termite activity; field pH 8.0; strongly calcareous; clear irregular-wavy boundary to

CR *44-80 cm* mixed strong brown (7.5YR 5/7) and brownish yellow (10YR 6/8) gravelly stony clay (field: clay loam); structureless; slightly sticky and slightly plastic when wet; very few medium and common very fine pores; common coarse and very coarse roots; field pH 8.0; strongly calcareous; clear irregular boundary to

R *80-200 cm* mixed, very pale brown (10YR 8/4), reddish yellow (7.5YR 6/8), red (2.5YR 5/8) and white (5YR 8/1) weathered, soft limestone; very few coarse roots; field pH 8.0-8.5; strongly calcareous

Profile no: 89/84A/090
Soil series: Mount Rosser
Lab no: 147/89

depth (cm)	particle size sand (%)	silt (%)	clay (%)	texture	natural clay (%)	dispersion-ratio* (%)	org. C (%)	N (%)	C/N
0-23	21	36	43	C	14	33	4.2	0.41	10
23-44	43	24	23	L	9	39	0.9	0.15	6
44-80	11	31	58	C	3	5	0.5	0.06	8
80-200	38	41	21	L	5	24	0.3	0.03	10

depth (cm)	CaCO3 (%)	pH H2O 1:2.5	pH KCl 1:2.5	EC2.5 mS/cm	ESP* (%)	SAR*	av. P2O5 (ppm)	av. K2O (ppm)
0-23	4.3	7.8	6.9	0.16	2	-	17	319
23-44	14.1	8.2	7.3	0.11	2	-	2	133
44-80	13.1	8.4	7.7	0.13	4	-	5	85
80-200	12.7	8.7	7.8	0.10	4	-	0	76

depth (cm)	exchangeable bases Ca2+ (me/100 g)	Mg2+	Na+	K+	sum	exchangeable acidity (me/100 g)	Al3+	CEC (NH4OAc) soil (me/100 g)	clay*	base sat.* (%)
0-23	27.1*	3.43	0.68	0.74	31.9*	-	-	31.9	74	100
23-44	7.9*	1.87	0.44	0.26	16.6*	-	-	16.6	72	100
44-80	6.1*	0.86	0.33	0.14	7.4*	-	-	7.4	12	100
80-200	4.4*	1.00	0.25	0.12	5.8*	-	-	5.8	28	100

depth (cm)	ECEC soil (%)	clay*	Al. sat.* (%)	bulk density (g/cubic cm)	pF 1.0 (vol. %)	2.0	4.2	available moisture* (vol. %)
0-23	-	-	-	-	-	-	-	-
23-44	-	-	-	-	-	-	-	-
44-80	-	-	-	-	-	-	-	-
80-200	-	-	-	-	-	-	-	-

- not determined
* derived value

Profile no.	**88/84C/098**
Map unit	B05
USDA (1987)	Typic Paleudult
Family	clayey, mixed, isohyperthermic
Series	**Rosemere variant I**
FAO/UNESCO (1988)	Ferric Acrisol, fine textured
Location	River Head, St. Catherine toposheet 84C, 454870 N, 514340 E
Parent material/rock	alluvial deposit on top of Somerset Limestone
Physiographic position	small flat area in hilly limestone surroundings
Topography	almost flat (0-2%)
Elevation	about 240 m above MSL
Land use	citrus orchard with cows
Drainage class	moderately well drained
Moisture condition	moist throughout; ground water not encountered
Surface stoniness/rock outcrop	nil
Described by	P. van Gent, G. Ford and P. White
Date	09-09-88
Remarks	coarse roots stop at 45 cm

(All colours are for moist conditions, auger hole-description from 130 cm)

Ah *0-16 cm* dark yellowish brown (10YR 4/4) clay (field: clay loam) with very faint mottles; strong fine, medium and coarse (sub)angular blocky structure; slightly sticky and slightly plastic when wet, firm when moist, very hard when dry; patchy humus thin coatings; few very fine pores; many fine and very fine roots; many worm casts, worms and many ants; few (15%) small soft round black Fe-Mn concretions; slightly gravelly (white calcareous gravels); field pH 7; non calcareous; clear broken boundary to

Bt1 *16-24 cm* red (2.5YR 4/8) clay (field: silty clay) with common to many medium faint to distinct strong brown (7.5YR 5/8) mottles; moderate medium and coarse (sub)angular blocky structure; sticky and plastic when wet, firm when moist; broken thin clay cutans; pressure faces; few very fine and fine pores; many very fine, fine and medium roots; few worm casts and ants channels; few small round red and black Fe-Mn-concretions; field pH 5.5; non calcareous; clear and wavy boundary to

Bt2 *24-45 cm* red (2.5YR 4/8) clay (field: silty clay) with common medium distinct light grey (10YR 7/2) and many medium distinct brownish yellow (10YR 6/8) mottles; moderate fine and medium subangular blocky structure; slightly sticky and slightly plastic when wet, friable when moist; continuous moderately thick clay cutans; pressure faces, not close enough to intersect; very few fine pores; very few very fine, fine and medium roots and common coarse roots; very few small soft and hard red round Fe-Mn-concretions; field pH 5; slightly calcareous; clear and irregular boundary to

Bt3 *45-130 cm* mixed red (10R 5/8) and light grey (10YR 7/1) clay with common medium distinct strong brown (7.5YR 5/8), many coarse prominent red (2.5YR 5/8) mottles and few medium distinct Mn-stains; massive to weakly developed structure; sticky and plastic when wet, very friable when moist; continuous moderately thick clay cutans; pressure faces; very few very fine pores; very few fine roots; very few small red iron concretions; field pH 4.5; non calcareous

BC *130-200 cm* (auger boring) yellowish brown (10YR 5/6) and white (N8/) clay with strong brown (7.5YR 5/8) mottles coming in again from 180 cm onwards

Profile no: 88/84C/098
Soil series: Rosemere variant I
Lab no: 190/88

depth (cm)	particle size sand (%)	silt (%)	clay (%)	texture	natural clay (%)	dispersion-ratio* (%)	org. C (%)	N (%)	C/N
0- 16	20	37	43	C	-	-	3.5	0.34	10
16- 24	4	11	85	C	-	-	0.5	0.10	5
24- 45	5	11	84	C	-	-	0.2	0.07	3
45-130	-	-	-	C	-	-	0.2	0.06	3
130-200	5	9	86	C	-	-	0.1	0.04	3

depth (cm)	CaCO3 (%)	pH H20 1:2.5	KCl 1:2.5	EC2.5 mS/cm	ESP* (%)	SAR*	av. P2O5 (ppm)	av. K20 (ppm)
0- 16	-	6.6	5.1	-	1	-	8	68
16- 24	-	5.4	3.6	-	1	-	5	7
24- 45	-	4.9	3.5	-	1	-	3	31
45-130	-	4.7	3.3	-	1	-	3	39
130-200	-	4.5	3.3	-	1	-	0	72

depth (cm)	exchangeable bases (me/100 g) Ca2+	Mg2+	Na+	K+	sum	exchangeable (me/100 g) acidity	Al3+	CEC (NH4OAc) (me/100 g) soil	clay	base sat.* (%)
0- 16	11.7	2.23	0.17	0.17	14.3	-	-	17.4	40	82
16- 24	3.7	0.67	0.14	0.06	4.6	5.28	5.28	12.5	15	37
24- 45	2.3	1.55	0.07	0.08	4.0	8.46	8.46	12.8	15	31
45-130	1.5	0.13	0.11	0.11	1.9	11.35	11.35	14.6	-	13
130-200	1.7	0.16	0.18	0.19	2.2	14.91	14.91	19.1	22	12

depth (cm)	ECEC* (me/100 g) soil	clay	Al. sat.* (%)	bulk density (g/cubic cm)	pF (vol. %) 1.0	2.0	4.2	available moisture* (vol. %)
0- 16	14.3	32	-	1.3	42	36	29	7
16- 24	9.9	12	53	-	-	-	-	-
24- 45	12.5	15	68	1.3	-	-	-	-
45-130	13.3	-	85	1.4	-	-	-	-
130-200	17.1	20	87	-	-	-	-	-

- not determined
* derived value
(about 10 kg organic carbon per cubic meter)

Profile no.	**88/84C/099**
Map unit	B06, HXx1
USDA (1987)	Humic Hapludalf
Family	fine, mixed, isohyperthermic
Series	**Riverhead**
FAO/UNESCO (1988)	Haplic Lixisol, fine textured
Location	River Head, St. Catherine toposheet 84C, 456910 N, 514540 E
Parent material/rock	alluvial (-colluvial) deposits on top of Somerset White Limestone
Physiographic position	transition of limestone hills to valley bottom, at fault
Topography	almost flat (2%)
Elevation	about 240 m above MSL
Land use	small ruinate area next to citrus nursery and mixed cropping garden
Drainage class	moderately well drained
Moisture condition	moist throughout
Surface stoniness/rock outcrop	few calcareous gravels
Described by	P. van Gent, G. Ford and P. White
Date	09-09-88
Remarks	(classification close to Kanhaplic Humic Haplustalf)

(All colours are for moist conditions, auger hole-description from 134 cm)

Ah *0-27/30 cm* (dark)brown (10YR 4/3) clay; moderate fine and medium subangular blocky structure; slightly sticky and slightly plastic when wet, friable when moist, very hard when dry; patchy thin clay and organic matter cutans; pores are not visible; common fine and very fine roots especially in the first 10 cm; many worm casts (2-3 mm) and ants; few small soft round black Fe-Mn-concretions; slightly gravelly (white calcareous gravels); field pH 7-8; non calcareous; clear wavy boundary to

Bt1 *27/30-45 cm* strong brown (7.5YR 4/6) clay with faint red (2.5YR 4/6) mottles and some big pinkish mottles; moderate fine, medium and coarse (sub)angular blocky structure; slightly sticky and slightly plastic when wet, friable when moist; continuous moderately thick clayey cutans; pressure faces; pores are not visible; few fine and very fine roots; few worm casts; some charcoal remnants; few small soft black Fe-Mn-concretions; field pH 8; non calcareous; clear smooth boundary to

Bt2 *45-75 cm* dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/8) clay with common medium distinct weak red (10R 4/4) and reddish brown (2.5YR 4/4) mottles; moderately weak fine medium and coarse subangular blocky structure; non sticky to slightly sticky and slightly plastic when wet, friable when moist; continuous moderately thick to thick clayey cutans; pressure faces; pores not visible; few very fine roots; some worm casts; very few small round Fe-Mn-concretions; some quartz-like gravels; field pH 4.5; non calcareous; gradual wavy boundary to

Bt3 *75-180 cm* (auger hole description from 134 cm) dark yellowish brown (10YR 4/4) clay with few very fine distinct yellow (10YR 8/8) and common to many coarse distinct strong brown (7.5YR 5/8) and red (10R 4/6) mottles surrounding grey (N 7/) veins; moderately weak fine subangular blocky structure; slightly sticky and slightly plastic when wet, friable when moist but grey parts are firm; continuous grey pressure faces (slickensides); very few very fine roots; very few very small Mn-concretions; very few gravels of different kinds and some broken quartz gravels; field pH 4.5; non calcareous

Profile no: 88/84C/099
Soil series: Riverhead
Lab no: 191/88

depth (cm)	particle size sand (%)	silt (%)	clay (%)	texture	natural clay (%)	dispersion-ratio* (%)	org. C (%)	N (%)	C/N
0-27/30	25	35	40	C	-	-	2.9	0.32	9
27/30-45	32	19	49	C	-	-	1.1	0.15	7
45-75	31	14	54	C	-	-	0.3	0.07	4
75-180	47	16	47	C	-	-	0.3	0.03	10

depth (cm)	CaCO3 (%)	pH H2O 1:2.5	pH KCl 1:2.5	EC2.5 mS/cm	ESP* (%)	SAR*	av. P2O5 (ppm)	av. K2O (ppm)
0-27/30	-	6.3	5.2	-	1	-	8	68
27/30-45	<0.5	6.8	5.5	-	1	-	5	41
45-75	<0.5	7.1	5.6	-	2	-	31	31
75-180	-	6.0	4.5	-	1	-	0	29

depth (cm)	exchangeable bases (me/100 g) Ca2+	Mg2+	Na+	K+	sum	exchangeable (me/100 g) acidity	Al3+	CEC (NH4OAc) (me/100 g) soil	clay	base sat.* (%)
0-27/30	11.5	2.50	0.21	0.28	14.5	-	-	17.1	43	85
27/30-45	8.9	1.70	0.13	0.01	10.7	-	-	12.5	26	86
45-75	10.3	1.43	0.21	0.10	12.0	-	-	11.8	22	100
75-180	7.5	0.80	0.14	0.09	8.5	-	-	9.8	21	87

depth (cm)	ECEC* (me/100 g) soil	clay	Al. sat.* (%)	bulk density (g/cubic cm)	pF (vol. %) 1.0	2.0	4.2	available moisture* (vol. %)
0-27/30	-	-	-	1.2	54	47	30	17
27/30-45	-	-	-	-	-	-	-	-
45-75	-	-	-	1.5	46	44	34	10
75-180	-	-	-	1.5	43	42	29	13

- not determined
* derived value
(about 15 kg organic carbon per cubic meter)

Profile no.	**88/84C/105**
Map unit	HLx4
USDA (1987)	Humic Kandiudalfic Eutrudox
Family	clayey, mixed, isohyperthermic
Series	**Union Hill variant I**
FAO/UNESCO (1988)	Haplic Lixisols, fine textured
Location	Polly Ground, St. Catherine toposheet 84C, 457170 N, 518420 E
Parent material/rock	residuum of Newport/Walderston-Brown's Town White Limestone
Physiographic position	flat mid-slope of limestone hill, at fault line
Topography	hilly (16-30%)
Elevation	about 245 m above MSL
Land use	scattered yam, coco yam, coconut- and breadfruit-trees
Drainage class	well drained
Moisture condition	moist throughout
Surface stoniness/rock outcrop	fairly gravelly
Described by	L.L.T. Dawkins, P. van Gent, R. Hennemann, D. Phillips and P. White
Date	09-11-88
Remarks	variant of very deep soil in Union Hill

(All colours are for moist conditions unless otherwise stated, auger hole-description from 120-180 cm)

Ah *0-22 cm* dark greyish brown (10YR 4/2), (dark) brown (10YR 4/3) when dry, gravelly clay; moderate medium, breaking into fine, subangular blocky structure; slightly sticky and slightly plastic when wet, friable when moist; dark greyish brown patchy thin clay-humus cutans around concretions; few fine and common very fine pores; very few small hard round black Fe-Mn-concretions; common very fine, fine and medium roots; high ant- and termite-activity; field pH 8.0; slightly calcareous; clear wavy boundary to

AB *22-30 cm* (dark) brown (7.5YR 4/4) clay; moderate fine to medium subangular blocky structure; slightly sticky and plastic when wet, firm when moist; dark brown patchy thin clay-humus cutans around concretions; few fine and very fine pores; very few small hard round black Fe-Mn-concretions; few fine and very fine roots; high termite activity; field pH 7.5; slightly calcareous; clear smooth boundary to

Bs1 *30-80 cm* strong brown (7.5YR 4/6) clay; weak to moderate medium subangular blocky, breaking into fine angular blocky, structure; slightly sticky to sticky and plastic when wet, friable when moist; possible clay-humus cutans; continuous pressure faces throughout; common micro-pores and few fine pores; few small and large round and irregular black Fe-Mn-concretions; very few medium and coarse roots; high termite activity; field pH 8.0; slightly calcareous; diffuse smooth boundary to

Bs2 *80-180 cm* (auger hole description form 120 cm) strong brown (7.5YR 4/6) clay with faint black Mn-stains weak to moderate subangular blocky structure; slightly sticky and slightly plastic when wet, friable when moist; continuous pressure faces throughout; common micro-pores; very few small hard round and irregular black Fe-Mn-concretions; termite-activity; field pH 8.0; slightly calcareous

Profile no: 88/84C/105
Soil series: Union Hill variant I
Lab no: 202/88

depth (cm)	particle size: sand (%)	silt (%)	clay (%)	texture	natural clay (%)	dispersion-ratio* (%)	org. C (%)	N (%)	C/N
0- 22	9	38	53	C	10	20	4.0	0.42	10
22- 30	8	21	71	C	11	15	1.6	0.24	7
30- 80	5	7	88	C	11	13	0.5	0.13	4
80-120	4	4	92	C	8	9	0.4	0.11	4
160-180	3	4	93	C	1	1	0.2	0.08	3

depth (cm)	CaCO3 (%)	pH H2O 1:2.5	pH KCl 1:2.5	EC2.5 mS/cm	ESP* (%)	SAR*	av. P2O5 (ppm)	av. K2O (ppm)
0- 22	1.0	7.9	6.9	-	1	-	28	139
22- 30	<0.5	8.2	6.6	-	1	-	4	33
30- 80	<0.5	8.1	6.8	-	2	-	4	13
80-120	<0.5	7.8	6.7	-	1	-	2	18
160-180	<0.5	8.0	6.4	-	1	-	2	20

depth (cm)	exchangeable bases (me/100 g): Ca2+	Mg2+	Na+	K+	sum	exchangeable (me/100 g): acidity	Al3+	CEC (NH4OAc) (me/100 g): soil	clay	base sat.* (%)
0- 22	18.9*	1.42	0.18	0.30	20.8*	-	-	20.8	41	100
22- 30	10.5*	0.43	0.09	0.07	11.1*	-	-	11.1	15	100
30- 80	7.3*	0.83	0.14	0.02	8.3*	-	-	8.3	9	100
80-120	7.4*	0.98	0.10	0.03	8.5*	-	-	8.5	9	100
160-180	8.2*	0.48	0.10	0.02	8.8*	-	-	8.8	9	100

depth (cm)	ECEC* (me/100 g): soil	clay	Al. sat.* (%)	bulk density (g/cubic cm)	pF (vol. %): 1.0	2.0	4.2	available moisture* (vol. %)
0- 22	-	-	-	-	-	-	-	-
22- 30	-	-	-	-	-	-	-	-
30- 80	-	-	-	-	-	-	-	-
80-120	-	-	-	-	-	-	-	-
160-180	-	-	-	-	-	-	-	-

- not determined
* derived value
(about 16 kg organic carbon per cubic meter)

Profile no.	**88/84C/107**
Map unit	PRx1
USDA (1987)	Typic Eutropept
Family	fine, mixed, isohyperthermic
Series	**Lluidas variant II**
FAO/UNESCO (1988)	Eutric Fluvisol, medium textured
Location	Worthy Park Estate, St. Catherine toposheet 84C, 451450 N, 503950 E
Parent material/rock	recent alluvial deposit, originating from rocks of the Central Inlier
Physiographic position	youngest terrace, bordering the Rio Cobre in the Lluidas Vale
Topography	almost flat (2% slope)
Elevation	about 347 m above MSL
Land use	sugar cane plantation
Drainage class	well drained
Moisture condition	dry topsoil, moist from 23 cm onwards
Surface stoniness/rock outcrop	gravelly
Described by	L.T.T. Dawkins and P. van Gent
Date	23-11-88
Remarks	pit described at the original site of Green Book description of Lluidas (Vernon 1958)

(All colours are for moist conditions, unless otherwise stated; auger hole-description from 155 cm)

Ap *0-14/23 cm* (dark) brown (7.5YR 4/2), brown (7.5YR 5/2) when dry, gravelly silty clay loam;weak medium granular and fine and medium subangular blocky structure; slightly sticky and slightly plastic when wet, friable when moist, very hard when dry; common very fine and fine and few medium pores; frequent very fine, fine and medium roots; frequent worm casts; gravelly on top; field pH 6.5; non calcareous; abrupt wavy boundary to

Bg1 *14/23 -99 cm* reddish brown (5YR 4/3) silty clay and gravelly (sandy) loam in places, with common medium distinct yellowish brown (10YR 5/8) and few fine distinct strong brown (7.5YR 5/8) and reddish grey (5YR 3/2) mottles in more gravelly spots; moderate fine, coarse and very coarse subangular blocky structure; sticky and plastic when wet, very firm when moist; common very fine to fine and few medium pores; common very fine and fine roots; gravelly in places; field pH 7; non calcareous; gradual wavy boundary to

C1 *99-170 cm* (auger hole description from 155 cm) reddish brown (5YR 4/3) gravelly "silty clay loam"; moderate medium and coarse subangular blocky structure; slightly sticky and slightly plastic when wet, firm when moist; common fine and very fine pores (mainly former root channels); field pH 7; slightly calcareous

C2 *170-200 cm* like the former horizon but with common medium distinct dark yellowish brown (7.5YR 4/6) mottles

