AGRICULTURAL LAND CAPABILITY OF THE CAYMAN ISLANDS

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AUGUST, 1996

PREFACE

The land capability classification of the soils and land units of the soil complexes of the Cayman Islands represents the final product of the assessment of the soil resources and their relative suitability for agriculture. The authorities will now have available, information on the physical aspects of the various soils and their distribution in the islands as well as a classification of their relative suitability for agriculture. A relevant scheme of land capability is generally lacking in developing countries even though it is vital in regulating the use of the land. For food security and self preservation, it is now strategically important for any country to have available, information on the relative suitabilities of its soils for agriculture so that preference may be given for the lands more suitable for this use to be so reserved.

In common with all small island states, in the Cayman Islands, land is very limited and the demands for its use are many. The demands for land for housing and tourism development are significant in this regard. This development is inevitable and must be sustained but some control and regulation on demands for land space is essential if agriculture is to survive and the environment is protected. In this process, it is important to know the relative quality of the land so that its use can be regulated in accordance with the suitability of the particular soils.

At the present time, land use for agriculture is considered within the regulations governing the use of the category of land designated residential/agricultural. In theory, permission is not granted to sub-divide lands with a high suitability for agriculture for intensive housing development, while such permission may be granted for lands with low suitability. In practice there are many anomalies resulting in intensive housing development around land presently in agriculture. While it has not been found possible at this time for Government to accept the proposal that agricultural lands should be zoned for this use, this measure is likely to be reviewed in the future as good and sustainable agriculture is firmly established in the islands. Whenever the question of agricultural land zoning is being raised, the land capability classification having been done, this would provide a rational and sound basis upon which to base such zoning. In the interim, the Department of Agriculture would be better informed in making recommendations for land sub-division for residential or agricultural uses. This study, therefore, is an investment in the future in anticipation of an orderly and planned programme of land use in which agriculture and the environment would be more seriously considered in decisions on the use of the lands.

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20 August, 1996.

ACKNOWLEDGEMENTS

The author is pleased to acknowledge the assistance of the following persons/officers:

Dr. A. Benjamin, Chief Agricultural and Veterinary Officer, Department of Agriculture, for the fore-sight in commissioning this study and for making all arrangements for its conduct;

Mr. A. Estwick, Agronomist, Department of Agriculture, who worked with the author and whose views were valuable and willingly given;

All other members of the Department of Agriculture who were always willing to assist in any way;

Professional staff of the Departments of Environment, Planning and Lands and Survey and the Water Authority and National Trust, for many discussions on matters related to this study and for making available published and unpublished information which was of great use and interest;

Many dedicated farmers in the three islands who were always willing to give their views and to discuss the essential features of the various farming enterprises which they manage.

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EXECUTIVE SUMMARY

1. The soil survey of Grand Cayman, Cayman Brac and Little Cayman was checked. Amendments were made to soil boundaries as required and errors in the maps were corrected. Since copies of the cartographically made maps are no longer available, the soils information was digitised with the help of the Lands and Survey Department and the information stored. The digitised soil map of Grand Cayman was printed on one sheet instead of two as before. With transparent overlays showing the block and parcel information with place names and cultural features for the three islands, the soil maps can now be more easily read and interpreted.

2. During the field work, samples of soil representative of good farming conditions were taken and analysed for clay mineralogy and chemical properties. A significant feature is that all the red and brown soils are rich in gibbsite and boehmite, the minerals which constitute bauxite, which makes the soils similar in origin to the bauxite soils of Jamaica.

   The soils are inherently fertile, being rich in organic matter and all the main nutrients. Only supplemental nitrogen may be essential to aid crop production.

3. The main environmental features of the islands affecting soil and land use include their geology, relief and drainage and climate. All the rocks of the islands are calcareous; there are discontinuities between the oldest rocks of the Bluff Formation which is similar in age to limestones in the Greater Antilles and the Ironshore Formation which is much more recent; the youngest rocks constitute the Coastal Formation which is not extensive.