Profile no: 88/84C/107
Soil series: Lluidas variant II
Lab no: 217/88

depth (cm)	particle size sand (%)	silt (%)	clay (%)	texture	natural clay (%)	dispersion-ratio* (%)	org. C (%)	N (%)	C/N
0-14/23	20	43	32	L	-	-	1.7	0.16	11
14/23-99	3	47	47	SiC	-	-	0.3	0.04	8
14/23-99@	-	-	-	•	-	-	0.2	0.03	7
99-170	-	-	-	•SiCL	-	-	0.1	0.02	5

depth (cm)	CaCO3 (%)	pH H20 1:2.5	pH KCl 1:2.5	EC2.5 mS/cm	ESP* (%)	SAR*	av. P205 (ppm)	av. K20 (ppm)
0-14/23	<0.5	6.8	5.1	-	1	-	100	77
14/23-99	<0.5	7.1	4.6	-	2	-	17	57
14/23-99@	<0.5	7.4	4.7	-	2	-	123	35
99-170	<0.5	7.4	4.5	-	3	-	69	46

depth (cm)	exchangeable bases (me/100 g) Ca2+	Mg2+	Na+	K+	sum	exchangeable (me/100 g) acidity	Al3+	CEC (NH4OAc) (me/100 g) soil	clay	base sat.* (%)
0-14/23	19.6*	7.15	0.24	0.20	27.2*	-	-	27.2	85	100
14/23-99	18.9*	11.09	0.56	0.19	30.7*	-	-	30.7	65	100
14/23-99@	12.7*	8.27	0.47	0.09	21.5*	-	-	21.5	-	100
99-170	13.5*	11.41	0.72	0.13	25.8*	-	-	25.8	-	100

depth (cm)	ECEC* (me/100 g) soil	clay	Al. sat.* (%)	bulk density (g/cubic cm)	pF (vol. %) 1.0	2.0	4.2	available moisture* (vol. %)
0-14/23	-	-	-	1.4	48	45	29	16
14/23-99	-	-	-	1.5	46	42	32	10
14/23-99@	-	-	-	1.5	47	43	32	11
99-170	-	-	-	-	-	-	-	-

• laboratory problems in determining the texture
@ gravelly part of the horizon
- not determined
* derived value
(about 8 kg organic carbon per cubic meter)

Profile no.	**88/84C/108**
Map unit	HL1
USDA (1987)	Rhodic Kandiudox
Family	clayey, gibbsitic, isohyperthermic
Series	**Mountain Hill**
FAO/UNESCO (1988)	Rhodic Ferralsol, fine textured
Location	CIDCO coffee estate (land lease of WP Estate), St. Catherine toposheet 84C, 452890 N, 505790 E
Parent material/rock	bauxitic deposit on White Limestone (Troy-Claremont Formation)
Physiographic position	depression, surrounded by limestone hills
Topography	undulating landscape (2% slope), surrounded by highly dissected hills
Elevation	about 480 m above MSL
Land use	coffee plantation and scattered bananas
Drainage class	well drained
Moisture condition	moist throughout
Surface stoniness/rock outcrop	nil
Described by	L.L.T. Dawkins and P. van Gent
Date	17-11-88
Remarks	Mn seems to be cementing the soil material; steeper sites are susceptible to erosion

(All colours are for moist conditions, auger hole-description from 128 cm)

Ap ***0-14 cm*** **weak red (10R 4/4) clay (field: clay loam) with black Mn-stains concentrated as cementing material; moderately weak medium subangular blocky structure; slightly sticky and slightly plastic when wet, friable when moist, hard when dry; pores not visible; frequent very fine and fine and few coarse roots; few worm casts; some krotovina-like holes, formerly filled with "bug-balls"; very few limestone gravels; field pH 5.5; non calcareous; clear smooth boundary to**

AB ***14-29 cm*** **dark reddish brown (2.5YR 3/4) clay (field: clay loam) with black Mn-stains; moderate medium and coarse (sub)angular blocky structure and few columnar structure elements; slightly sticky and slightly plastic when wet, friable when moist; very few very fine pores; few very fine and fine roots; few worm casts; few big black round Mn-rich (to 3 cm diameter) balls as a results of bug-activity, filled with soil material; field pH 5.5; non calcareous; gradual smooth boundary to**

Bs1 ***29-80 cm*** **dark red (2.5YR 3/6) clay (field: clay loam) with black Mn-stains; weak medium and coarse angular blocky structure as well as some columnar structure elements; slightly sticky and slightly plastic when wet, friable to firm when moist; few clay cutans on structure elements; very few fine pores (former root channels); few very fine roots; some "bug-balls" in the upper part of this horizon; field pH 7; non calcareous; gradual smooth boundary to**

Bs2 ***80-200 cm*** **(auger hole description from 128 cm) red (2.5YR 4/6) clay with few small Mn-stains; weakly developed medium, coarse and very coarse angular blocky and structure elements; slightly sticky and slightly plastic when wet, firm when moist; some thin shiny cutans on peds and around pores and Mn-gravels; common very fine pores; very few small hard round black Fe-Mn-concretions; field pH 7; slightly calcareous**

Profile no: 88/84C/108
Soil series: Mountain Hill
Lab no: 219/88

depth (cm)	particle size sand (%)	silt (%)	clay (%)	texture	natural clay (%)	dispersion-ratio* (%)	org. C (%)	N (%)	C/N
0- 14	2	35	61	C	0.8	1	2.0	0.20	10
14- 29	1	31	68	C	0.7	1	1.2	0.15	8
29- 80	2	14	84	C	0.6	1	0.4	0.07	6
80-128	5	12	83	C	0.5	1	0.3	0.05	6
190-200	2	3	95	C	0.5	1	0.2	0.07	3

depth (cm)	CaCO3 (%)	pH H2O 1:2.5	pH KCl 1:2.5	EC2.5 mS/cm	ESP* (%)	SAR*	av. P2O5 (ppm)	av. K2O (ppm)
0- 14	-	4.2	3.8	-	1	-	100	86
14- 29	-	4.4	3.9	-	1	-	7	55
29- 80	-	4.8	5.0	-	2	-	6	131
80-128	-	6.6	6.2	-	4	-	7	270
190-200	-	5.5	5.7	-	0	-	2	46

depth (cm)	exchangeable bases (me/100 g) Ca2+	Mg2+	Na+	K+	sum	exchangeable (me/100 g) acidity	Al3+	CEC (NH4OAc) (me/100 g) soil	clay	base sat.* (%)
0- 14	0.5	0.19	0.04	0.20	0.9	3.46	3.30	7.7	12	12
14- 29	0.4	0.14	0.05	0.12	0.7	2.70	2.60	4.6	7	15
29- 80	1.8	0.29	0.08	0.29	2.5	0.18	0.09	4.4	5	57
80-128	3.3*	1.60	0.21	0.63	5.7*	-	-	5.7	7	100
190-200	8.4	1.47	<0.01	0.14	10.0	0	0	9.8	10	100

depth (cm)	ECEC* (me/100 g) soil	clay	Al. sat.* (%)	bulk density (g/cubic cm)	pF (vol. %) 1.0	2.0	4.2	available moisture* (vol. %)
0- 14	4.4	7	75	1.1	55	43	25	18
14- 28	3.4	5	76	-	-	-	-	-
28- 80	2.7	3	3	1.3	50	44	30	14
80-128	-	-	-	1.3	48	46	35	11
190-200	10.0	11	0	-	-	-	-	-

- not determined
* derived value
(about 9 kg organic carbon per cubic meter)

Profile no.	**88/84C/109**
Map unit	B01
USDA (1987)	Vertic Haplohumult
Family	clayey, mixed, isohyperthermic
Series	**Pennants variant I**
FAO/UNESCO (1988)	Humic Nitisol, medium textured
Location	Worthy Park Estate, St. Catherine toposheet 84C, 459080 N, 498680 E
Parent material/rock	uniform inland basin deposits of lacustrine origin
Physiographic position	convex to straight slope
Topography	rolling (10% slope)
Elevation	about 350 m above MSL
Land use	sugar cane plantation
Drainage class	moderately well drained
Moisture condition	moist throughout
Surface stoniness/rock outcrop	nil
Described by	L.T.T. Dawkins and P. van Gent
Date	24-11-88
Remarks	pit described at the original site of the Green Book description of Pennants (Vernon 1958); abrupt textural change

(All colours are for moist conditions, unless otherwise stated, auger hole-description from 150 cm onwards)

Ap *0-14 cm* (9-24 cm in furrows-ridges) (dark) brown (10YR 3/3), brown (10YR 4/3) when dry, loam; moderate very fine to coarse subangular blocky structure; slightly sticky and slightly plastic when wet, friable when moist, hard when dry; common very fine and fine pores; frequent very fine and fine roots; frequent worm casts and ant activity; field pH 4.5; non calcareous; abrupt smooth boundary to

Bt(g)1 *14-27/38 cm* mixed light grey (10YR 7/2) and reddish yellow (7.5YR 6/8) clay with common medium distinct red (2.5YR 4/8) mottles; moderate fine, medium and coarse angular blocky structure; sticky and slightly plastic when wet, firm when moist; brown broken moderately thick clay-humus coatings on ped surfaces; common very fine and fine pores; common very fine and fine roots; few worm casts; field pH 4.5; non calcareous; clear wavy boundary to

Btg2 *27/38-64 cm* red (10R 4/8) clay with many coarse distinct light grey (10YR 7/1) and common fine faint strong brown (7.5YR 5/8) mottles; strong fine, medium and coarse angular blocky structure; sticky and slightly plastic when wet, firm when moist; brown patchy moderately thick clay-humus coatings on ped surfaces; some pressure faces; common very fine pores; common very fine and fine roots; very few small hard round black Fe-Mn-concretions; field pH 4.5; non calcareous; gradual wavy boundary to

Btg3 *64-108 cm* light grey (10YR 7/2) clay with many coarse prominent red (10R 4/6) and common fine faint yellowish brown (10YR 5/8) mottles; strong fine, medium and coarse angular blocky structure; sticky and slightly plastic when wet, firm when moist; some coatings of topsoil on ped surfaces; clear pressure faces; few very fine pores; common very fine roots; field pH 4.5; non calcareous; gradual wavy boundary to (see page A60)

Profile no: 88/84C/109
Soil series: Pennants variant I
Lab no: 218/88

depth (cm)	particle size sand (%)	silt (%)	clay (%)	texture	natural clay (%)	dispersion-ratio* (%)	org. C (%)	N (%)	C/N
0-14	50	30	20	L	9	45	1.8	0.13	14
14-27/38	26	14	60	C	29	49	0.9	0.10	9
27/38-64	36	15	49	C	7	14	0.4	0.04	10
64-108	25	15	60	C	3	5	0.3	0.03	10
108-170	31	19	50	C	6	12	0.1	0.02	5
170-200	28	24	48	C	7	15	0.1	0.01	10

depth (cm)	CaCO3 (%)	pH H20 1:2.5	KCl 1:2.5	EC2.5 mS/cm	ESP* (%)	SAR*	av. P2O5 (ppm)	av. K2O (ppm)
0- 14	-	4.7	3.7	-	1	-	82	67
14-27/38	-	4.7	3.7	-	0	-	5	39
27/38-64	-	4.7	3.7	-	1	-	2	44
64-108	-	4.4	3.6	-	1	-	1	69
108-170	-	4.6	3.6	-	2	-	2	64
170-200	-	4.9	3.5	-	1	-	2	107

depth (cm)	exchangeable bases Ca2+ (me/100 g)	Mg2+	Na+	K+	sum	exchangeable acidity (me/100 g)	Al3+	CEC (NH4OAc) soil (me/100 g)	clay	base sat.* (%)
0- 14	2.7	0.85	0.09	0.16	3.8	2.77	2.74	9.8	49	39
14-27/38	4.1	1.72	0.06	0.09	6.0	8.83	8.83	16.5	28	36
27/38-64	1.4	1.28	0.11	0.10	2.9	11.04	11.04	14.3	29	20
64-108	0.2	1.28	0.13	0.15	1.8	16.67	16.62	17.8	30	10
108-170	0.3	1.28	0.25	0.14	2.0	14.48	14.48	15.7	31	13
170-200	0.3	1.94	0.16	0.22	2.6	16.79	16.79	19.3	40	13

depth (cm)	ECEC* soil (me/100 g)	clay	Al. sat.* (%)	bulk density (g/cubic cm)	pF 1.0 (vol. %)	2.0	4.2	available moisture* (vol. %)
0- 14	6.6	33	42	1.4	-	-	-	-
14-27/38	14.8	25	60	-	-	-	-	-
27/38-64	13.9	28	79	1.4	41	38	26	12
64-108	18.5	31	90	1.5	39	36	28	8
108-170	16.5	33	88	-	-	-	-	-
170-200	19.4	40	87	-	-	-	-	-

- not determined
* derived value
(about 9 kg organic carbon per cubic meter)

Profile no.	**88/84C/110**
Map unit	B02
USDA (1987)	Aeric Albaquult
Family	coarse loamy over clayey, mixed, isohyperthermic
Series	**Tydixon**
FAO/UNESCO (1988)	Dystric Planosol, medium textured
Location	Worthy Park Estate (Tydixon park), St. Catherine; toposheet 84C, 453820 N, 493360 E
Parent material/rock	inland basin deposit of lacustrine origin
Physiographic position	straight slope
Topography	undulating (4% slope)
Elevation	about 375 m above MSL
Land use	citrus plantation on former pasture land
Drainage class	poorly (to imperfectly) drained
Moisture condition	moist throughout below the topsoil
Surface stoniness/rock outcrop	nil
Described by	L.L.T. Dawkins and P. van Gent
Date	06-12-88
Remarks	the day after digging the pit, it was filled up with water to 40 cm from the surface; pit is described at original site of Green Book description of Tydixon (Vernon 1958)

(All colours are for moist conditions, unless otherwise stated)

Ap *0-23 cm* dark brown (10YR 3/3), light brownish grey (10YR 7/2) when dry, sandy loam; moderately weak fine, medium and coarse granular structure; non sticky and slightly plastic when wet, friable when moist, slightly hard when dry; common fine, medium and coarse pores; frequent worm-activity and worm-casts; field pH 4.5; non calcareous; abrupt broken boundary to

E *23-39 cm* light grey (10YR 7/2) sandy loam with faint brownish yellow (10YR 6/8) mottles; very weak structure; non sticky and slightly plastic when wet, firm when moist; very many very fine, fine and medium tubular pores; very few very fine and fine roots; little worm-activity; field pH 5; non calcareous; clear wavy boundary to

Btg1 *39-72 cm* mixed light yellowish brown and brownish yellow (10YR 6/4 and 6/8) clay; moderately weak fine and medium (sub) angular blocky structure; sticky and slightly plastic when wet, firm when moist; big pressure faces; many very fine pores; few fine, medium and coarse roots; very little worm-activity; very few (quartz) gravels; field pH 4.5; non calcareous; gradual wavy boundary to

Btg2 *72-120 cm* mixed light grey and brownish yellow (10YR 7/2 and 6/8) clay with common medium distinct red and dark red (10R 5/8 and 3/6) mottles; moderately weak medium, coarse and very coarse (sub)angular blocky structure; sticky and slightly plastic when wet, firm when moist; big continuous pressure faces; common very fine and fine pores; few fine and medium roots; very few small gravels of different origin; field pH 4.5; non calcareous; gradual wavy boundary to

Btg3 *120-150 cm* light grey (10YR 7/1) clay with many coarse distinct to prominent brownish yellow (10YR 6/8) and red (10R 4/6) mottles; moderately weak medium, coarse and very coarse (sub)angular blocky structure, slightly sticky to sticky and slightly plastic when wet, firm when moist; big pressure faces but less than in the third and fourth horizon; common very fine and fine pores; common fine and medium roots; field pH 4.5; non calcareous

Profile no: 88/84C/110
Soil series: Tydixon
Lab no: 220/88

depth (cm)	particle size sand (%)	silt (%)	clay (%)	texture	natural clay (%)	dispersion-ratio* (%)	org. C (%)	N (%)	C/N
0-23	63	27	10	SL	1	10	1.3	0.08	16
23-39	55	31	14	SL	10	71	0.1	0.01	10
39-72	19	6	75	C	11	15	0.5	0.05	10
72-120	27	10	63	C	8	29	0.3	0.03	10
120-150	28	13	61	C	8	13	0.2	0.03	7

depth (cm)	CaCO3 (%)	pH H2O 1:2.5	pH KCl 1:2.5	EC2.5 mS/cm	ESP* (%)	SAR*	av. P205 (ppm)	av. K20 (ppm)
0-23	-	4.9	4.0	0.04	0	-	17	24
23-39	-	6.5	5.2	0.04	1	-	12	14
39-72	-	4.7	3.7	0.04	0	-	2	40
72-120	-	4.8	3.7	0.03	0	-	4	55
120-150	-	4.6	3.6	0.03	0	-	2	60

depth (cm)	exchangeable bases (me/100 g) Ca2+	Mg2+	Na+	K+	sum	exchangeable (me/100 g) acidity	Al3+	CEC (NH4OAc) (me/100 g) soil	clay	base sat.* (%)
0-23	0.6	0.14	0.01	0.06	0.8	0.68	0.47	2.7	27	30
23-39	0.6	0.10	0.01	0.02	0.7	-	-	0.7	5	100
39-72	1.8	0.35	0.03	0.09	2.3	9.08	9.08	13.5	18	17
72-120	1.5	0.19	0.01	0.12	1.8	9.19	9.19	13.1	21	14
120-150	0.1	0.12	0.06	0.13	0.4	10.99	10.99	13.4	22	3

depth (cm)	ECEC* (me/100 g) soil	clay	Al. sat.* (%)	bulk density (g/cubic cm)	pF (vol. %) 1.0	2.0	4.2	available moisture* (vol. %)
0-23	1.5	15	31	1.4	40	30	4	26
23-39	0.7	5	-	1.6	38	28	13	15
39-72	11.4	15	80	1.3?	49	45	34	11
72-120	11.0	17	84	-	-	-	-	-
120-150	11.4	19	96	-	-	-	-	-

- not determined
* derived value
(about 8 kg organic carbon per cubic meter)

Profile no.	**88/84C/111**
Map unit	B03
USDA (1987)	Aquic Argiudoll
Family	fine, mixed, isohyperthermic
Series	**Knollis**
FAO/UNESCO (1988)	Gleyic Luvic Phaozem, fine textured
Location	Worthy Park Estate, St. Catherine toposheet 84C, 448620 N, 497830 E
Parent material/rock	inland basin deposit of lacustrine origin
Physiographic position	straight slope in undulating inland basin
Topography	almost flat (2% slope)
Elevation	about 365 m above MSL
Land use	sugar cane plantation
Drainage class	imperfectly drained
Moisture condition	moist throughout
Surface stoniness/rock outcrop	nil
Described by	L.T.T. Dawkins and P. van Gent
Date	30-11-88
Remarks	relatively unweathered compared to profile 88/84C/109; abrupt textural change

(All colours are for moist conditions, unless otherwise stated; auger hole-description from 140 cm onwards)

Ap *0-23/48 cm* mixed dark brown (10YR3/3) and (dark) yellowish brown (10YR 4.5/4), dark brown (10YR 4/2, rubbed colour) when dry, clay loam; moderate fine and medium subangular blocky structure; slightly sticky and slightly plastic when wet, firm when moist, very hard when dry; common very fine, fine and few medium pores; common very fine, fine and medium roots; some big worm channels; frequent (about 15%) small and few large, mainly hard round black-reddish Fe-Mn-concretions; slightly gravelly; field pH 7; non calcareous; abrupt irregular boundary to

Btg1 *23/48-65 cm* mixed light grey (10 YR 7/2) and brownish yellow (10YR 6/8) clay with common fine distinct red (10R 4/8 and 2.5YR 5/8) mottles; moderately weak coarse subangular blocky structure; sticky and plastic when wet, firm when moist; common very fine and fine pores; common very fine and fine roots; few worm channels; field pH 4.5; non calcareous; gradual wavy boundary to

Btg2 *65-90 cm* mixed but more yellowish brown (10YR 5/8) than light grey (10YR 7/2) clay; moderately weak coarse subangular blocky structure; slightly sticky and slightly plastic when wet, firm when moist; not continuous pressure faces; common very fine exped pores (former root channels); few very fine and fine roots; field pH 4.5; non calcareous; clear wavy boundary to

Btg3 *90-170 cm* (auger hole description from 140 cm) light grey (10YR 7/2) clay with many coarse distinct strong brown (7.5YR 5/8) mottles; weak very coarse (sub-) angular blocky structure; slightly sticky and plastic when wet, firm when moist; not continuous pressure faces; few very fine exped pores (former root channels); very few fine roots; field pH 4.5; non calcareous

Profile no: 88/84C/111
Soil series: Knollis
Lab no: 221/88

depth (cm)	particle size sand (%)	silt (%)	clay (%)	texture	natural clay (%)	dispersion-ratio* (%)	org. C (%)	N (%)	C/N
0-23/48	20	40	40	CL	11	28	1.6	0.16	10
23/48-65	8	12	80	C	4	5	0.6	0.10	6
65-90	7	12	81	C	9	11	0.4	0.06	7
90-140	6	15	79	C	24	30	0.2	0.04	5
140-200	16	29	55	C	21	38	0.1	0.01	10

depth (cm)	CaCO3 (%)	pH H2O 1:2.5	pH KCl 1:2.5	EC2.5 mS/cm	ESP* (%)	SAR*	av. P2O5 (ppm)	av. K2O (ppm)
0-23/48	<0.50	7.1	5.9	0.12	1	-	30	50
23/48-65	-	5.2	3.9	0.11	1	-	3	71
65-90	-	4.7	3.4	0.09	2	-	3	86
90-140	-	4.7	3.2	0.09	5	-	2	97
140-200	-	4.8	3.2	0.06	4	-	3	122

depth (cm)	exchangeable bases (me/100 g) Ca2+	Mg2+	Na+	K+	sum	exchangeable (me/100 g) acidity	Al3+	CEC (NH4OAc) (me/100 g) soil	clay	base sat.* (%)
0-23/48	12.8*	2.82	0.14	0.11	15.9*	-	-	15.9	40	100
23/48-65	12.7	3.77	0.21	0.20	16.8	2.20	2.20	19.9	25	84
65-90	10.2	5.04	0.55	0.25	16.0	9.06	9.06	23.0	28	70
90-140	14.8	8.96	1.27	0.28	25.3	18.22	18.22	26.1	33	97
140-200	0.9	9.87	0.99	0.30	12.1	16.06	16.06	23.1	41	52

depth (cm)	ECEC* (me/100 g) soil	clay	Al. sat.* (%)	bulk density (g/cubic cm)	pF (vol. %) 1.0	2.0	4.2	available moisture* (vol. %)
0-23/48	15.9	40	-	-	-	-	-	-
23/48-65	19.0	24	11	-	-	-	-	-
65-90	25.1	31	36	-	-	-	-	-
90-140	41.5	53	44	-	-	-	-	-
140-200	28.2	50	57	-	-	-	-	-

- not determined
* derived value
(about 12 kg organic carbon per cubic meter)

Profile no.	**88/84C/112**
Map unit	PR1
USDA (1987)	Fluventic Hapludoll
Family	fine silty, mixed, isohyperthermic
Series	**Lluidas**
FAO/UNESCO (1988)	Haplic Phaozem, medium textured
Location	Worthy Park Estate, St. Catherine toposheet 84C, 451780 N, 499740 E
Parent material/rock	recent river alluvium of the Rio Cobre
Physiographic position	river terrace bordering Rio Cobre in inland basin
Topography	almost flat (2% slope)
Elevation	about 357 m above MSL
Land use	sugar cane plantation
Drainage class	somewhat excessively drained
Moisture condition	almost dry throughout
Surface stoniness/rock outcrop	nil
Described by	L.L.T. Dawkins and P. van Gent
Date	30-11-88
Remarks	river cut; soil at site of description is not gravelly; erosion is severe along the riversides; high P205 content due to fertilizer application

(All colours are for moist conditions, unless otherwise stated)

Ap *0-43 cm* dark reddish brown (5YR 3/2), brown (7.5YR 5/2) when dry, loam; moderate coarse and very coarse subangular blocky structure; slightly sticky and slightly plastic when wet, firm when moist, hard when dry; many very fine and fine pores; frequent very fine to coarse roots; few worm casts and worms; slightly gravelly; field pH 8; non calcareous; gradual smooth boundary to

Bw1 *43-77 cm* dark reddish grey (5YR 4/2), pinkish grey (7.5YR 6/2) when dry, silt loam; moderate coarse subangular blocky structure; slightly sticky and slightly plastic when wet, firm when moist, hard when dry; many very fine, fine and medium pores; common very fine to coarse roots; little worm-activity; field pH 7; slightly calcareous; clear smooth boundary to

Bw2 *77-112 cm* dark reddish grey (5YR 4/2), pinkish grey (7.5YR 6/2) when dry, silt loam; moderate to strong medium, coarse and very coarse angular blocky structure; slightly sticky to sticky and slightly plastic when wet, firm when moist, hard when dry; common fine and very fine pores; few fine and medium roots; field pH 7; slightly calcareous; abrupt smooth boundary to

Ab *112-126 cm* dark reddish brown (5YR 3/2), brown (7.5YR 5/2) when dry, silt loam; moderate coarse platy, columnar and angular blocky structure; slightly sticky and slightly plastic when wet, firm when moist, hard when dry; many very fine and fine pores; very few very fine, fine and medium roots; field pH 6.5; slightly calcareous; abrupt smooth boundary to

Bb *126-190 cm* reddish brown (5YR4/3), pinkish grey (7.5YR 7/2), fine sandy clay loam; moderate coarse angular blocky structure; slightly sticky to sticky and slightly plastic when wet, friable when moist, slightly hard when dry; many very fine and fine pores; very few very fine, fine and medium roots; field pH 8; slightly calcareous

Profile no: 88/84C/112
Soil series: Lluidas
Lab no: 222/88

depth (cm)	particle size sand (%)	silt (%)	clay (%)	texture	natural clay (%)	dispersion-ratio* (%)	org. C (%)	N (%)	C/N
0-43	30	46	24	L	5	21	1.2	0.11	11
43-77	23	58	19	SiL	5	26	0.6	0.07	9
77-112	11	64	25	SiL	6	24	0.6	0.08	8
112-126	16	59	25	SiL	6	24	0.6	0.06	10
126-190	29	49	22	L	5	22	0.3	0.07	4

depth (cm)	CaCO3 (%)	pH H2O 1:2.5	pH KCl 1:2.5	EC2.5 mS/cm	ESP* (%)	SAR*	av. P2O5 (ppm)	av. K2O (ppm)
0-43	-	5.9	4.5	0.21	1	-	194	115
43-77	<0.5	7.4	5.6	0.16	1	-	>400	60
77-112	<0.5	7.3	5.1	0.08	1	-	>400	66
112-126	<0.5	7.5	5.4	0.07	1	-	>400	65
126-190	<0.5	7.6	5.3	0.05	1	-	>400	55

depth (cm)	exchangeable bases (me/100 g) Ca2+	Mg2+	Na+	K+	sum	exchangeable acidity (me/100 g)	Al3+	CEC (NH4OAc) soil (me/100 g)	clay	base sat.* (%)
0-43	18.0*	5.61	0.21	0.27	24.1*	-	-	24.1	100	100
43-77	17.8*	6.99	0.22	0.17	25.2*	-	-	25.2	103	100
77-112	19.0*	7.54	0.29	0.19	27.0*	-	-	27.0	108	100
112-126	18.7*	6.94	0.33	0.17	26.1*	-	-	26.1	104	100
126-190	16.2*	6.29	0.31	0.13	22.9*	-	-	22.9	104	100

depth (cm)	ECEC* soil (me/100 g)	clay	Al. sat.* (%)	bulk density (g/cubic cm)	pF 1.0 (vol. %)	2.0	4.2	available moisture* (vol. %)
0-43	-	-	-	-	-	-	-	-
43-77	-	-	-	-	-	-	-	-
77-112	-	-	-	-	-	-	-	-
112-126	-	-	-	-	-	-	-	-
126-190	-	-	-	-	-	-	-	-

- not determined
* derived value
(about 12 kg organic carbon per cubic meter)

89/84A/046 cont:

Cg3 *112-129 cm* yellowish red (5YR 5/6, colour of the rubbed soil) sandy loam (field: loamy sand) weak very fine to medium granular structure; slightly sticky and slightly plastic when wet, very friable when moist; many very fine and fine and few medium pores; slightly calcareous; clear smooth boundary to

Cg4 *129-150 cm* red (2.5YR 4/6) silty clay loam (field: clay)with many medium distinct light yellowish brown (10YR 6/4) mottles and few fine distinct black Mn-stains; weak fine to coarse subangular blocky structure; sticky and plastic when wet, very firm when moist; few coated pores (former root channels?); few pressure faces; common very fine and few medium pores; slightly calcareous

Cg5 *150-195 cm* (auger boring) yellowish red (5YR 5/6) clay with common fine distinct light brownish grey (10YR 6/2) mottles and limestone gravels

C6 *195-210 cm* light reddish brown (5YR 6/4) sandy clay with Mn stains

C7 *210-250 cm* light reddish brown (5YR 6/4) clay with limestone gravels

89/84A/047 cont:

Cg *138-150 cm* yellowish red (5YR 5/6) gravelly loam (field: gravelly clay loam) with few medium faint strong brown (7.5YR 5/8) mottles; moderately weak fine to very coarse subangular blocky structure; slightly sticky and slightly plastic when wet, friable when moist; cutans in former root channels; many micro to fine pores; very few fine roots; common small limestone gravels; strongly calcareous

88/84C/109 cont:

Btg4 *108-170 cm* (auger hole description from 150 cm) red (10R 4/6) clay with many coarse distinct light grey (10YR 7/2) and many medium distinct strong brown (7.5YR 5/8) mottles; moderate fine and medium angular blocky structure; slightly sticky and slightly plastic when wet, firm when moist; coatings of topsoil on ped surfaces; some pressure faces; few very fine pores; field pH 4.5; non calcareous;

Cg *170-200 cm* light grey (10YR 7/2) (silty) clay with many coarse prominent yellowish red (5YR 5/8) mottles

APPENDIX V

USDA Soil Taxonomy classification of the major soil series and related mapping units

Soil Series	Subgroup	Family*	Map unit(s)
Bonnygate	Lithic Oxic Eutropepts	Clayey-skeletal, mixed	HLx1-3, HLx5-7
Brysons var. I	Entic Chromuderts	Very fine montmorillonitic	BFy1
Brysons var. II	Aquentic Chromuderts	Very fine mixed	BFy1
Carron Hall	Vertic Eutropepts	Fine montmorillonitic	HJ2
Donnington var. II	Typic Eutropepts	Loamy-skeletal mixed	BF1
Knollis	Aquic Argiudolls	Fine mixed	BO3
Linstead var. I	Aquic Kandiudalfs	Fine mixed	BO4
Lluidas	Fluventic Hapludolls	Fine silty mixed	PR1
Lluidas var. I	Typic Hapludolls	Fine mixed	PRx1
Lluidas var. II	Typic Eutropepts	Fine mixed	PRx1
Mountain Hill	Rhodic Kandiudoxs	Clayey gibbsitic	HL1
Mount Rosser	Paralithic Hapludolls	Fine mixed	HJ2
Pennants var. I	Vertic Haplohumults	Fine mixed	BO1
Prospect var. I	Typic Hapludolls	Fine loamy mixed	PFy1
Riverhead	Humic Hapludalfs	Fine mixed	BO6, HXx1
Rose Hall	Aquic Eutropepts	Fine mixed	PR2
Rose Hall var. I	Vertic Eutropepts	Fine mixed	PFy1
Rosemere var. I	Typic Paleudults	Clayey mixed	BO5
St. Ann var. I	Kandiudalfic Rhodic Eutrudoxs	Clayey gibbsitic	HLx1-3, HLx7
Swansea	Kandiudalfic Ruptic-Lithic Eutrudoxs	Clayey gibbsitic	HLx2
Tydixon	Aeric Albaquults	Course loamy over clayey, mixed	BO2
Union Hill	Lithic Vertic Eutropepts	Clayey-skeletal	HLx4-7, HXx1
Union Hill var. I	Humic Kandiudalfic Eutrudoxs	Clayey mixed	HLx4

* Temperature regime for all soils is "isohyperthermic"

APPENDIX VI
Correlation of the soil mapping units with those of the Green Books.

Soil mapping units		"Green Book" mapping units	
code	hectares*	Major components	Main inclusions
HL1	27	77, 78	
HLx1	5008	77,78	73
HLx2	620	77, 78	36, 94
HLx3	1890	77, 78	32
HLx4	257	61, 75, 77	
HLx5	772	75, 77, 78	12
HLx6	69	77, 78	
HLx7	207	75, 77, 78	
HJ1	13	77, 78	
HJ2	33	94, 95	34
HXx1	26	61, 75	
BO1	549	33, 74	66
BO2	145	66	
BO3	112	33	74, 78
BO4	97	61, 75	
BO5	38	61, 75	
BO6	48	61, 75	
BF1	187	33, 36, 77	
BFy1	68	74, 78, 79	
PR1	87	106	
PR2	93	13	
PRx1	297	106	
PFy1	29	6, 13	
Np	37	not indicated	77, 78
Nu	329	urban area, 61, 75	

* acreages are +/- 5%; planimetry by G. Derby;

APPENDIX VII

Legend to the 1:25,000 soil map of the Lluidas Vale Area (survey area: approximately 11,040 ha)

H: SOILS OF THE HILLS AND FOOTHILLS

(overall characteristics: relief intensity 20-200 m; slopes over 16%; elevation 260-900 m)

HL: SOILS FORMED ON HARD LIMESTONE

HL1: Mountain Hill clay: deep, well drained, red clay over hard white limestone. *Clayey gibbsitic isohyperthermic Rhodic Kandiudoxs*

HLx1: Bonnygate - rock outcrops - St. Ann variant I complex: complex of: a) very shallow, excessively drained, dark yellowish brown to yellowish red and red, stony clay loam to stony clay over hard white limestone, b) limestone rock outcrops, and c) deep, well drained to excessively drained, dark red to red clay over hard white limestone. *Clayey-skeletal mixed isohyperthermic Lithic Oxic Eutropepts, rock outcrops & clayey gibbsitic isohyperthermic Kandiudalfic Rhodic Eutrudoxs*

HLx2: Bonnygate - rock outcrops - Swansea complex: complex of: a) very shallow, excessively drained, dark yellowish brown to yellowish red and red, stony clay loam to stony clay over hard white limestone, b) limestone rock outcrops, and c) moderately deep, well drained to excessively drained, yellowish red to red clay over hard white limestone. *Clayey-skeletal mixed isohyperthermic Lithic Oxic Eutropepts, rock outcrops & clayey gibbsitic isohyperthermic Kandiudalfic Ruptic-Lithic Eutrudoxs*

HLx3: St. Ann variant I - Bonnygate complex: complex of deep, well drained to excessively drained, dark red to red clay over hard white limestone, and very shallow, excessively drained, dark yellowish brown to yellowish red and red, stony clay loam to stony clay over hard white limestone. *Clayey gibbsitic isohyperthermic Kandiudalfic Rhodic Eutrudoxs & clayey-skeletal mixed isohyperthermic Lithic Oxic Eutropepts.*

HLx4: Union Hill - Union Hill variant I complex: complex of shallow, well drained, reddish brown and strong brown to (dark) yellowish brown, slightly cracking stony clay, and deep, well drained, dark greyish brown to strong brown and yellowish brown clay over hard white limestone, in places with a humic topsoil. *Clayey-skeletal mixed isohyperthermic Lithic Vertic Eutropepts & clayey mixed isohyperthermic Humic Kandiudalfic Eutrudoxs*

HLx5: Union Hill - Bonnygate complex: complex of shallow, well drained, reddish brown and strong brown to (dark) yellowish brown, slightly cracking stony clay, and very shallow, excessively drained, dark yellowish brown to yellowish red and red, stony clay loam to stony clay over hard white limestone. *Clayey-skeletal mixed isohyperthermic Lithic Vertic Eutropepts & clayey-skeletal mixed isohyperthermic Lithic Oxic Eutropepts.*

HLx6: Bonnygate - rock outcrops - Union Hill complex: complex of: a) very shallow, excessively drained, dark yellowish brown to yellowish red and red, stony clay loam to stony clay over hard white limestone, b) limestone rock outcrops, and c) shallow, well drained, reddish brown and strong brown to (dark) yellowish brown, slightly cracking stony clay. *Clayey-skeletal mixed isohyperthermic Lithic Oxic Eutropepts, rock outcrops & clayey-skeletal mixed isohyperthermic Lithic Vertic Eutropepts.*

HLx7: Bonnygate - Union Hill - St. Ann variant I complex: complex of: a) very shallow, excessively drained, dark yellowish brown to yellowish red and red, stony clay loam to stony clay over hard white limestone, b) shallow, well drained, reddish brown and strong brown to (dark) yellowish brown, slightly cracking stony clay, and c) deep, well drained to excessively drained, dark red to red clay over hard white limestone. *Clayey-skeletal mixed isohyperthermic Lithic Oxic Eutropepts & clayey-skeletal mixed isohyperthermic Lithic-Vertic Eutropepts & clayey gibbsitic isohyperthermic Kandiudalfic Rhodic Eutrudoxs.*

HJ: SOILS FORMED ON WHITE RUBBLY AND SOFT YELLOW LIMESTONE

HJ1: Mount Rosser clay: shallow, well drained, strong brown to brownish yellow, stony clay over white rubbly and soft yellow limestone, with a humic topsoil. *Fine mixed isohyperthermic Paralithic Hapludolls.*

HJ2: Carron Hall silty clay: moderately deep, moderately well drained to well drained, yellowish brown to brownish yellow, cracking gravelly clay over rubbly white and soft yellow limestone. *Fine montmorillonitic isohyperthermic Vertic Eutropepts.*

HX: SOILS FORMED ON HARD LIMESTONE AND OLD ALLUVIAL DEPOSITS

HXx1: Union Hill - Riverhead complex: complex of shallow, well drained, reddish brown and strong brown to (dark) yellowish brown, slightly cracking stony clay, and deep, moderately well drained, brownish yellow to yellowish red and light grey, mottled clay over old alluvial deposits, with a humic topsoil. *Clayey-skeletal mixed isohyperthermic Lithic Vertic Eutropepts & fine mixed isohyperthermic Humic Hapludalfs.*

B: SOILS OF THE INLAND BASINS

(overall characteristics: relief intensity: 5-20 m; slopes: 0-16 %; elevation: approximately 260 and 370 m, respectively)

BO: SOILS FORMED ON OLD ALLUVIUM

BO1: Pennants variant I clay loam: deep, imperfectly drained, light grey and yellowish brown to strong brown, mottled, acid, slightly cracking clay over old alluvial/lacustrine deposits. *Fine mixed isohyperthermic Vertic Haplohumults.*

BO2: Tydixon sandy loam: deep, poorly drained, light grey and yellowish brown to brownish yellow, mottled, acid clay over old alluvial/lacustrine deposits, abruptly underlying a grey sandy horizon. *Coarse loamy over clayey mixed isohyperthermic Aeric Albaquults.*

BO3: Knollis clay loam: deep, imperfectly drained to poorly drained, strong brown, yellowish brown and light grey, mottled, acid clay over old alluvial/lacustrine deposits, with a humic topsoil. *Fine mixed isohyperthermic Aquic Argiudolls.*

BO4: Linstead variant I clay loam: deep, moderately well drained to imperfectly drained, strong brown to yellowish red and red, mottled, acid, very firm clay over old alluvial deposits. *Fine mixed isohyperthermic Aquic Kandiudalfs.*

BO5: Rosemere variant I clay: deep, moderately well drained, strong brown, red and light grey, mottled, acid clay over old alluvial deposits. *Clayey mixed isohyperthermic Typic Paleudults.*

BO6: Riverhead clay: deep, moderately well drained, brownish yellow to yellowish red and light grey, mottled clay over old alluvial deposits, with a humic topsoil. *Fine mixed isohyperthermic Humic Hapludalfs.*

BF: SOILS FORMED ON FLUVIO-COLLUVIAL DEPOSITS

BF1: Donnington variant II clay loam: moderately deep, well drained, mixed yellowish red, reddish grey to strong brown and dark brown gravelly loam to gravelly clay loam over transported pre-weathered conglomerates. *Loamy-skeletal mixed isohyperthermic Typic Eutropepts.*

BFy1: Brysons variant I - Brysons variant II complex: complex of deep, imperfectly drained, dark yellowish brown to pale brown and light grey, mottled clay over lacustrine deposits with admixtures of limestone colluvium, with a cracking topsoil, and deep, imperfectly to poorly drained, light grey, yellowish brown to brownish yellow, mottled, acid clay over lacustrine deposits with admixtures of limestone colluvium, with a slightly cracking topsoil. *Very fine montmorillonitic isohyperthermic Entic Chromuderts & very fine mixed isohyperthermic Aquentic Chromuderts.*

P: SOILS OF THE RIVER PLAINS

(Overall characteristics: relief intensity <10 m, slopes 0-5%, elevation: approximately 260 and 350 m, respectively).