The islands are flat and low-lying with no natural external drainage systems; rainfall evaporates, percolates or accumulates in depressions. Rainfall data shows Grand Cayman to be the most humid of the islands with rainfall varying from 1200 to 1400 mm per annum increasing from east to west. The annual rainfall of Little Cayman and Cayman Brac ranges from 1000 to 1100 mm per annum. The rainfall is received from May to November and it is characteristically unreliable. Typically, it comes in heavy showers punctuated by long dry spells. Supplemental irrigation throughout the year is normally necessary for crop production.

4. Grand Cayman has significant ground water resources and with increasing availability of desalinated water for domestic use, increasing amounts of ground water is available for agriculture. The water quality changes rapidly in most areas except for East End and it fluctuates in response to rainfall received, rate of exploitation and tidal movements; therefore, careful monitoring of water quality is essential as a pre-requisite to its use for irrigation.

   Cayman Brac and Little Cayman have no substantial usable ground water resources which is an important constraint in agricultural development in these islands.

5. Agricultural production has increased significantly in recent years, the main areas being in food crops, vegetable crops and livestock. There has been important improvements in techniques in land reclamation, soil management, use of irrigation, pasture establishment and marketing and the farmers are keen to accept improved and proven technologies. There is thus increased demand for land resources for agricultural production.

Other competing demands for land resources are housing, urban development and tourism. The Government is also committed to preserving the environment and to maintain the touristic appeal of the islands. Therefore, it is important to establish a land use policy in which the use of the limited land resources can take place in a planned and orderly manner.

6. An important step in the development of a national land use policy is the establishment of the relative capabilities of the various soils and land units for agricultural development.

7. In developing a capability classification for land suitability for agriculture, the soil depth including the effective soil depth, rockiness and stoniness, the nature of the underlying rocks with respect to its suitability for ripping, water availability and its quality, soil salinity and land drainage and its susceptibility to flooding are considered as determinants.

The depth of soil is considered the most important factor since this determines rooting volume and water storage. The degree of rockiness and stoniness and nature of the underlying rock restrict the available land surface for crop planting and greatly influence the types of crops which can be grown. The nature of the underlying rock with respect to its resistance to ripping, and so contributing to the effective rooting depth, the degree to which it serves as a mechanical barrier for root and water penetration and its resistance to machinery, are the important factors.

Water availability and quality virtually determines what land can be farmed on an all-year basis and this factor gives the land over sustainable water lenses in Grand Cayman a special quality. Soil salinity is important particularly due to the fact that since there is no through drainage, leaching of the salts is not possible and therefore saline areas must be recognised as such. The potential of soils to be secondarily salinised by irrigation or by encroachment of sea water caused by draining of the swamps in the Mosquito Control Programme are significant factors in determining the capability of the land.

Finally, land drainage and susceptibility to flooding are important limitations which must be recognised. In some cases due to the relative impervious nature of the underlying limestone, water collects in depressions following rainfall incidents which restricts the use of such land for agriculture and encourages the development of soil salinity at those locations.

8. Based on the factors outlined in 7 above, the established soil series, phases of soil series, soil associations, soil complexes and other land units are classified into six major Land Capability Classes and adequate justification is given for the inclusion in any of these in a particular Class. The environmental conditions in each of the islands are considered separately, and accordingly, a particular unit of land may be put in different capability classes in any of the islands, depending upon the importance and extent of constraints for agriculture. Class I land is the most suitable for agriculture and this type of land only occurs in Grand Cayman. It is restricted to the soils with the deepest profiles occurring over usable ground water and which can be farmed without restriction for any type of agricultural production.

Land in Classes I-V are suitable for agriculture but the limitations increase substantially and the range of agricultural enterprises possible progressively decreases. In general as the Classes increase from I-V, arable crops become less important and pastures with species tolerant to salinity and waterlogging become important.

The lands in Class VI are not considered suitable for agriculture as is presently practised. These lands are too rocky and stony and devoid of soil, too waterlogged, swampy or marshy or too saline or exposed for the cultivation of crops or pasture. Some of it may be suitable for fish farming when this is developed and this can eventually alter the classification of this group.