PR: SOILS FORMED ON RECENT ALLUVIUM

PR1: Lluidas loam-silty loam: deep, well drained, (dark) reddish grey to dark reddish brown, medium textured soils over recent alluvium, with a humic topsoil. *Fine silty, mixed isohyperthermic Fluventic Hapludolls.*

PR2: Rose Hall clay loam - clay: deep, imperfectly drained, dark reddish brown over a mottled grey and brownish yellow clay over recent alluvium, with old alluvium admixture in places. *Fine mixed isohyperthermic Aquic Eutropepts.*

PRx1: Lluidas variant I - Lluidas variant II complex: complex of deep, well to moderately well drained, (dark) reddish brown, moderately fine textured soils over recent alluvium, with a humic topsoil, and deep, moderately well drained to well drained, dark reddish brown, slightly mottled, moderately fine to fine textured soils over recent alluvium. *Fine mixed isohyperthermic Typic Hapludolls & fine mixed isohyperthermic Typic Eutropepts.*

PF: SOILS FORMED OVER FLUVIO-COLLUVIAL DEPOSITS

PFy1: Prospect variant I - Rose Hall variant I complex: complex of deep, well drained, yellowish red to strong brown, medium to moderately fine textured soils over recent alluvium with admixtures of limestone colluvium, with a humic topsoil and deep, moderately well drained, yellowish red to strong brown, slightly mottled, moderately fine textured soils over recent alluvium with limestone colluvium admixture, with a slightly cracking topsoil. *Fine loamy mixed isohyperthermic Typic Hapludolls & fine mixed isohyperthermic Vertic Eutropepts.*

N: Miscellaneous land types

Np: Ponds
Nu: Rural residential areas

EXPLANATION OF MAP UNIT SYMBOL:

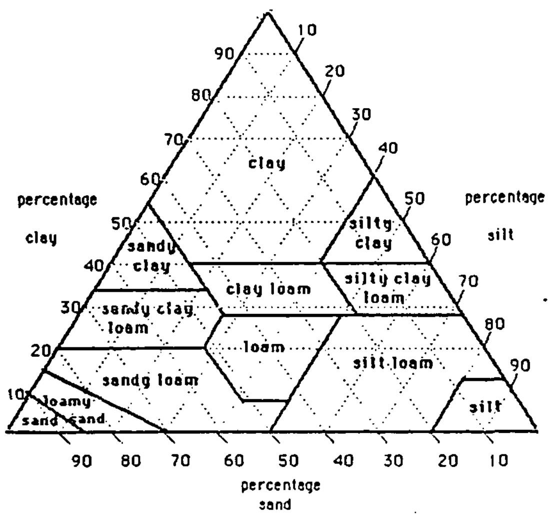
HLx1 : / e	H	physiography (Hills and Foothills)
	L	parent rock/material (hard Limestone)
	x	symbol for complex (x) or association (y)
	1	mapping unit order number (for Bonnygate - rock outcrop- St. Ann variant I)
	e	slope class (16-30%)

A------B	: Schematic cross-section of Figure 3.
■ 099	: Location of the soil pits and pit number (Appendix IV)
◆ 075	: Location of analysed rock samples (Appendix II)

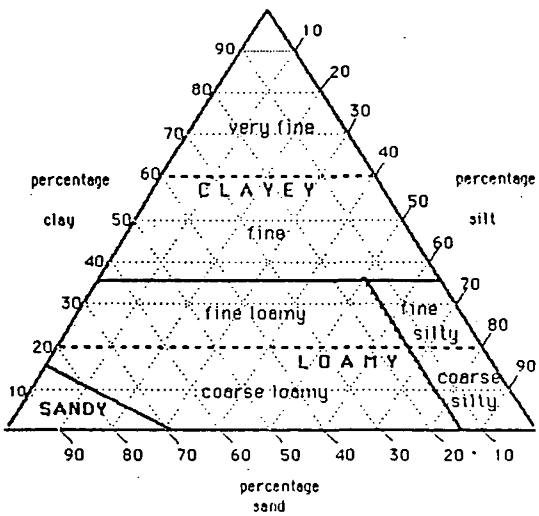
KEY TO SOIL DEPTH CLASSES:

very shallow	less than 25 cm
shallow	25 - 50 cm
moderately deep	50 - 100 cm
deep	over 100 cm

KEY TO TEXTURAL CLASSES:



Triangle textural classes



Triangle particle size classes (USDA)

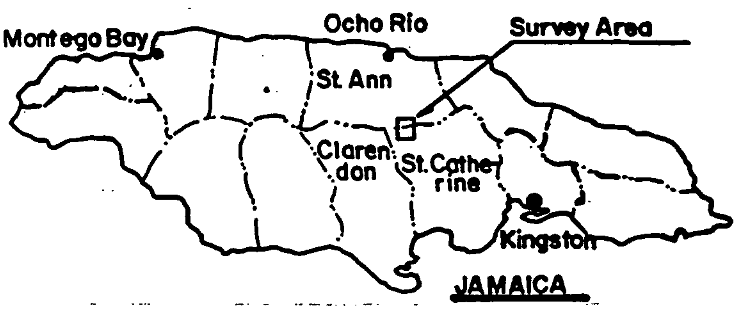
KEY TO TEXTURAL GROUPS:

fine	sandy clay, silty clay, clay
moderately fine	clay loam, sandy clay loam, silty clay loam
medium	very fine sandy loam, loam, silt loam, silt
moderately coarse	sandy loam, fine sandy loam
coarse	sand, loamy sand

KEYS TO SLOPE PHASES:

code	overall range in max. slope gradient (%)	single slope	complex slope
a	0-2	almost flat	flat to almost flat
b	2-5	very gently sloping	gently undulating
c	5-8	gently sloping	undulating
d	8-16	sloping	rolling
e	16-30	moderately steep	hilly
f	30-50	steep	steeply dissected
g	>50	very steep	v. steeply dissected

LOCATION:



MINISTRY OF AGRICULTURE
RURAL PHYSICAL PLANNING DIVISION
JAMAICA SOIL SURVEY PROJECT

Base map derived from 50% reduced toposheets 84A and 84C (scale 1:12,500) from Survey Department, Kingston.

Map compilation: P.A.M. van Gent, April 1990
Cartography: V.A. Ricketts, July 1990.

Soil survey: Staff of JSSP (1986), and L.L.T. Dawkins, G.J. Ford and P.A.M. van Gent (1988-1989).

Soil correlation and classification: N.H. Batjes, P.A.M. van Gent and G.R. Hennemann.

APPENDIX VIII
Agro-ecological limitations of the major soil series for selected crops.

Explanation of the tables:

The results of the matching procedure are presented in tables showing the degree of limitation of the land qualities for specific crops under current conditions. Each land quality is given a letter code. The limitations are indicated by a number.

Land qualities:

LT - temperature limitations for crops at the lowest point of the land unit
HT - temperature limitations for crops at the highest point of the land unit
OX - availability of oxygen for crops in the rootable zone.
RC - adequacy of rooting conditions for crops
NR - possibility for nutrient retention (ECEC), 0-30 cm
NA - available nutrients (OM%, avail. P, exch. Ca, Mg, K), 0-30 cm
PH - adequacy of soil pH, 0-30 cm and 30-50 cm
CC - occurrence of toxic levels of finely divided lime, 0-50 cm
AL - occurrence of toxic levels of exchangeable aluminium, 0-50 cm
SA - soil salinity toxicity, 0-100 cm
SO - soil sodicity toxicity, 0-50 cm
WH - workability by hand
WM - mechanized workability
Erosion - long term erosion hazard, as shown for slope classes a (0-2%), b (2-5%), c (5-8%), d (8-16%), e (16-30%), f (30-50%) and g (> 50%).

Degree of limitation:

0 - no limitations (e.g. AL0 means exchangeable aluminium is not limiting)
1 - slight/moderate limitations (e.g. RC1 means rooting conditions are limiting)
2 - strong limitations (e.g. Erosion d2 erosion is strongly limiting on slopes of 8-16%)

Table 1. Agro-ecological limitations for Donnington soils for selected crops under current conditions (soil profile 001)

Crop	land qualities													
	LT	HT	OX	RC	NR	NA	PH	CC	AL	SA	SO	WH	WM	Erosion
sugar cane	0	0	0	0	0	1	1	0	0	0	0	0	1	d0
maize	0	0	0	0	0	1	1	0	1	0	0	0	1	d0
tobacco	0	0	0	0	0	2	2	0	1	0	0	0	1	d0
groundnut	0	0	0	0	0	2	2	0	1	0	0	0	1	d0
pigeon pea	0	0	0	0	0	1	1	0	0	0	0	0	1	d0
common bean	0	0	0	0	0	2	2	0	1	0	0	0	1	d0
red pea	0	0	0	0	0	2	2	0	1	0	0	0	1	d0
onion	0	0	0	0	0	2	2	0	1	0	0	0	1	d0
cassava	0	0	0	0	0	1	1	0	0	0	0	0	1	d0
yam	0	0	0	1	0	2	2	0	1	0	0	0	1	d0
cocoyam	0	0	0	0	0	1	1	0	1	0	0	0	1	d0
sweet potato	0	0	0	0	0	2	2	0	1	0	0	0	1	d0
calaloo	0	0	0	0	0	1	1	0	0	0	0	0	1	d0
cabbage	0	0	0	0	0	2	2	0	1	0	0	0	1	d0
tomato	0	0	0	0	0	2	2	0	1	0	0	0	1	d0
cucumber	0	0	0	0	0	2	2	0	1	0	0	0	1	d0
pumpkin	0	0	0	0	0	1	1	0	1	0	0	0	1	d0
coconut	1	1	0	1	0	1	1	0	1	0	0	0	0	d0
cocoa	0	0	0	1	0	1	0	0	0	0	0	0	0	d0
coffee (arab.)	1	1	0	1	0	1	0	0	0	0	0	0	0	d0
coffee (cane.)	0	0	0	1	0	1	0	0	0	0	0	0	0	d0
breadfruit	0	0	0	1	0	1	1	0	1	0	0	0	0	d0
citrus	0	0	0	1	0	1	1	0	0	0	0	0	0	d0
ackee	0	0	0	1	0	1	1	0	0	0	0	0	0	d0
mango	0	0	0	1	0	1	1	0	0	0	0	0	0	d0
pimento	0	0	0	1	0	2	2	0	1	0	0	0	0	d0
forestry	0	0	0	1	0	1	1	0	0	0	0	0	0	d0
natural forest	0	0	0	0	0	0	0	0	0	0	0	0	0	d0
banana	0	0	0	1	0	2	2	0	1	0	0	0	1	d0
plantain	0	0	0	0	0	1	1	0	1	0	0	0	1	d0
pineapple	0	0	0	0	0	1	1	0	0	0	0	0	1	d0
unimpr. pasture	0	0	0	0	0	1	1	0	0	0	0	0	0	d0
impr. pasture	0	0	0	0	0	1	1	0	0	0	0	0	0	d0
ginger	0	0	0	0	0	1	1	0	0	0	0	0	1	d0

Table 2. Agro-ecological limitations for Brysons variant II soils for selected crops under current conditions (soil profile 003)

Crop	land qualities LT	HT	OX	RC	NR	NA	PH	CC	AL	SA	SO	WH	WM	Erosion
sugar cane	0	0	1	1	0	1	1	0	0	0	0	2	1	b0
maize	0	0	2	2	0	1	1	0	0	0	0	2	1	b0
tobacco	0	0	2	2	0	1	1	0	0	0	0	2	1	b0
groundnut	0	0	2	2	0	1	1	0	0	0	0	2	1	b0
pigeon pea	0	0	2	2	0	1	1	0	0	0	0	2	1	b0
common bean	0	0	2	2	0	1	1	0	0	0	0	2	1	b0
red pea	0	0	2	2	0	1	1	0	0	0	0	2	1	b0
onion	0	0	2	2	0	1	1	0	0	0	0	2	1	b0
cassava	0	0	2	2	0	1	1	0	0	0	0	2	1	b0
yam	0	0	2	2	0	1	1	0	0	0	0	2	1	b0
cocoyam	0	0	0	0	0	1	1	0	0	0	0	2	1	b0
sweet potato	0	0	2	2	0	1	1	0	0	0	0	2	1	b0
calaloo	0	0	2	2	0	1	1	0	0	0	0	2	1	b0
cabbage	0	0	2	2	0	1	1	0	0	0	0	2	1	b0
tomato	0	0	2	2	0	1	1	0	0	0	0	2	1	b0
cucumber	0	0	2	2	0	1	1	0	0	0	0	2	1	b0
pumpkin	0	0	2	2	0	1	1	0	0	0	0	2	1	b0
coconut	1	1	2	2	0	1	1	0	0	0	0	0	0	b0
cocoa	0	0	2	2	0	1	1	0	0	0	0	0	0	b0
coffee (arab.)	1	1	2	2	0	1	1	0	0	0	0	0	0	b0
coffee (cane.)	0	0	2	2	0	1	1	0	0	0	0	0	0	b0
breadfruit	0	0	2	2	0	1	1	0	0	0	0	0	0	b0
citrus	0	0	2	2	0	1	1	0	0	0	0	0	0	b0
ackee	0	0	2	2	0	1	1	0	0	0	0	0	0	b0
mango	0	0	2	2	0	1	1	0	0	0	0	0	0	b0
pimento	0	0	2	2	0	1	1	0	0	0	0	0	0	b0
forestry	0	0	2	2	0	1	1	0	0	0	0	0	0	b0
natural forest	0	0	1	1	0	0	0	0	0	0	0	0	0	b0
banana	0	0	2	2	0	1	1	0	0	0	0	2	1	b0
plantain	0	0	2	2	0	1	1	0	0	0	0	2	1	b0
pineapple	0	0	2	2	0	1	1	0	0	0	0	2	1	b0
unimpr. pasture	0	0	0	0	0	1	1	0	0	0	0	0	0	b0
impr. pasture	0	0	0	0	0	1	1	0	0	0	0	0	0	b0
ginger	0	0	2	2	0	1	1	0	0	0	0	2	1	b0

Table 3. Agro-ecological limitations for Brysons variant I soils for selected crops under current conditions (soil profile 004)

	land qualities													
Crop	LT	HT	OX	RC	NR	NA	PH	CC	AL	SA	SO	WH	WM	Erosion
sugar cane	0	0	1	1	0	1	1	0	0	0	0	1	0	b0
maize	0	0	2	2	0	1	1	1	0	0	0	1	0	b0
tobacco	0	0	2	2	0	1	1	1	0	0	0	1	0	b0
groundnut	0	0	2	2	0	1	1	1	0	0	0	1	0	b0
pigeon pea	0	0	2	2	0	1	1	0	0	0	0	1	0	b0
common bean	0	0	2	2	0	1	1	1	0	0	0	1	0	b0
red pea	0	0	2	2	0	1	1	1	0	0	0	1	0	b0
onion	0	0	2	2	0	1	1	0	0	0	0	1	0	b0
cassava	0	0	2	2	0	1	1	1	0	0	0	1	0	b0
yam	0	0	2	2	0	1	1	1	0	0	0	1	0	b0
cocoyam	0	0	0	0	0	1	1	1	0	0	0	1	0	b0
sweet potato	0	0	2	2	0	1	1	1	0	0	0	1	0	b0
calaloo	0	0	2	2	0	1	1	1	0	0	0	1	0	b0
cabbage	0	0	2	2	0	1	1	1	0	0	0	1	0	b0
tomato	0	0	2	2	0	1	1	1	0	0	0	1	0	b0
cucumber	0	0	2	2	0	1	1	1	0	0	0	1	0	b0
pumpkin	0	0	2	2	0	1	1	0	0	0	0	1	0	b0
coconut	1	1	2	2	0	1	1	0	0	0	0	0	0	b0
cocoa	0	0	2	2	0	2	1	2	0	0	0	0	0	b0
coffee (arab.)	1	1	2	2	0	2	1	2	0	0	0	0	0	b0
coffee (cane.)	0	0	2	2	0	2	1	2	0	0	0	0	0	b0
breadfruit	0	0	2	2	0	0	0	0	0	0	0	0	0	b0
citrus	0	0	2	2	0	1	1	1	0	0	0	0	0	b0
ackee	0	0	2	2	0	0	0	0	0	0	0	0	0	b0
mango	0	0	2	2	0	1	1	1	0	0	0	0	0	b0
pimento	0	0	2	2	0	1	1	1	0	0	0	0	0	b0
forestry	0	0	2	2	0	1	1	1	0	0	0	0	0	b0
natural forest	0	0	1	1	0	0	0	0	0	0	0	0	0	b0
banana	0	0	2	2	0	1	1	1	0	0	0	1	0	b0
plantain	0	0	2	2	0	1	1	1	0	0	0	1	0	b0
pineapple	0	0	2	2	0	2	1	2	0	0	0	1	0	b0
unimpr. pasture	0	0	0	0	0	1	1	0	0	0	0	0	0	b0
impr. pasture	0	0	0	0	0	0	0	0	0	0	0	0	0	b0
ginger	0	0	2	2	0	2	1	2	0	0	0	1	0	b0

Table 4. Agro-ecological limitations for Lluidas variant I soils for selected crops under current conditions (soil profile 010)

	land qualities														
Crop	LT	HT	OX	RC	NR	NA	PH	CC	AL	SA	SO	WH	WM	Erosion	
sugar cane	0	0	0	0	0	1	0	0	0	0	0	1	0	a0	b0
maize	0	0	1	1	0	1	0	0	0	0	0	1	0	a0	b0
tobacco	0	0	1	1	0	0	0	0	0	0	0	1	0	a0	b0
groundnut	0	0	1	1	0	0	0	0	0	0	0	1	0	a0	b0
pigeon pea	0	0	1	1	0	0	0	0	0	0	0	1	0	a0	b0
common bean	0	0	1	1	0	1	0	0	0	0	0	1	0	a0	b0
red pea	0	0	1	1	0	0	0	0	0	0	0	1	0	a0	b0
onion	0	0	1	1	0	0	0	0	0	0	0	1	0	a0	b0
cassava	0	0	1	1	0	0	0	0	0	0	0	1	0	a0	b0
yam	0	0	1	1	0	0	0	0	0	0	0	1	0	a0	b0
cocoyam	0	0	0	0	0	1	1	0	0	0	0	1	0	a0	b0
sweet potato	0	0	1	1	0	1	0	0	0	0	0	1	0	a0	b0
calaloo	0	0	1	1	0	0	0	0	0	0	0	1	0	a0	b0
cabbage	0	0	1	1	0	1	0	0	0	0	0	1	0	a0	b0
tomato	0	0	1	1	0	1	0	0	0	0	0	1	0	a0	b0
cucumber	0	0	1	1	0	1	0	0	0	0	0	1	0	a0	b0
pumpkin	0	0	1	1	0	0	0	0	0	0	0	1	0	a0	b0
coconut	1	1	1	1	0	0	0	0	0	0	0	0	0	a0	b0
cocoa	0	0	1	1	0	1	1	0	0	0	0	0	0	a0	b0
coffee (arab.)	1	1	1	1	0	1	1	0	0	0	0	0	0	a0	b0
coffee (cane.)	0	0	1	1	0	1	1	0	0	0	0	0	0	a0	b0
breadfruit	0	0	1	1	0	0	0	0	0	0	0	0	0	a0	b0
citrus	0	0	1	1	0	0	0	0	0	0	0	0	0	a0	b0
ackee	0	0	1	1	0	0	0	0	0	0	0	0	0	a0	b0
mango	0	0	1	1	0	0	0	0	0	0	0	0	0	a0	b0
pimento	0	0	1	1	0	0	0	0	0	0	0	0	0	a0	b0
forestry	0	0	1	1	0	0	0	0	0	0	0	0	0	a0	b0
natural forest	0	0	0	0	0	0	0	0	0	0	0	0	0	a0	b0
banana	0	0	1	1	0	1	0	0	0	0	0	1	0	a0	b0
plantain	0	0	1	1	0	0	0	0	0	0	0	1	0	a0	b0
pineapple	0	0	1	1	0	1	1	0	0	0	0	1	0	a0	b0
unimpr. pasture	0	0	0	0	0	0	0	0	0	0	0	0	0	a0	b0
impr. pasture	0	0	0	0	0	0	0	0	0	0	0	0	0	a0	b0
ginger	0	0	1	1	0	1	1	0	0	0	0	1	0	a0	b0

Table 5. Agro-ecological limitations for Rose Hall variant I soils for selected crops under current conditions (soil profile 046)

	land qualities													
Crop	LT	HT	OX	RC	NR	NA	PH	CC	AL	SA	SO	WH	WM	Erosion
sugar cane	0	0	0	0	0	1	0	0	0	0	0	0	0	b0
maize	0	0	1	1	0	1	1	0	0	0	0	0	0	b0
tobacco	0	0	1	1	0	1	1	0	0	0	0	0	0	b0
groundnut	0	0	1	1	0	1	1	0	0	0	0	0	0	b0
pigeon pea	0	0	1	1	0	0	0	0	0	0	0	0	0	b0
common bean	0	0	1	1	0	1	1	0	0	0	0	0	0	b0
red pea	0	0	1	1	0	1	1	0	0	0	0	0	0	b0
onion	0	0	1	1	0	1	1	0	0	0	0	0	0	b0
cassava	0	0	1	1	0	0	0	0	0	0	0	0	0	b0
yam	0	0	1	1	0	1	1	0	0	0	0	0	0	b0
cocoyam	0	0	0	0	0	1	1	0	0	0	0	0	0	b0
sweet potato	0	0	1	1	0	1	1	0	0	0	0	0	0	b0
calaloo	0	0	1	1	0	1	1	0	0	0	0	0	0	b0
cabbage	1	1	1	1	0	1	1	0	0	0	0	0	0	b0
tomato	0	0	1	1	0	1	1	0	0	0	0	0	0	b0
cucumber	0	0	1	1	0	1	1	0	0	0	0	0	0	b0
pumpkin	0	0	1	1	0	1	1	0	0	0	0	0	0	b0
coconut	0	0	1	1	0	0	0	0	0	0	0	0	0	b0
cocoa	0	0	1	1	0	1	1	0	0	0	0	0	0	b0
coffee (arab.)	1	1	1	1	0	1	1	0	0	0	0	0	0	b0
coffee (cane.)	0	0	1	1	0	1	1	0	0	0	0	0	0	b0
breadfruit	0	0	1	1	0	0	0	0	0	0	0	0	0	b0
citrus	0	0	1	1	0	0	0	0	0	0	0	0	0	b0
ackee	0	0	1	1	0	0	0	0	0	0	0	0	0	b0
mango	0	0	1	1	0	0	0	0	0	0	0	0	0	b0
pimento	0	0	1	1	0	1	1	0	0	0	0	0	0	b0
forestry	0	0	1	1	0	0	0	0	0	0	0	0	0	b0
natural forest	0	0	0	0	0	0	0	0	0	0	0	0	0	b0
banana	0	0	1	1	0	1	1	0	0	0	0	0	0	b0
plantain	0	0	1	1	0	1	1	0	0	0	0	0	0	b0
pineapple	0	0	1	1	0	1	1	0	0	0	0	0	0	b0
unimpr. pasture	0	0	0	0	0	0	0	0	0	0	0	0	0	b0
impr. pasture	0	0	0	0	0	0	0	0	0	0	0	0	0	b0
ginger	0	0	1	1	0	1	1	0	0	0	0	0	0	b0

Table 6. Agro-ecological limitations for Prospect variant I soils for selected crops under current conditions (soil profile 047)

	land qualities													
Crop	LT	HT	OX	RC	NR	NA	PH	CC	AL	SA	SO	WH	WM	Erosion
sugar cane	0	0	0	0	0	1	0	0	0	0	0	0	0	b0
maize	0	0	0	0	0	1	1	0	0	0	0	0	0	b0
tobacco	0	0	0	0	0	1	1	0	0	0	0	0	0	b0
groundnut	0	0	0	0	0	1	1	0	0	0	0	0	0	b0
pigeon pea	0	0	0	0	0	0	0	0	0	0	0	0	0	b0
common bean	0	0	0	0	0	1	1	0	0	0	0	0	0	b0
red pea	0	0	0	0	0	1	1	0	0	0	0	0	0	b0
onion	0	0	0	0	0	1	1	0	0	0	0	0	0	b0
cassava	0	0	0	0	0	0	0	0	0	0	0	0	0	b0
yam	0	0	0	0	0	1	1	0	0	0	0	0	0	b0
cocoyam	0	0	0	0	0	1	1	0	0	0	0	0	0	b0
sweet potato	0	0	0	0	0	1	1	0	0	0	0	0	0	b0
calaloo	0	0	0	0	0	1	1	0	0	0	0	0	0	b0
cabbage	1	1	0	0	0	1	1	0	0	0	0	0	0	b0
tomato	0	0	0	0	0	1	1	0	0	0	0	0	0	b0
cucumber	0	0	0	0	0	1	1	0	0	0	0	0	0	b0
pumpkin	0	0	0	0	0	1	1	0	0	0	0	0	0	b0
coconut	0	0	0	0	0	0	0	0	0	0	0	0	0	b0
cocoa	0	0	0	0	0	1	1	0	0	0	0	0	0	b0
coffee (arab.)	1	1	0	0	0	1	1	0	0	0	0	0	0	b0
coffee (cane.)	0	0	0	0	0	1	1	0	0	0	0	0	0	b0
breadfruit	0	0	0	0	0	0	0	0	0	0	0	0	0	b0
citrus	0	0	0	0	0	0	0	0	0	0	0	0	0	b0
ackee	0	0	0	0	0	0	0	0	0	0	0	0	0	b0
mango	0	0	0	0	0	0	0	0	0	0	0	0	0	b0
pimento	0	0	0	0	0	1	1	0	0	0	0	0	0	b0
forestry	0	0	0	0	0	0	0	0	0	0	0	0	0	b0
natural forest	0	0	0	0	0	0	0	0	0	0	0	0	0	b0
banana	0	0	0	0	0	1	1	0	0	0	0	0	0	b0
plantain	0	0	0	0	0	1	1	0	0	0	0	0	0	b0
pineapple	0	0	0	0	0	1	1	0	0	0	0	0	0	b0
unimpr. pasture	0	0	0	0	0	0	0	0	0	0	0	0	0	b0
impr. pasture	0	0	0	0	0	0	0	0	0	0	0	0	0	b0
ginger	0	0	0	0	0	1	1	0	0	0	0	0	0	b0

Table 7. Agro-ecological limitations for St. Ann variant I soils for selected crops under current conditions (soil profile 054)

	land qualities													
Crop	LT	HT	OX	RC	NR	NA	PH	CC	AL	SA	SO	WH	WM	Erosion
sugar cane	0	1	0	0	1	1	1	0	0	0	0	0	1	c0 d0
maize	0	0	0	0	1	1	1	0	0	0	0	0	1	c0 d0
tobacco	0	1	0	0	1	1	1	0	0	0	0	0	1	c0 d0
groundnut	0	1	0	0	0	1	1	0	0	0	0	0	1	c0 d0
pigeon pea	0	0	0	0	0	0	0	0	0	0	0	0	1	c0 d0
common bean	0	0	0	0	1	1	1	0	0	0	0	0	1	c0 d0
red pea	0	0	0	0	0	1	1	0	0	0	0	0	1	c0 d0
onion	0	0	0	0	0	1	1	0	0	0	0	0	1	c0 d0
cassava	0	0	0	0	0	0	0	0	0	0	0	0	1	c0 d0
yam	0	0	0	0	0	1	1	0	0	0	0	0	1	c0 d0
cocoyam	0	1	0	0	1	1	1	0	0	0	0	0	1	c0 d0
sweet potato	0	0	0	0	1	1	1	0	0	0	0	0	1	c0 d0
calaloo	0	0	0	0	0	1	1	0	0	0	0	0	1	c0 d0
cabbage	0	0	0	0	1	1	1	0	0	0	0	0	1	c0 d0
tomato	0	0	0	0	1	1	1	0	0	0	0	0	1	c0 d0
cucumber	0	0	0	0	1	1	1	0	0	0	0	0	1	c0 d0
pumpkin	0	0	0	0	0	1	1	0	0	0	0	0	1	c0 d0
coconut	1	2	0	0	0	0	0	0	0	0	0	0	0	c0 d0
cocoa	0	1	0	0	1	1	1	0	0	0	0	0	0	c0 d0
coffee (arab.)	1	0	0	0	1	2	2	0	0	0	0	0	0	c0 d0
coffee (cane.)	0	1	0	0	1	2	2	0	0	0	0	0	0	c0 d0
breadfruit	0	0	0	0	0	0	0	0	0	0	0	0	0	c0 d0
citrus	0	0	0	0	0	1	1	0	0	0	0	0	0	c0 d0
ackee	0	0	0	0	0	0	0	0	0	0	0	0	0	c0 d0
mango	0	0	0	0	0	0	0	0	0	0	0	0	0	c0 d0
pimento	0	0	0	0	0	1	1	0	0	0	0	0	0	c0 d0
forestry	0	0	0	0	0	1	1	0	0	0	0	0	0	c0 d0
natural forest	0	0	0	0	0	0	0	0	0	0	0	0	0	c0 d0
banana	0	1	0	0	1	1	1	0	0	0	0	0	1	c0 d0
plantain	0	0	0	0	0	1	1	0	0	0	0	0	1	c0 d0
pineapple	0	1	0	0	0	1	1	0	0	0	0	0	1	c0 d0
unimpr. pasture	0	0	0	0	0	0	0	0	0	0	0	0	0	c0 d0
impr. pasture	0	0	0	0	0	0	0	0	0	0	0	0	0	c0 d0
ginger	0	0	0	0	1	1	1	0	0	0	0	0	1	c0 d0

Table 8. Agro-ecological limitations for soils like St. Ann variant I (inclusion) for selected crops under current conditions (soil profile 066)

	land qualities													
Crop	LT	HT	OX	RC	NR	NA	PH	CC	AL	SA	SO	WH	WM	Erosion
sugar cane	0	1	0	0	2	1	0	0	0	0	0	0	0	c0 d0
maize	0	0	0	0	2	1	1	0	0	0	0	0	0	c0 d0
tobacco	0	1	0	0	2	1	1	0	0	0	0	0	0	c0 d0
groundnut	0	1	0	0	1	1	1	0	0	0	0	0	0	c0 d0
pigeon pea	0	0	0	0	0	0	0	0	0	0	0	0	0	c0 d0
common bean	0	0	0	0	2	1	1	0	0	0	0	0	0	c0 d0
red pea	0	0	0	0	1	1	1	0	0	0	0	0	0	c0 d0
onion	0	0	0	0	1	1	1	0	0	0	0	0	0	c0 d0
cassava	0	0	0	0	0	0	0	0	0	0	0	0	0	c0 d0
yam	0	0	0	0	1	1	1	0	0	0	0	0	0	c0 d0
cocoyam	0	1	0	0	2	1	0	0	0	0	0	0	0	c0 d0
sweet potato	0	0	0	0	2	1	1	0	0	0	0	0	0	c0 d0
calaloo	0	0	0	0	1	1	1	0	0	0	0	0	0	c0 d0
cabbage	0	0	0	0	2	1	1	0	0	0	0	0	0	c0 d0
tomato	0	0	0	0	2	1	1	0	0	0	0	0	0	c0 d0
cucumber	0	0	0	0	2	1	1	0	0	0	0	0	0	c0 d0
pumpkin	0	0	0	0	1	1	1	0	0	0	0	0	0	c0 d0
coconut	1	2	0	0	0	0	0	0	0	0	0	0	0	c0 d0
cocoa	0	1	0	0	2	1	0	0	0	0	0	0	0	c0 d0
coffee (arab.)	1	0	0	0	2	1	0	0	0	0	0	0	0	c0 d0
coffee (cane.)	0	1	0	0	2	1	0	0	0	0	0	0	0	c0 d0
breadfruit	0	0	0	0	1	0	0	0	0	0	0	0	0	c0 d0
citrus	0	0	0	0	1	0	0	0	0	0	0	0	0	c0 d0
ackee	0	0	0	0	1	0	0	0	0	0	0	0	0	c0 d0
mango	0	0	0	0	1	0	0	0	0	0	0	0	0	c0 d0
pimento	0	0	0	0	1	1	1	0	0	0	0	0	0	c0 d0
forestry	0	0	0	0	1	0	0	0	0	0	0	0	0	c0 d0
natural forest	0	0	0	0	0	0	0	0	0	0	0	0	0	c0 d0
banana	0	1	0	0	2	1	1	0	0	0	0	0	0	c0 d0
plantain	0	0	0	0	1	1	1	0	0	0	0	0	0	c0 d0
pineapple	0	1	0	0	1	0	0	0	0	0	0	0	0	c0 d0
unimpr. pasture	0	0	0	0	0	0	0	0	0	0	0	0	0	c0 d0
impr. pasture	0	0	0	0	1	0	0	0	0	0	0	0	0	c0 d0
ginger	0	0	0	0	2	1	0	0	0	0	0	0	0	c0 d0

Table 9. Agro-ecological limitations for soils like Swansea (inclusion) for selected crops under current conditions (soil profile 067)

	land qualities													
Crop	LT	HT	OX	RC	NR	NA	PH	CC	AL	SA	SO	WH	WM	Erosion
sugar cane	0	1	0	1	1	1	1	0	0	0	0	1	2	d0 e1
maize	0	0	0	1	1	1	1	0	0	0	0	1	2	d0 e2
tobacco	0	1	0	1	1	1	1	0	0	0	0	1	2	d0 e2
groundnut	0	1	0	1	0	1	1	0	0	0	0	1	2	d0 e2
pigeon pea	0	0	0	0	0	0	0	0	0	0	0	1	2	d0 e2
common bean	0	0	0	1	1	1	1	0	0	0	0	1	2	d0 e2
red pea	0	0	0	1	0	1	1	0	0	0	0	1	2	d0 e2
onion	0	0	0	1	0	1	1	0	0	0	0	1	2	d0 e2
cassava	0	0	0	1	0	0	0	0	0	0	0	1	2	d0 e2
yam	0	0	0	2	0	1	1	0	0	0	0	1	2	d0 e2
cocoyam	0	1	0	1	1	1	1	0	0	0	0	1	2	d0 e2
sweet potato	0	0	0	1	1	1	1	0	0	0	0	1	2	d0 e2
calaloo	0	0	0	1	0	1	1	0	0	0	0	1	2	d0 e2
cabbage	0	0	0	1	1	1	1	0	0	0	0	1	2	d0 e2
tomato	0	0	0	1	1	1	1	0	0	0	0	1	2	d0 e2
cucumber	0	0	0	1	1	1	1	0	0	0	0	1	2	d0 e2
pumpkin	0	0	0	1	0	1	1	0	0	0	0	1	2	d0 e2
coconut	1	2	0	2	0	0	0	0	0	0	0	0	0	d0 e1
cocoa	0	1	0	2	1	1	1	0	0	0	0	0	0	d0 e0
coffee (arab.)	1	0	0	2	1	1	1	0	0	0	0	0	0	d0 e0
coffee (cane.)	0	1	0	2	1	1	1	0	0	0	0	0	0	d0 e0
breadfruit	0	0	0	2	0	0	0	0	0	0	0	0	0	d0 e0
citrus	0	0	0	2	0	1	1	0	0	0	0	0	0	d0 e0
ackee	0	0	0	2	0	0	0	0	0	0	0	0	0	d0 e0
mango	0	0	0	2	0	0	0	0	0	0	0	0	0	d0 e0
pimento	0	0	0	2	0	1	1	0	0	0	0	0	0	d0 e0
forestry	0	0	0	2	0	1	1	0	0	0	0	0	0	d0 e0
natural forest	0	0	0	0	0	0	0	0	0	0	0	0	0	d0 e0
banana	0	1	0	2	1	1	1	0	0	0	0	1	2	d0 e1
plantain	0	0	0	1	0	1	1	0	0	0	0	1	2	d0 e1
pineapple	0	1	0	1	0	1	1	0	0	0	0	1	2	d0 e2
unimpr. pasture	0	0	0	0	0	0	0	0	0	0	0	0	0	d0 e0
impr. pasture	0	0	0	0	0	0	0	0	0	0	0	0	0	d0 e0
ginger	0	0	0	1	1	1	1	0	0	0	0	1	2	d0 e2

Table 10. Agro-ecological limitations for Swansea soils
for selected crops under current conditions (soil profile 068)

	land qualities													
Crop	LT	HT	OX	RC	NR	NA	PH	CC	AL	SA	SO	WH	WM	Erosion
sugar cane	0	1	0	1	1	1	0	0	0	0	0	1	2	d0 e1
maize	0	0	0	1	1	1	0	0	0	0	0	1	2	d0 e2
tobacco	0	1	0	1	1	0	0	0	0	0	0	1	2	d0 e2
groundnut	0	1	0	1	0	0	0	0	0	0	0	1	2	d0 e2
pigeon pea	0	0	0	0	0	0	0	0	0	0	0	1	2	d0 e2
common bean	0	0	0	1	1	1	0	0	0	0	0	1	2	d0 e2
red pea	0	0	0	1	0	0	0	0	0	0	0	1	2	d0 e2
onion	0	0	0	1	0	0	0	0	0	0	0	1	2	d0 e2
cassava	0	0	0	1	0	0	0	0	0	0	0	1	2	d0 e2
yam	0	0	0	2	0	0	0	0	0	0	0	1	2	d0 e2
cocoyam	0	1	0	1	1	1	1	0	0	0	0	1	2	d0 e2
sweet potato	0	0	0	1	1	1	0	0	0	0	0	1	2	d0 e2
calaloo	0	0	0	1	0	0	0	0	0	0	0	1	2	d0 e2
cabbage	0	0	0	1	1	1	0	0	0	0	0	1	2	d0 e2
tomato	0	0	0	1	1	1	0	0	0	0	0	1	2	d0 e2
cucumber	0	0	0	1	1	1	0	0	0	0	0	1	2	d0 e2
pumpkin	0	0	0	1	0	0	0	0	0	0	0	1	2	d0 e2
coconut	1	2	0	2	0	0	0	0	0	0	0	0	0	d0 e1
cocoa	0	1	0	2	1	1	1	0	0	0	0	0	0	d0 e0
coffee (arab.)	1	0	0	2	1	1	1	0	0	0	0	0	0	d0 e1
coffee (cane.)	0	1	0	2	1	1	1	0	0	0	0	0	0	d0 e1
breadfruit	0	0	0	2	0	0	0	0	0	0	0	0	0	d0 e1
citrus	0	0	0	2	0	0	0	0	0	0	0	0	0	d0 e1
ackee	0	0	0	2	0	0	0	0	0	0	0	0	0	d0 e1
mango	0	0	0	2	0	0	0	0	0	0	0	0	0	d0 e1
pimento	0	0	0	2	0	0	0	0	0	0	0	0	0	d0 e1
forestry	0	0	0	2	0	0	0	0	0	0	0	0	0	d0 e0
natural forest	0	0	0	0	0	0	0	0	0	0	0	0	0	d0 e0
banana	0	1	0	2	1	1	0	0	0	0	0	1	2	d0 e2
plantain	0	0	0	1	0	0	0	0	0	0	0	1	2	d0 e2
pineapple	0	1	0	1	0	1	1	0	0	0	0	1	2	d0 e2
unimpr. pasture	0	0	0	0	0	0	0	0	0	0	0	0	0	d0 e0
impr. pasture	0	0	0	0	0	0	0	0	0	0	0	0	0	d0 e0
ginger	0	0	0	1	1	1	1	0	0	0	0	1	2	d0 e2

Table 11. Agro-ecological limitations for Linstead variant I soils for selected crops under current conditions (soil profile 084)

	land qualities													
Crop	LT	HT	OX	RC	NR	NA	PH	CC	AL	SA	SO	WH	WM	Erosion
sugar cane	0	0	1	1	1	2	0	0	0	0	0	0	0	b0 c0
maize	0	0	2	2	1	2	0	0	0	0	0	0	0	b0 c0
tobacco	0	0	2	2	1	1	0	0	0	0	0	0	0	b0 c0
groundnut	0	0	2	2	0	1	0	0	0	0	0	0	0	b0 c0
pigeon pea	0	0	2	2	0	0	0	0	0	0	0	0	0	b0 c0
common bean	0	0	2	2	1	2	0	0	0	0	0	0	0	b0 c0
red pea	0	0	2	2	0	1	0	0	0	0	0	0	0	b0 c0
onion	0	0	2	2	0	1	0	0	0	0	0	0	0	b0 c0
cassava	0	0	2	2	0	0	0	0	0	0	0	0	0	b0 c0
yam	0	0	2	2	0	1	0	0	0	0	0	0	0	b0 c0
cocoyam	0	0	0	0	1	2	1	0	0	0	0	0	0	b0 c0
sweet potato	0	0	2	2	1	2	0	0	0	0	0	0	0	b0 c0
calaloo	0	0	2	2	0	1	0	0	0	0	0	0	0	b0 c0
cabbage	1	1	2	2	1	2	0	0	0	0	0	0	0	b0 c0
tomato	0	0	2	2	1	2	0	0	0	0	0	0	0	b0 c0
cucumber	0	0	2	2	1	2	0	0	0	0	0	0	0	b0 c0
pumpkin	0	0	2	2	0	1	0	0	0	0	0	0	0	b0 c0
coconut	0	0	2	2	0	0	0	0	0	0	0	0	0	b0 c0
cocoa	0	0	2	2	1	2	1	0	0	0	0	0	0	b0 c0
coffee (arab.)	1	1	2	2	1	2	1	0	0	0	0	0	0	b0 c0
coffee (cane.)	0	0	2	2	1	2	1	0	0	0	0	0	0	b0 c0
breadfruit	0	0	2	2	0	1	0	0	0	0	0	0	0	b0 c0
citrus	0	0	2	2	0	1	0	0	0	0	0	0	0	b0 c0
ackee	0	0	2	2	0	1	0	0	0	0	0	0	0	b0 c0
mango	0	0	2	2	0	1	0	0	0	0	0	0	0	b0 c0
pimento	0	0	2	2	0	1	0	0	0	0	0	0	0	b0 c0
forestry	0	0	2	2	0	1	0	0	0	0	0	0	0	b0 c0
natural forest	0	0	1	1	0	0	0	0	0	0	0	0	0	b0 c0
banana	0	0	2	2	1	2	0	0	0	0	0	0	0	b0 c0
plantain	0	0	2	2	0	1	0	0	0	0	0	0	0	b0 c0
pineapple	0	0	2	2	0	1	1	0	0	0	0	0	0	b0 c0
unimpr. pasture	0	0	0	0	0	1	0	0	0	0	0	0	0	b0 c0
impr. pasture	0	0	0	0	0	1	0	0	0	0	0	0	0	b0 c0
ginger	0	0	2	2	1	2	1	0	0	0	0	0	0	b0 c0

Table 12. Agro-ecological limitations for Mount Rosser soils for selected crops under current conditions (soil profile 090)

	land qualities															
Crop	LT	HT	OX	RC	NR	NA	PH	CC	AL	SA	SO	WH	WM	Erosion		
sugar cane	0	0	0	2	0	1	1	1	0	0	0	1	2	e2	f2	g2
maize	0	0	0	2	0	1	1	1	0	0	0	1	2	e2	f2	g2
tobacco	0	0	0	2	0	2	1	2	0	0	0	1	2	e2	f2	g2
groundnut	0	0	0	2	0	1	1	1	0	0	0	1	2	e2	f2	g2
pigeon pea	0	0	0	1	0	1	1	1	0	0	0	1	2	e2	f2	g2
common bean	0	0	0	2	0	2	1	2	0	0	0	1	2	e2	f2	g2
red pea	0	0	0	2	0	2	1	2	0	0	0	1	2	e2	f2	g2
onion	0	0	0	2	0	1	1	1	0	0	0	1	2	e2	f2	g2
cassava	0	0	0	2	0	1	1	1	0	0	0	1	2	e2	f2	g2
yam	0	0	0	2	0	2	1	2	0	0	0	1	2	e2	f2	g2
cocoyam	0	0	0	2	0	2	1	2	0	0	0	1	2	e2	f2	g2
sweet potato	0	0	0	2	0	2	1	2	0	0	0	1	2	e2	f2	g2
calaloo	0	0	0	2	0	2	1	2	0	0	0	1	2	e2	f2	g2
cabbage	0	0	0	2	0	2	1	2	0	0	0	1	2	e2	f2	g2
tomato	0	0	0	2	0	2	1	2	0	0	0	1	2	e2	f2	g2
cucumber	0	0	0	2	0	2	1	2	0	0	0	1	2	e2	f2	g2
pumpkin	0	0	0	2	0	1	1	1	0	0	0	1	2	e2	f2	g2
coconut	1	1	0	2	0	1	1	1	0	0	0	0	0	e2	f2	g2
cocoa	0	0	0	2	0	2	2	2	0	0	0	0	0	e2	f2	g2
coffee (arab.)	1	1	0	2	0	2	2	2	0	0	0	0	0	e2	f2	g2
coffee (cane.)	0	0	0	2	0	2	2	2	0	0	0	0	0	e2	f2	g2
breadfruit	0	0	0	2	0	1	1	1	0	0	0	0	0	e2	f2	g2
citrus	0	0	0	2	0	1	1	1	0	0	0	0	0	e2	f2	g2
ackee	0	0	0	2	0	1	1	1	0	0	0	0	0	e2	f2	g2
mango	0	0	0	2	0	2	1	2	0	0	0	0	0	e2	f2	g2
pimento	0	0	0	2	0	2	1	2	0	0	0	0	0	e2	f2	g2
forestry	0	0	0	2	0	1	1	1	0	0	0	0	0	e2	f2	g2
natural forest	0	0	0	0	0	0	0	0	0	0	0	0	0	e0	f0	g0
banana	0	0	0	2	0	2	1	2	0	0	0	1	2	e2	f2	g2
plantain	0	0	0	2	0	2	1	2	0	0	0	1	2	e2	f2	g2
pineapple	0	0	0	2	0	2	2	2	0	0	0	1	2	e2	f2	g2
unimpr. pasture	0	0	0	1	0	1	1	1	0	0	0	0	0	e0	f1	g2
impr. pasture	0	0	0	1	0	1	0	1	0	0	0	0	0	e0	f1	g2
ginger	0	0	0	2	0	2	2	2	0	0	0	1	2	e2	f2	g2

Table 13. Agro-ecological limitations for Riverhead soils for selected crops under current conditions (soil profile 098)

	land qualities													
Crop	LT	HT	OX	RC	NR	NA	PH	CC	AL	SA	SO	WH	WM	Erosion
sugar cane	0	0	0	0	1	2	1	0	2	0	0	1	0	b0 c0
maize	0	0	1	1	1	2	1	0	2	0	0	1	0	b0 c0
tobacco	0	0	1	1	1	2	1	0	2	0	0	1	0	b0 c0
groundnut	0	0	1	1	0	2	1	0	2	0	0	1	0	b0 c0
pigeon pea	0	0	1	1	0	2	1	0	2	0	0	1	0	b0 c0
common bean	0	0	1	1	1	2	1	0	2	0	0	1	0	b0 c0
red pea	0	0	1	1	0	2	1	0	2	0	0	1	0	b0 c0
onion	0	0	1	1	0	2	1	0	2	0	0	1	0	b0 c0
cassava	0	0	1	1	0	2	1	0	2	0	0	1	0	b0 c0
yam	0	0	1	1	0	2	1	0	2	0	0	1	0	b0 c0
cocoyam	0	0	0	0	1	2	1	0	2	0	0	1	0	b0 c0
sweet potato	0	0	1	1	1	2	1	0	2	0	0	1	0	b0 c0
calaloo	0	0	1	1	0	2	1	0	2	0	0	1	0	b0 c0
cabbage	1	1	1	1	1	2	1	0	2	0	0	1	0	b0 c0
tomato	0	0	1	1	1	2	1	0	2	0	0	1	0	b0 c0
cucumber	0	0	1	1	1	2	1	0	2	0	0	1	0	b0 c0
pumpkin	0	0	1	1	0	2	1	0	2	0	0	1	0	b0 c0
coconut	0	0	1	1	0	2	1	0	2	0	0	0	0	b0 c0
cocoa	0	0	1	1	1	2	0	0	2	0	0	0	0	b0 c0
coffee (arab.)	1	1	1	1	1	2	0	0	2	0	0	0	0	b0 c0
coffee (cane.)	0	0	1	1	1	2	0	0	2	0	0	0	0	b0 c0
breadfruit	0	0	1	1	0	2	1	0	2	0	0	0	0	b0 c0
citrus	0	0	1	1	0	2	1	0	2	0	0	0	0	b0 c0
ackee	0	0	1	1	0	2	1	0	2	0	0	0	0	b0 c0
mango	0	0	1	1	0	2	1	0	2	0	0	0	0	b0 c0
pimento	0	0	1	1	0	2	1	0	2	0	0	0	0	b0 c0
forestry	0	0	1	1	0	2	1	0	2	0	0	0	0	b0 c0
natural forest	0	0	0	0	0	1	0	0	1	0	0	0	0	b0 c0
banana	0	0	1	1	1	2	1	0	2	0	0	1	0	b0 c0
plantain	0	0	1	1	0	2	1	0	2	0	0	1	0	b0 c0
pineapple	0	0	1	1	0	2	1	0	2	0	0	1	0	b0 c0
unimpr. pasture	0	0	0	0	0	2	1	0	2	0	0	0	0	b0 c0
impr. pasture	0	0	0	0	0	2	1	0	2	0	0	0	0	b0 c0
ginger	0	0	1	1	1	2	1	0	2	0	0	1	0	b0 c0

Table 14. Agro-ecological limitations for Rosemere variant I soils for selected crops under current conditions (soil profile 099)

	land qualities													
Crop	LT	HT	OX	RC	NR	NA	PH	CC	AL	SA	SO	WH	WM	Erosion
sugar cane	0	0	0	0	0	1	0	0	0	0	0	1	0	b0 c0
maize	0	0	1	1	0	1	0	0	0	0	0	1	0	b0 c0
tobacco	0	0	1	1	0	0	0	0	0	0	0	1	0	b0 c0
groundnut	0	0	1	1	0	0	0	0	0	0	0	1	0	b0 c0
pigeon pea	0	0	1	1	0	0	0	0	0	0	0	1	0	b0 c0
common bean	0	0	1	1	0	1	0	0	0	0	0	1	0	b0 c0
red pea	0	0	1	1	0	0	0	0	0	0	0	1	0	b0 c0
onion	0	0	1	1	0	0	0	0	0	0	0	1	0	b0 c0
cassava	0	0	1	1	0	0	0	0	0	0	0	1	0	b0 c0
yam	0	0	1	1	0	0	0	0	0	0	0	1	0	b0 c0
cocoyam	0	0	0	0	0	1	1	0	0	0	0	1	0	b0 c0
sweet potato	0	0	1	1	0	1	0	0	0	0	0	1	0	b0 c0
calaloo	0	0	1	1	0	0	0	0	0	0	0	1	0	b0 c0
cabbage	1	1	1	1	0	1	0	0	0	0	0	1	0	b0 c0
tomato	0	0	1	1	0	1	0	0	0	0	0	1	0	b0 c0
cucumber	0	0	1	1	0	1	0	0	0	0	0	1	0	b0 c0
pumpkin	0	0	1	1	0	0	0	0	0	0	0	1	0	b0 c0
coconut	0	0	1	1	0	0	0	0	0	0	0	0	0	b0 c0
cocoa	0	0	1	1	0	1	1	0	0	0	0	0	0	b0 c0
coffee (arab.)	1	1	1	1	0	1	1	0	0	0	0	0	0	b0 c0
coffee (cane.)	0	0	1	1	0	1	1	0	0	0	0	0	0	b0 c0
breadfruit	0	0	1	1	0	0	0	0	0	0	0	0	0	b0 c0
citrus	0	0	1	1	0	0	0	0	0	0	0	0	0	b0 c0
ackee	0	0	1	1	0	0	0	0	0	0	0	0	0	b0 c0
mango	0	0	1	1	0	0	0	0	0	0	0	0	0	b0 c0
pimento	0	0	1	1	0	0	0	0	0	0	0	0	0	b0 c0
forestry	0	0	1	1	0	0	0	0	0	0	0	0	0	b0 c0
natural forest	0	0	0	0	0	0	0	0	0	0	0	0	0	b0 c0
banana	0	0	1	1	0	1	0	0	0	0	0	1	0	b0 c0
plantain	0	0	1	1	0	0	0	0	0	0	0	1	0	b0 c0
pineapple	0	0	1	1	0	1	1	0	0	0	0	1	0	b0 c0
unimpr. pasture	0	0	0	0	0	0	0	0	0	0	0	0	0	b0 c0
impr. pasture	0	0	0	0	0	0	0	0	0	0	0	0	0	b0 c0
ginger	0	0	1	1	0	1	1	0	0	0	0	1	0	b0 c0

Table 15. Agro-ecological limitations for Union Hill variant I soils for selected crops under current conditions (soil profile 105)

	land qualities															
Crop	LT	HT	OX	RC	NR	NA	PH	CC	AL	SA	SO	WH	WM	Erosion		
sugar cane	0	0	0	0	0	1	1	0	0	0	0	0	1	c0	d0	e0
maize	0	0	0	0	0	1	1	0	0	0	0	0	1	c0	d0	e1
tobacco	0	0	0	0	0	1	1	0	0	0	0	0	1	c0	d0	e1
groundnut	0	0	0	0	0	1	1	0	0	0	0	0	1	c0	d0	e1
pigeon pea	0	0	0	0	0	1	1	0	0	0	0	0	1	c0	d0	e1
common bean	0	0	0	0	0	1	1	0	0	0	0	0	1	c0	d0	e1
red pea	0	0	0	0	0	1	1	0	0	0	0	0	1	c0	d0	e1
onion	0	0	0	0	0	1	1	0	0	0	0	0	1	c0	d0	e1
cassava	0	0	0	0	0	1	1	0	0	0	0	0	1	c0	d0	e1
yam	0	0	0	0	0	1	1	0	0	0	0	0	1	c0	d0	e1
cocoyam	0	0	0	0	0	1	1	0	0	0	0	0	1	c0	d0	e1
sweet potato	0	0	0	0	0	1	1	0	0	0	0	0	1	c0	d0	e1
calaloo	0	0	0	0	0	1	1	0	0	0	0	0	1	c0	d0	e1
cabbage	1	0	0	0	0	1	1	0	0	0	0	0	1	c0	d0	e1
tomato	0	0	0	0	0	1	1	0	0	0	0	0	1	c0	d0	e1
cucumber	0	0	0	0	0	1	1	0	0	0	0	0	1	c0	d0	e1
pumpkin	0	0	0	0	0	1	1	0	0	0	0	0	1	c0	d0	e1
coconut	0	1	0	0	0	1	1	0	0	0	0	0	0	c0	d0	e0
cocoa	0	0	0	0	0	2	2	0	0	0	0	0	0	c0	d0	e0
coffee (arab.)	1	1	0	0	0	2	2	0	0	0	0	0	0	c0	d0	e0
coffee (cane.)	0	0	0	0	0	2	2	0	0	0	0	0	0	c0	d0	e0
breadfruit	0	0	0	0	0	0	0	0	0	0	0	0	0	c0	d0	e0
citrus	0	0	0	0	0	1	1	0	0	0	0	0	0	c0	d0	e0
ackee	0	0	0	0	0	0	0	0	0	0	0	0	0	c0	d0	e0
mango	0	0	0	0	0	1	1	0	0	0	0	0	0	c0	d0	e0
pimento	0	0	0	0	0	1	1	0	0	0	0	0	0	c0	d0	e0
forestry	0	0	0	0	0	1	1	0	0	0	0	0	0	c0	d0	e0
natural forest	0	0	0	0	0	0	0	0	0	0	0	0	0	c0	d0	e0
banana	0	0	0	0	0	1	1	0	0	0	0	0	1	c0	d0	e0
plantain	0	0	0	0	0	1	1	0	0	0	0	0	1	c0	d0	e0
pineapple	0	0	0	0	0	2	2	0	0	0	0	0	1	c0	d0	e1
unimpr. pasture	0	0	0	0	0	1	1	0	0	0	0	0	0	c0	d0	e0
impr. pasture	0	0	0	0	0	0	0	0	0	0	0	0	0	c0	d0	e0
ginger	0	0	0	0	0	2	2	0	0	0	0	0	1	c0	d0	e1

Table 16. Agro-ecological limitations for Lluidas variant II soils for selected crops under current conditions (soil profile 107)

	land qualities													
Crop	LT	HT	OX	RC	NR	NA	PH	CC	AL	SA	SO	WH	WM	Erosion
sugar cane	0	0	0	0	0	1	0	0	0	0	0	0	0	a0 b0
maize	0	0	0	0	0	1	0	0	0	0	0	0	0	a0 b0
tobacco	0	0	0	0	0	0	0	0	0	0	0	0	0	a0 b0
groundnut	0	0	0	0	0	0	0	0	0	0	0	0	0	a0 b0
pigeon pea	0	0	0	0	0	0	0	0	0	0	0	0	0	a0 b0
common bean	0	0	0	0	0	1	0	0	0	0	0	0	0	a0 b0
red pea	0	0	0	0	0	0	0	0	0	0	0	0	0	a0 b0
onion	0	0	0	0	0	0	0	0	0	0	0	0	0	a0 b0
cassava	0	0	0	0	0	0	0	0	0	0	0	0	0	a0 b0
yam	0	0	0	0	0	0	0	0	0	0	0	0	0	a0 b0
cocoyam	0	0	0	0	0	1	1	0	0	0	0	0	0	a0 b0
sweet potato	0	0	0	0	0	1	0	0	0	0	0	0	0	a0 b0
calaloo	0	0	0	0	0	0	0	0	0	0	0	0	0	a0 b0
cabbage	0	0	0	0	0	1	0	0	0	0	0	0	0	a0 b0
tomato	0	0	0	0	0	1	0	0	0	0	0	0	0	a0 b0
cucumber	0	0	0	0	0	1	0	0	0	0	0	0	0	a0 b0
pumpkin	0	0	0	0	0	0	0	0	0	0	0	0	0	a0 b0
coconut	1	1	0	0	0	0	0	0	0	0	0	0	0	a0 b0
cocoa	0	0	0	0	0	1	1	0	0	0	0	0	0	a0 b0
coffee (arab.)	1	1	0	0	0	1	1	0	0	0	0	0	0	a0 b0
coffee (cane.)	0	0	0	0	0	1	1	0	0	0	0	0	0	a0 b0
breadfruit	0	0	0	0	0	0	0	0	0	0	0	0	0	a0 b0
citrus	0	0	0	0	0	0	0	0	0	0	0	0	0	a0 b0
ackee	0	0	0	0	0	0	0	0	0	0	0	0	0	a0 b0
mango	0	0	0	0	0	0	0	0	0	0	0	0	0	a0 b0
pimento	0	0	0	0	0	0	0	0	0	0	0	0	0	a0 b0
forestry	0	0	0	0	0	0	0	0	0	0	0	0	0	a0 b0
natural forest	0	0	0	0	0	0	0	0	0	0	0	0	0	a0 b0
banana	0	0	0	0	0	1	0	0	0	0	0	0	0	a0 b0
plantain	0	0	0	0	0	0	0	0	0	0	0	0	0	a0 b0
pineapple	0	0	0	0	0	1	1	0	0	0	0	0	0	a0 b0
unimpr. pasture	0	0	0	0	0	0	0	0	0	0	0	0	0	a0 b0
impr. pasture	0	0	0	0	0	0	0	0	0	0	0	0	0	a0 b0
ginger	0	0	0	0	0	1	1	0	0	0	0	0	0	a0 b0

Table 17. Agro-ecological limitations for Mountain Hill soils for selected crops under current conditions (soil profile 108)

Crop	LT	HT	OX	RC	NR	NA	PH	CC	AL	SA	SO	WH	WM	Erosion
	land qualities													
sugar cane	0	0	0	0	2	2	1	0	2	0	0	0	0	c0
maize	0	0	0	0	2	2	2	0	2	0	0	0	0	c0
tobacco	0	0	0	0	2	2	2	0	2	0	0	0	0	c0
groundnut	0	0	0	0	1	2	2	0	2	0	0	0	0	c0
pigeon pea	0	0	0	0	0	2	2	0	2	0	0	0	0	c0
common bean	0	0	0	0	2	2	2	0	2	0	0	0	0	c0
red pea	0	0	0	0	1	2	2	0	2	0	0	0	0	c0
onion	0	0	0	0	1	2	2	0	2	0	0	0	0	c0
cassava	0	0	0	0	0	2	1	0	2	0	0	0	0	c0
yam	0	0	0	0	1	2	2	0	2	0	0	0	0	c0
cocoyam	0	0	0	0	2	2	2	0	2	0	0	0	0	c0
sweet potato	0	0	0	0	2	2	2	0	2	0	0	0	0	c0
calaloo	0	0	0	0	1	2	1	0	2	0	0	0	0	c0
cabbage	0	0	0	0	2	2	2	0	2	0	0	0	0	c0
tomato	0	0	0	0	2	2	2	0	2	0	0	0	0	c0
cucumber	0	0	0	0	2	2	2	0	2	0	0	0	0	c0
pumpkin	0	0	0	0	1	2	2	0	2	0	0	0	0	c0
coconut	1	1	0	0	0	2	2	0	2	0	0	0	0	c0
cocoa	0	0	0	0	2	2	1	0	2	0	0	0	0	c0
coffee (arab.)	1	1	0	0	2	2	1	0	2	0	0	0	0	c0
coffee (cane.)	0	0	0	0	2	2	1	0	2	0	0	0	0	c0
breadfruit	0	0	0	0	1	2	1	0	2	0	0	0	0	c0
citrus	0	0	0	0	1	2	1	0	2	0	0	0	0	c0
ackee	0	0	0	0	1	2	1	0	2	0	0	0	0	c0
mango	0	0	0	0	1	2	1	0	2	0	0	0	0	c0
pimento	0	0	0	0	1	2	2	0	2	0	0	0	0	c0
forestry	0	0	0	0	1	2	1	0	2	0	0	0	0	c0
natural forest	0	0	0	0	0	2	0	0	2	0	0	0	0	c0
banana	0	0	0	0	2	2	2	0	2	0	0	0	0	c0
plantain	0	0	0	0	1	2	2	0	2	0	0	0	0	c0
pineapple	0	0	0	0	1	2	1	0	2	0	0	0	0	c0
unimpr. pasture	0	0	0	0	0	2	1	0	2	0	0	0	0	c0
impr. pasture	0	0	0	0	1	2	1	0	2	0	0	0	0	c0
ginger	0	0	0	0	2	2	1	0	2	0	0	0	0	c0

Table 18. Agro-ecological limitations for Pennants variant I soils for selected crops under current conditions (soil profile 109)

	land qualities													
Crop	LT	HT	OX	RC	NR	NA	PH	CC	AL	SA	SO	WH	WM	Erosion
sugar cane	0	0	0	0	1	2	1	0	2	0	0	0	0	b0 c0
maize	0	0	1	1	1	2	2	0	2	0	0	0	0	b0 c0
tobacco	0	0	1	1	1	2	2	0	2	0	0	0	0	b0 c0
groundnut	0	0	1	1	0	2	2	0	2	0	0	0	0	b0 c0
pigeon pea	0	0	1	1	0	2	2	0	2	0	0	0	0	b0 c0
common bean	0	0	1	1	1	2	2	0	2	0	0	0	0	b0 c0
red pea	0	0	1	1	0	2	2	0	2	0	0	0	0	b0 c0
onion	0	0	1	1	0	2	2	0	2	0	0	0	0	b0 c0
cassava	0	0	1	1	0	2	1	0	2	0	0	0	0	b0 c0
yam	0	0	1	1	0	2	2	0	2	0	0	0	0	b0 c0
cocoyam	0	0	0	0	1	2	2	0	2	0	0	0	0	b0 c0
sweet potato	0	0	1	1	1	2	2	0	2	0	0	0	0	b0 c0
calaloo	0	0	1	1	0	2	1	0	2	0	0	0	0	b0 c0
cabbage	0	0	1	1	1	2	2	0	2	0	0	0	0	b0 c0
tomato	0	0	1	1	1	2	2	0	2	0	0	0	0	b0 c0
cucumber	0	0	1	1	1	2	2	0	2	0	0	0	0	b0 c0
pumpkin	0	0	1	1	0	2	2	0	2	0	0	0	0	b0 c0
coconut	1	1	1	1	0	2	2	0	2	0	0	0	0	b0 c0
cocoa	0	0	1	1	1	2	0	0	2	0	0	0	0	b0 c0
coffee (arab.)	1	1	1	1	1	2	0	0	2	0	0	0	0	b0 c0
coffee (cane.)	0	0	1	1	1	2	0	0	2	0	0	0	0	b0 c0
breadfruit	0	0	1	1	0	2	1	0	2	0	0	0	0	b0 c0
citrus	0	0	1	1	0	2	1	0	2	0	0	0	0	b0 c0
ackee	0	0	1	1	0	2	1	0	2	0	0	0	0	b0 c0
mango	0	0	1	1	0	2	1	0	2	0	0	0	0	b0 c0
pimento	0	0	1	1	0	2	2	0	2	0	0	0	0	b0 c0
forestry	0	0	1	1	0	2	1	0	2	0	0	0	0	b0 c0
natural forest	0	0	0	0	0	2	0	0	2	0	0	0	0	b0 c0
banana	0	0	1	1	1	2	2	0	2	0	0	0	0	b0 c0
plantain	0	0	1	1	0	2	2	0	2	0	0	0	0	b0 c0
pineapple	0	0	1	1	0	2	1	0	2	0	0	0	0	b0 c0
unimpr. pasture	0	0	0	0	0	2	1	0	2	0	0	0	0	b0 c0
impr. pasture	0	0	0	0	0	2	1	0	2	0	0	0	0	b0 c0
ginger	0	0	1	1	1	2	1	0	2	0	0	0	0	b0 c0

Table 19. Agro-ecological limitations for Tydixon soils for selected crops under current conditions (soil profile 110)

	land qualities													
Crop	LT	HT	OX	RC	NR	NA	FH	CC	AL	SA	SO	WH	WM	Erosion
sugar cane	0	0	1	1	2	2	1	0	2	0	0	0	0	a0 b0
maize	0	0	2	2	2	2	1	0	2	0	0	0	0	a0 b0
tobacco	0	0	2	2	2	2	1	0	2	0	0	0	0	a0 b0
groundnut	0	0	2	2	1	2	1	0	2	0	0	0	0	a0 b0
pigeon pea	0	0	2	2	0	2	1	0	2	0	0	0	0	a0 b0
common bean	0	0	2	2	2	2	1	0	2	0	0	0	0	a0 b0
red pea	0	0	2	2	1	2	1	0	2	0	0	0	0	a0 b0
onion	0	0	2	2	1	2	1	0	2	0	0	0	0	a0 b0
cassava	0	0	2	2	0	2	1	0	2	0	0	0	0	a0 b0
yam	0	0	2	2	1	2	1	0	2	0	0	0	0	a0 b0
cocoyam	0	0	0	0	2	2	1	0	2	0	0	0	0	a0 b0
sweet potato	0	0	2	2	2	2	1	0	2	0	0	0	0	a0 b0
calaloo	0	0	2	2	1	2	1	0	2	0	0	0	0	a0 b0
cabbage	0	0	2	2	2	2	1	0	2	0	0	0	0	a0 b0
tomato	0	0	2	2	2	2	1	0	2	0	0	0	0	a0 b0
cucumber	0	0	2	2	2	2	1	0	2	0	0	0	0	a0 b0
pumpkin	0	0	2	2	1	2	1	0	2	0	0	0	0	a0 b0
coconut	1	1	2	2	0	2	1	0	2	0	0	0	0	a0 b0
cocoa	0	0	2	2	2	2	0	0	2	0	0	0	0	a0 b0
coffee (arab.)	1	1	2	2	2	2	0	0	2	0	0	0	0	a0 b0
coffee (cane.)	0	0	2	2	2	2	0	0	2	0	0	0	0	a0 b0
breadfruit	0	0	2	2	1	2	1	0	2	0	0	0	0	a0 b0
citrus	0	0	2	2	1	2	1	0	2	0	0	0	0	a0 b0
ackee	0	0	2	2	1	2	1	0	2	0	0	0	0	a0 b0
mango	0	0	2	2	1	2	1	0	2	0	0	0	0	a0 b0
pimento	0	0	2	2	1	2	1	0	2	0	0	0	0	a0 b0
forestry	0	0	2	2	1	2	1	0	2	0	0	0	0	a0 b0
natural forest	0	0	1	1	0	2	0	0	2	0	0	0	0	a0 b0
banana	0	0	2	2	2	2	1	0	2	0	0	0	0	a0 b0
plantain	0	0	2	2	1	2	1	0	2	0	0	0	0	a0 b0
pineapple	0	0	2	2	1	2	1	0	2	0	0	0	0	a0 b0
unimpr. pasture	0	0	0	0	0	2	1	0	2	0	0	0	0	a0 b0
impr. pasture	0	0	0	0	1	2	1	0	2	0	0	0	0	a0 b0
ginger	0	0	2	2	2	2	1	0	2	0	0	0	0	a0 b0

Table 20. Agro-ecological limitations for Knollis soils for selected crops under current conditions (soil profile 111)

	land qualities													
Crop	LT	HT	OX	RC	NR	NA	PH	CC	AL	SA	SO	WH	WM	Erosion
sugar cane	0	0	1	1	1	2	1	0	0	0	0	1	0	a0 b0
maize	0	0	2	2	1	2	1	0	0	0	0	1	0	a0 b0
tobacco	0	0	2	2	1	1	1	0	0	0	0	1	0	a0 b0
groundnut	0	0	2	2	0	1	1	0	0	0	0	1	0	a0 b0
pigeon pea	0	0	2	2	0	1	1	0	0	0	0	1	0	a0 b0
common bean	0	0	2	2	1	2	1	0	0	0	0	1	0	a0 b0
red pea	0	0	2	2	0	1	1	0	0	0	0	1	0	a0 b0
onion	0	0	2	2	0	1	1	0	0	0	0	1	0	a0 b0
cassava	0	0	2	2	0	1	1	0	0	0	0	1	0	a0 b0
yam	0	0	2	2	0	1	1	0	0	0	0	1	0	a0 b0
cocoyam	0	0	0	0	1	2	1	0	0	0	0	1	0	a0 b0
sweet potato	0	0	2	2	1	2	1	0	0	0	0	1	0	a0 b0
calaloo	0	0	2	2	0	1	1	0	0	0	0	1	0	a0 b0
cabbage	0	0	2	2	1	2	1	0	0	0	0	1	0	a0 b0
tomato	0	0	2	2	1	2	1	0	0	0	0	1	0	a0 b0
cucumber	0	0	2	2	1	2	1	0	0	0	0	1	0	a0 b0
pumpkin	0	0	2	2	0	1	1	0	0	0	0	1	0	a0 b0
coconut	1	1	2	2	0	1	1	0	0	0	0	0	0	a0 b0
cocoa	0	0	2	2	1	2	1	0	0	0	0	0	0	a0 b0
coffee (arab.)	1	1	2	2	1	2	1	0	0	0	0	0	0	a0 b0
coffee (cane.)	0	0	2	2	1	2	1	0	0	0	0	0	0	a0 b0
breadfruit	0	0	2	2	0	1	1	0	0	0	0	0	0	a0 b0
citrus	0	0	2	2	0	1	1	0	0	0	0	0	0	a0 b0
ackee	0	0	2	2	0	1	1	0	0	0	0	0	0	a0 b0
mango	0	0	2	2	0	1	0	0	0	0	0	0	0	a0 b0
pimento	0	0	2	2	0	1	1	0	0	0	0	0	0	a0 b0
forestry	0	0	2	2	0	1	1	0	0	0	0	0	0	a0 b0
natural forest	0	0	1	1	0	0	0	0	0	0	0	0	0	a0 b0
banana	0	0	2	2	1	2	1	0	0	0	0	1	0	a0 b0
plantain	0	0	2	2	0	1	1	0	0	0	0	1	0	a0 b0
pineapple	0	0	2	2	0	1	1	0	0	0	0	1	0	a0 b0
unimpr. pasture	0	0	0	0	0	1	0	0	0	0	0	0	0	a0 b0
impr. pasture	0	0	0	0	0	1	1	0	0	0	0	0	0	a0 b0
ginger	0	0	2	2	1	2	1	0	0	0	0	1	0	a0 b0

Table 21. Agro-ecological limitations for Lluidas soils
for selected crops under current conditions (soil profile 112)

	land qualities													
Crop	LT	HT	OX	RC	NR	NA	PH	CC	AL	SA	SO	WH	WM	Erosion
sugar cane	0	0	0	0	0	0	0	0	0	0	0	1	0	a0 b0
maize	0	0	0	0	0	1	1	0	0	0	0	1	0	a0 b0
tobacco	0	0	0	0	0	1	1	0	0	0	0	1	0	a0 b0
groundnut	0	0	0	0	0	1	1	0	0	0	0	1	0	a0 b0
pigeon pea	0	0	0	0	0	0	0	0	0	0	0	1	0	a0 b0
common bean	0	0	0	0	0	1	1	0	0	0	0	1	0	a0 b0
red pea	0	0	0	0	0	1	1	0	0	0	0	1	0	a0 b0
onion	0	0	0	0	0	1	1	0	0	0	0	1	0	a0 b0
cassava	0	0	0	0	0	0	0	0	0	0	0	1	0	a0 b0
yam	0	0	0	0	0	1	1	0	0	0	0	1	0	a0 b0
cocoyam	0	0	0	0	0	1	1	0	0	0	0	1	0	a0 b0
sweet potato	0	0	0	0	0	1	1	0	0	0	0	1	0	a0 b0
calaloo	0	0	0	0	0	1	1	0	0	0	0	1	0	a0 b0
cabbage	0	0	0	0	0	1	1	0	0	0	0	1	0	a0 b0
tomato	0	0	0	0	0	1	1	0	0	0	0	1	0	a0 b0
cucumber	0	0	0	0	0	1	1	0	0	0	0	1	0	a0 b0
pumpkin	0	0	0	0	0	1	1	0	0	0	0	1	0	a0 b0
coconut	1	1	0	0	0	0	0	0	0	0	0	0	0	a0 b0
cocoa	0	0	0	0	0	1	1	0	0	0	0	0	0	a0 b0
coffee (arab.)	1	1	0	0	0	1	1	0	0	0	0	0	0	a0 b0
coffee (cane.)	0	0	0	0	0	1	1	0	0	0	0	0	0	a0 b0
breadfruit	0	0	0	0	0	0	0	0	0	0	0	0	0	a0 b0
citrus	0	0	0	0	0	0	0	0	0	0	0	0	0	a0 b0
ackee	0	0	0	0	0	0	0	0	0	0	0	0	0	a0 b0
mango	0	0	0	0	0	0	0	0	0	0	0	0	0	a0 b0
pimento	0	0	0	0	0	1	1	0	0	0	0	0	0	a0 b0
forestry	0	0	0	0	0	0	0	0	0	0	0	0	0	a0 b0
natural forest	0	0	0	0	0	0	0	0	0	0	0	0	0	a0 b0
banana	0	0	0	0	0	1	1	0	0	0	0	1	0	a0 b0
plantain	0	0	0	0	0	1	1	0	0	0	0	1	0	a0 b0
pineapple	0	0	0	0	0	1	1	0	0	0	0	1	0	a0 b0
unimpr. pasture	0	0	0	0	0	0	0	0	0	0	0	0	0	a0 b0
impr. pasture	0	0	0	0	0	0	0	0	0	0	0	0	0	a0 b0
ginger	0	0	0	0	0	1	1	0	0	0	0	1	0	a0 b0

APPENDIX IX

Recommended soil conservation practices for specified land use.

Description of the conservation options:

K	Mechanical practices:	Cultural practices:
0	none	none
1	none	very low
2	colluvial terraces	very low
3	none	low
4	colluvial terraces	low
5	hillside ditches/orchard terraces	low
6	none	moderate
7	colluvial terraces	moderate
8	hillside ditches/orchard terraces	moderate
9	graded bench terraces	moderate
10	none	high
11	colluvial terraces	high
12	hillside ditches/orchard terraces	high
13	graded bench terraces	high

Definitions of the level of cultural and mechanical practices of soil conservation.

Levels of cultural practices:

Very low: Zero mulch; crop residues removed; no application of manure; no use of mineral fertilizers; no farm plan; no crop rotation; bare fallow; mono-cropping; no living barriers

Low: Low application of mulch (less than 0.5 ton/ha); crop residues burnt on the site; no application of mineral fertilizers; no farm plan; limited crop rotation/intercropping; living barriers along contours.

Medium: Surface mulch application (1-3 ton/ha); application of manure and/or composts; sub-optimal use of mineral fertilizers; crop rotation; farm plan; intercropping; contour strip-cropping; perennials; use of annual intercrops.

High: Surface mulch application (>3 ton/ha); application of mineral fertilizers in combination with manure or compost; farm plan; crop rotation with legumes; intercropping or monocropping with good rotation; perennials; use of intercrops and leguminous cover crops; contour cropping with grass strips.

Levels of mechanical practices:

None: No soil conservation practices; field boundary effects only.

Low: Colluvial terraces (stone wall/bamboo/wood/other living barriers).

Medium: Annual crops; hillside ditches and grassed waterways. Perennials; graded orchard terraces with reverse slope and grassed waterways.

High: Graded bench terraces with reverse slope and stabilized terraces; water disposal system.

Detailed information on the methodology can be found in Technical Soils Bulletin No. 2 (SSU 1985).

Survey area: Lluidas Vale
Average rainfall erosivity factor: 1250
Crop: standard; crop-factor: 0.45

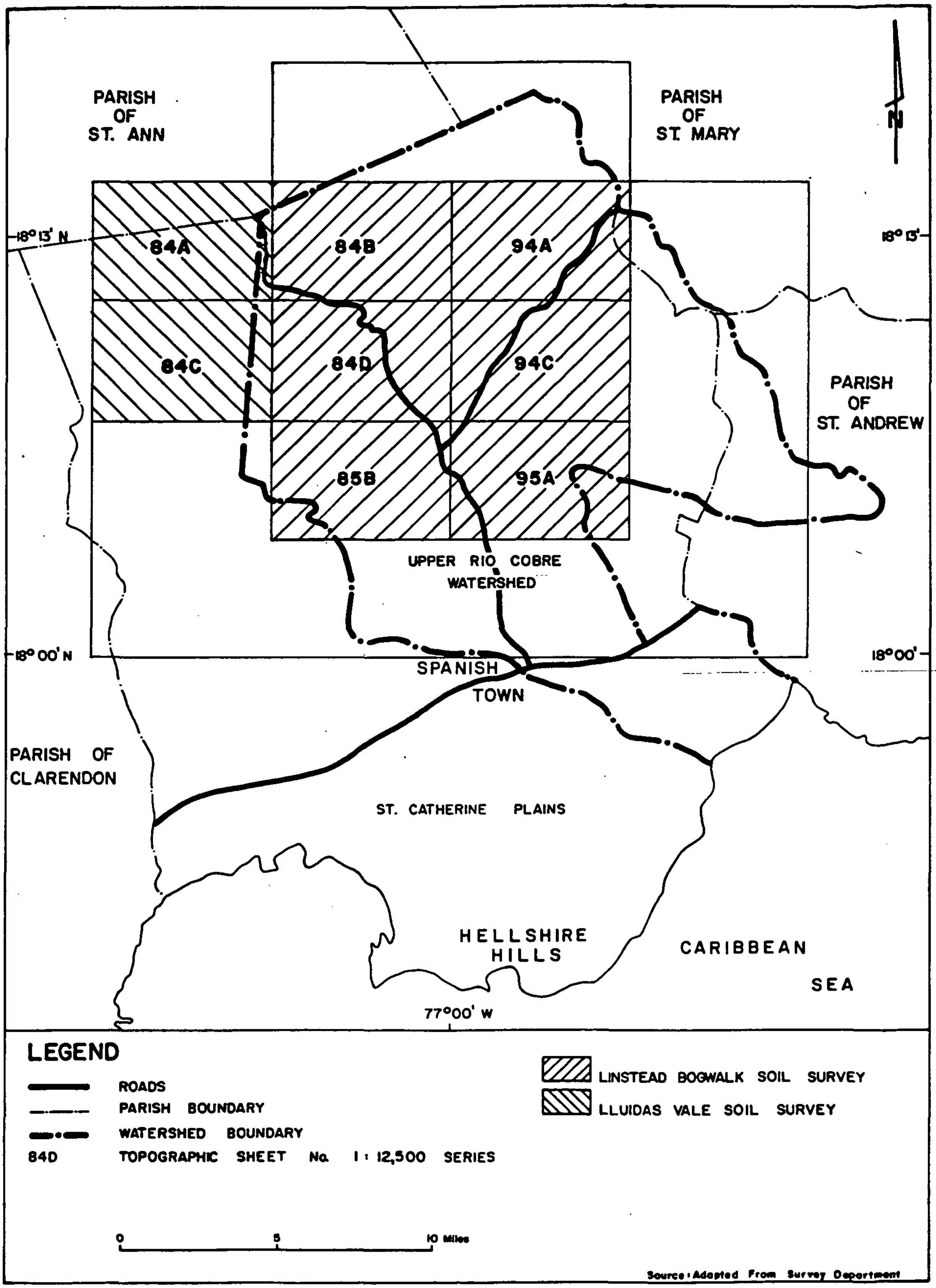
Soil name:	Slope (%):	Conservation options:
Mount Rosser	16	No feasible practices; only (food) forest
	30	No feasible practices; only (food) forest
	50	No feasible practices; only (food) forest
Swansea	16	13
	30	No feasible practices; only (food) forest
St. Ann var. I	8	8, 9, 10, 11, 12, 13
	16	9, 13
	30	No feasible practices; only (food) forest
Mountain Hill	5	8, 9, 10, 11, 12, 13
	8	8, 9, 11, 12, 13
	16	13
Union Hill var. I	8	8, 9, 10, 11, 12, 13
	16	9, 13
	30	13
Pennants var. I	2	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
	8	8, 9, 10, 11, 12, 13
Tydixon	2	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
	5	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
Knollis	2	4, 5, 6, 7, 8, 9, 10, 11, 12, 13
	5	8, 9, 10, 11, 12, 13
Linstead var. I	2	5, 6, 7, 8, 9, 10, 11, 12, 13
	8	9, 13
Rosemere var. I	2	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
	8	8, 9, 11, 12, 13
Riverhead	2	4, 5, 6, 7, 8, 9, 10, 11, 12, 13
	8	8, 9, 11, 12, 13
Brysons var. I	2	4, 5, 6, 7, 8, 9, 10, 11, 12, 13
	5	8, 9, 10, 11, 12, 13
Brysons var. II	2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
	5	4, 5, 6, 7, 8, 9, 10, 11, 12, 13
Donnington var. II	8	9, 12, 13
	16	13
Lluidas	2	4, 5, 6, 7, 8, 9, 10, 11, 12, 13
	5	8, 9, 10, 11, 12, 13
Lluidas var. I	2	5, 6, 7, 8, 9, 10, 11, 12, 13
	5	8, 9, 11, 12, 13
Lluidas var. II	2	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
	5	5, 6, 7, 8, 9, 10, 11, 12, 13
Rose Hall var. I	2	5, 6, 7, 8, 9, 10, 11, 12, 13
	5	8, 9, 11, 12, 13
Prospect var. I	2	7, 8, 9, 10, 11, 12, 13
	5	8, 9, 11, 12, 13

APPENDIX X

Conversion table.

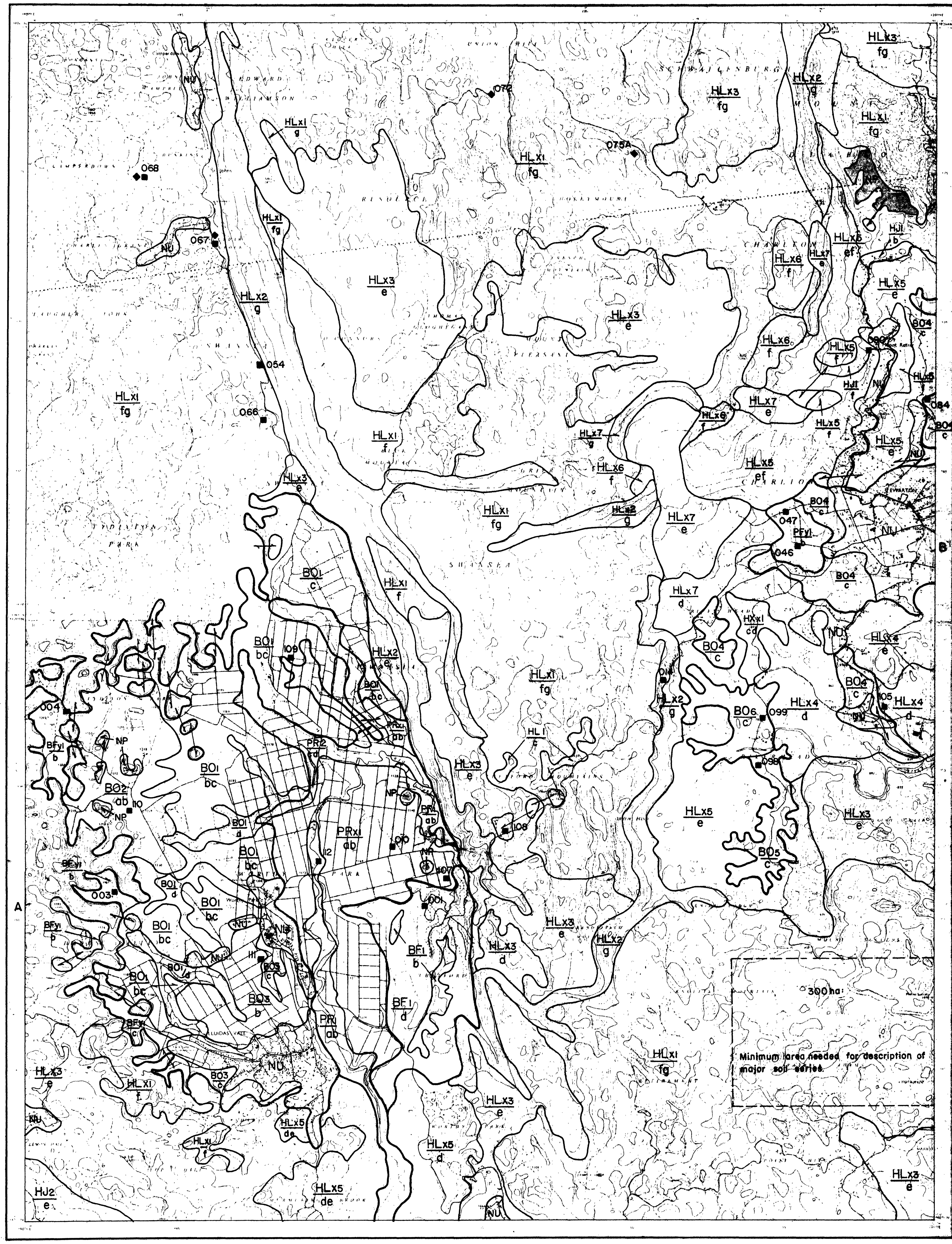
1 inch = 2.54 cm	1 centimeter = 0.39 inch
1 foot = 30.48 cm	1 meter = 100 cm = 3.28 feet
1 mile = 1.61 kilometer	1 kilometer = 1000 m = 0.62 mile
1 acre = 0.41 hectare	1 hectare = 2.47 acres
1 tonnes = 1.016 metrics tons	1 metric ton = 0.984 tonnes
1 pound/acre = 1.12 kg/ha	1 kg/ha = 0.89 pound/acre
1 °C = 5/9 (°F - 32)	1 °F = 9/5 °C + 32
1 mile/hour = 0.45 m/s	1 meter/second = 2.2 miles/hour

APPENDIX XI
Lluidas Vale Survey as part of the Upper Rio Cobre Survey



Semi-detailed soil map of the Lluidas Vale area, St. Catherine - St. Ann, Jamaica.

1:25,000



Km 1 1/2 0 1 2 3 Km

LEGEND TO THE 1:25,000 SOIL MAP OF THE LLUIDAS VALE AREA
(survey area: approximately 11,040 ha)

H: SOILS OF THE HILLS AND FOOTHILLS

(overall characteristics: relief intensity 20-200 m; slopes over 16%; elevation 260-900 m)

HL: SOILS FORMED ON HARD LIMESTONE

HL1: Mountain Hill clay: deep, well drained, red clay over hard white limestone. *Clayey gibbsitic isohyperthermic Rhodic Kandiudoxs*

HLx1: Bonnygate - rock outcrops - St. Ann variant I complex: complex of: a) very shallow, excessively drained, dark yellowish brown to yellowish red and red, stony clay loam to stony clay over hard white limestone, b) limestone rock outcrops, and c) deep, well drained to excessively drained, dark red to red clay over hard white limestone. *Clayey-skeletal mixed isohyperthermic Lithic Oxic Eutropepts, rock outcrops & clayey gibbsitic isohyperthermic Kandiudalfic Rhodic Eutrudoxs*

HLx2: Bonnygate - rock outcrops - Swansea complex: complex of: a) very shallow, excessively drained, dark yellowish brown to yellowish red and red, stony clay loam to stony clay over hard white limestone, b) limestone rock outcrops, and c) moderately deep, well drained to excessively drained, yellowish red to red clay over hard white limestone. *Clayey-skeletal mixed isohyperthermic Lithic Oxic Eutropepts, rock outcrops & clayey gibbsitic isohyperthermic Kandiudalfic Ruptic-Lithic Eutrudoxs*

HLx3: St. Ann variant I - Bonnygate complex: complex of deep, well drained to excessively drained, dark red to red clay over hard white limestone, and very shallow, excessively drained, dark yellowish brown to yellowish red and red, stony clay loam to stony clay over hard white limestone. *Clayey gibbsitic isohyperthermic Kandiudalfic Rhodic Eutrudoxs & clayey-skeletal mixed isohyperthermic Lithic Oxic Eutropepts.*

HLx4: Union Hill - Union Hill variant I complex: complex of shallow, well drained, reddish brown and strong brown to (dark) yellowish brown, slightly cracking stony clay, and deep, well drained, dark greyish brown to strong brown and yellowish brown clay over hard white limestone, in places with a humic topsoil. *Clayey-skeletal mixed isohyperthermic Lithic-Vertic Eutropepts & clayey mixed isohyperthermic Humic Kandiudalfic Eutrudoxs*

HLx5: Union Hill - Bonnygate complex: complex of shallow, well drained, reddish brown and strong brown to (dark) yellowish brown, slightly cracking stony clay, and very shallow, excessively drained, dark yellowish brown to yellowish red and red, stony clay loam to stony clay over hard white limestone. *Clayey-skeletal mixed isohyperthermic Lithic Vertic Eutropepts & clayey-skeletal mixed isohyperthermic Lithic Oxic Eutropepts.*

HLx6: Bonnygate - rock outcrops - Union Hill complex: complex of: a) very shallow, excessively drained, dark yellowish brown to yellowish red and red, stony clay loam to stony clay over hard white limestone, b) limestone rock outcrops, and c) shallow, well drained, reddish brown and strong brown to (dark) yellowish brown, slightly cracking stony clay. *Clayey-skeletal mixed isohyperthermic Lithic Oxic Eutropepts, rock outcrops, & clayey-skeletal mixed isohyperthermic Lithic Vertic Eutropepts.*

HLx7: Bonnygate - Union Hill - St. Ann variant I complex: complex of: a) very shallow, excessively drained, dark yellowish brown to yellowish red and red, stony clay loam to stony clay over hard white limestone, b) shallow, well drained, reddish brown and strong brown to (dark) yellowish brown, slightly cracking stony clay, and c) deep, well drained to excessively drained, dark red to red clay over hard white limestone. *Clayey-skeletal mixed isohyperthermic Lithic Oxic Eutropepts & clayey-skeletal mixed isohyperthermic Lithic Vertic Eutropepts & clayey gibbsitic isohyperthermic Kandiudalfic Rhodic Eutrudoxs*

HJ: SOILS FORMED ON WHITE RUBBLY AND SOFT YELLOW LIMESTONE

HJ1: Mount Rosser clay: shallow, well drained, strong brown to brownish yellow, stony clay over white rubbly and soft yellow limestone, with a humic topsoil. *Fine mixed isohyperthermic Paralithic Hapludolls*

HJ2: Carron Hall silty clay: moderately deep, moderately well drained to well drained, yellowish brown to brownish yellow, cracking gravelly clay over rubbly white and soft yellow limestone. *Fine montmorillonitic isohyperthermic Vertic Eutropepts*

HX: SOILS FORMED ON HARD LIMESTONE AND OLD ALLUVIAL DEPOSITS

HXx1: Union Hill - Riverhead complex: complex of shallow, well drained, reddish brown and strong brown to (dark) yellowish brown, slightly cracking stony clay, and deep, moderately well drained, brownish yellow to yellowish red and light grey, mottled clay over old alluvial deposits, with a humic topsoil. *Clayey-skeletal mixed isohyperthermic Lithic-Vertic Eutropepts & fine mixed isohyperthermic Humic Hapludalfs*

B: SOILS OF THE INLAND BASINS

(overall characteristics: relief intensity: 5-20 m; slopes: 0-16 %; elevation: approximately 260 and 370 m, respectively).

BO: SOILS FORMED ON OLD ALLUVIUM

BO1: Pennants variant I clay loam: deep, imperfectly drained, light grey and yellowish brown to strong brown, mottled, acid, slightly cracking clay over old alluvial/lacustrine deposits. *Fine mixed isohyperthermic Vertic Haplohumults*

BO2: Tydixon sandy loam: deep, poorly drained, light grey and yellowish brown to brownish yellow, mottled, acid clay over old alluvial/lacustrine deposits, abruptly underlying a grey sandy horizon. *Coarse loamy over clayey mixed isohyperthermic Aeric Albaquults*

BO3: Knollis clay loam: deep, imperfectly drained to poorly drained, strong brown, yellowish brown and light grey, mottled, acid clay over old alluvial/lacustrine deposits, with a humic topsoil. *Fine mixed isohyperthermic Aquic Argiudolls*

BO4: Linstead variant I clay loam: deep, moderately well drained to imperfectly drained, strong brown to yellowish red and red, mottled, acid, very firm clay over old alluvial deposits. *Fine mixed isohyperthermic Aquic Kandiudalfs*

BO5: Rosemere variant I clay: deep, moderately well drained, strong brown, red and light grey, mottled, acid clay over old alluvial deposits. *Clayey mixed isohyperthermic Typic Paleudults*

BO6: Riverhead clay: deep, moderately well drained, brownish yellow to yellowish red and light grey, mottled clay over old alluvial deposits, with a humic topsoil. *Fine mixed isohyperthermic Humic Hapludalfs*

BF: SOILS FORMED ON FLUVIO-COLLUVIAL DEPOSITS

BF1: Donnington variant II clay loam: moderately deep, well drained, mixed yellowish red, reddish grey to strong brown and dark brown gravelly loam to gravelly clay loam over transported pre-weathered conglomerates. *Loamy-skeletal mixed isohyperthermic Typic Eutropepts*

BFy1: Brysons variant I - Brysons variant II complex: complex of deep, imperfectly drained, dark yellowish brown to pale brown and light grey, mottled clay over lacustrine deposits with admixtures of limestone colluvium, with a cracking topsoil, and deep, imperfectly to poorly drained, light grey, yellowish brown to brownish yellow, mottled, acid clay over lacustrine deposits with admixtures of limestone colluvium, with a slightly cracking topsoil. *Vary fine montmorillonitic isohyperthermic Entic Chromuderts & very fine mixed isohyperthermic Aquentic Chromuderts.*

P: SOILS OF THE RIVER PLAINS

(Overall characteristics: relief intensity <10 m, slopes 0-5%, elevation: approximately 260 and 350 m, respectively).

PR: SOILS FORMED ON RECENT ALLUVIUM

PR1. Lluidas loam - silty loam: deep, well drained, (dark) reddish grey to dark reddish brown, medium textured soils over recent alluvium, with a humic topsoil. *Fine silty mixed isohyperthermic Fluventic Hapludolls*

PR2: Rose Hall clay loam - clay: deep, imperfectly drained, dark reddish brown over a mottled grey and brownish yellow clay over recent alluvium, with old alluvium admixture in places. *Fine mixed isohyperthermic Aquic Eutropepts*

PRx1. Lluidas variant I - Lluidas variant II complex: complex of deep, well to moderately well drained, (dark) reddish brown, moderately fine textured soils over recent alluvium, with a humic topsoil, and deep, moderately well drained to well drained, dark reddish brown, slightly mottled, moderately fine to fine textured soils over recent alluvium. *Fine mixed isohyperthermic Typic Hapludolls & fine mixed isohyperthermic Typic Eutropepts*

PF: SOILS FORMED OVER FLUVIO-COLLUVIAL DEPOSITS

PFy1: Prospect variant I - Rose Hall variant I complex: complex of deep, well drained, yellowish red to strong brown, medium to moderately fine textured soils over recent alluvium with admixtures of limestone colluvium, with a humic topsoil and deep, moderately well drained, yellowish red to strong brown, slightly mottled, moderately fine textured soils over recent alluvium with limestone colluvium admixture, with a slightly cracking topsoil. *Fine loamy mixed isohyperthermic Typic Hapludolls & fine mixed isohyperthermic Vertic Eutropepts*

N: Miscellaneous land types

Np: Ponds
Nu: Rural residential areas

EXPLANATION OF MAP UNIT SYMBOL:

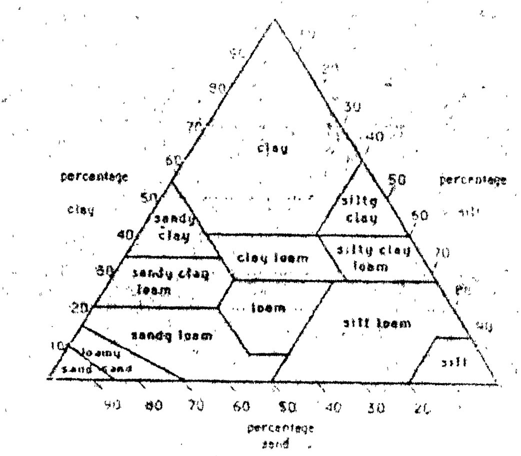
HLx1 / e:	H	physiography (Hills and Foothills)
	L	parent rock/material (hard Limestone)
	x	symbol for complex (x) or association (y)
	1	mapping unit order number (for Bonnygate - rock outcrop- St. Ann variant I)
	e	slope class (16-30%)

A------B : Schematic cross-section of Figure 3.
■ 099 : Location of the soil pits and pit number (Appendix IV)
◆ 075 : Location of analysed rock samples (Appendix II)

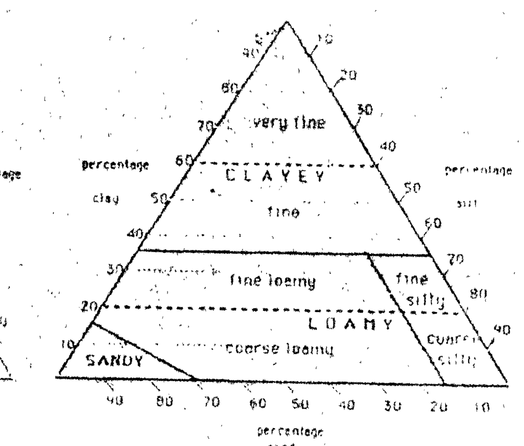
KEY TO SOIL DEPTH CLASSES:

very shallow	less than 25 cm
shallow	25 - 50 cm
moderately deep	50 - 100 cm
deep	over 100 cm

KEY TO TEXTURAL CLASSES:



Triangle textural classes



Triangle particle size classes (USDA)

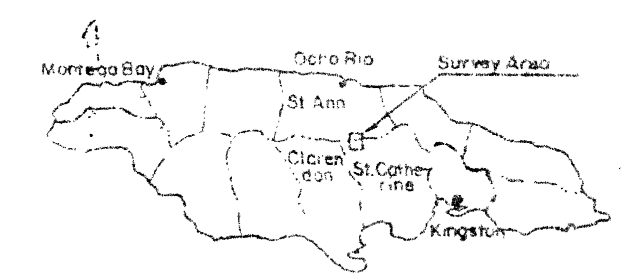
KEY TO TEXTURAL GROUPS:

fine	sandy clay, silty clay, clay
moderately fine	clay loam, sandy clay loam, silty clay loam
medium	very fine sandy loam, loam, silt loam, silt
moderately coarse	sandy loam, fine sandy loam
coarse	sand, loamy sand

KEYS TO SLOPE PHASES:

code	overall range in max. slope gradient (%)	single slope	complex slope
a	0-2	almost flat	flat to almost flat
b	2-5	very gently sloping	gently undulating
c	5-8	gently sloping	undulating
d	8-16	sloping	rolling
e	16-30	moderately steep	hilly
f	30-50	steep	steeply dissected
g	>50	very steep	v. steeply dissected

LOCATION:



MINISTRY OF AGRICULTURE
RURAL PHYSICAL PLANNING DIVISION
JAMAICA SOIL SURVEY PROJECT

Base map derived from 50% reduced toposheets 84A and 84C (scale 1:12,500) from Survey Department, Kingston.

Map compilation: P.A.M. van Gent, April 1990
Cartography: V.A. Ricketts, July 1990.

Soil survey: Staff of JSSP (1986). and L.L.T. Dawkins, G.J. Ford and P.A.M. van Gent (1988-1989)

Soil correlation and classification: N.H. Batjes, P.A.M. van Gent and G.R. Hennemann.