It is hoped that this study can influence the evolution of an appropriate land use policy for the Cayman Islands, in which, other factors permitting, land with lower capabilities for agriculture can be used for non-agricultural purposes and land with higher capabilities be preferred for agriculture.

9. The report is complete with revised soil maps and maps showing the capability classification of the various soil series and land units for the three islands. For easy identification and location, transparent over-lays showing the block and parcel information with place names and cultural features, are presented.

1.0 Introduction:

The Cayman Islands, consisting of Grand Cayman, Cayman Brac and Little Cayman comprise an island state with restricted land area of approximately 102 square miles. With a resident population of 31,200, the islands can already be regarded as well populated; however, with over an additional 1 million visitors (in 1995) the land area has become very valuable, the main competitor for its use being tourism, housing and urban development.

In the past, agriculture was much more important as a source of employment than at present and there is a trend for the percentage of the population employed in agriculture and related industries to decrease with time. Yet the statistics show huge increases in agricultural production in recent years, especially in the crop production component. Orchard crops such as citrus, mango and avocado and food crops such as banana, plantain and vegetables have been the main areas of increase. A main cause for this increase in production is the realisation by the local population and catering industry that local agricultural products are of exceptionally good quality and when available, are preferred.

The increase in agricultural production and recent awareness that agriculture can be a satisfying profession is associated with a group of highly enterprising, determined and dedicated farmers who are ready to utilise improved technologies in all stages of production and marketing. This new thrust is strongly supported by a staff of veterinary and agricultural scientists in the Department of Agriculture who are adequately trained and dedicated to the task.

With an increased demand for land for agriculture together with an ever-increasing demand for tourism and housing, the capability of the land, or its relative suitability for different uses, is becoming increasingly relevant. This assessment is necessary if the most appropriate use is to be made of the land. It must always be kept in focus that if land is used beyond its capability, the type of usage would not be sustainable and land degradation would result. Equally important is the fact that if land is used below its true capability, then the full economic potential of the use of the land would not be realised.

Economically, a capability classification of the soils and land resources can assist administrators in agriculture in encouraging the concentration of the various farming systems on the most suitable land in each case. In this way the individual soils can be utilised for the types of agricultural production for which they are best and most economically suited. It can assist the authorities in developing an effective land zoning policy in which the best suited areas for agriculture, housing, tourism, urban and industrial development and other uses can be identified and the land rationally used. In land use, Government's policy up to the present (Development Plan, 1977 and Draft Plan, 1995), is to recognise, in the same category, uses of land for residential and agricultural purposes. The same classification is being recommended in the Draft Development Plan for the immediate future, without elaborating further on the criteria for the two uses. In the past, this policy has led to conflicts in which residential land use has encroached on previously established farm land with detrimental effects. While it is recognised as desirable overall for lands suitable for agriculture to be retained for this use, there is at present inadequate protection for the use of such lands. The Department of Agriculture's advice is sought on applications for residential sub-divisions but the recommendations may not be followed. Ideally, there should be a clearer policy for the use of land for agriculture and for residential purposes. In general, if food production is regarded as strategic, the suitability of land for non-agricultural uses increases with decrease in its suitability for agriculture.

An assessment of the capability of the land for agriculture is an important stage in the development of rational land use plans for any country which is yet to be given its due importance. Where land use capability assessment has been attempted especially in developing countries, it has been invariably based on general systems developed by the USDA and FAO. An approximate land capability assessment for any area must be based on local circumstances including physical aspects as well as socio-economic conditions. The main features of the two general systems are outlined in Section 2 of this report.

The need to establish a capability classification and land use potential for the Cayman Islands in present day circumstances has been appreciated by the Ministry of Agriculture, and accordingly, a study to achieve these objectives has been commissioned. It is hoped that the guidelines which will be proposed will assist in more rational land use which is compatible with environmental preservation and protection. The Terms of Reference for this study are as follows:

1. Review and revise the existing soil survey of the Cayman Islands and to prepare a soil distribution map on scale 1:25,000 for the three islands.

2. Assess the level of agricultural technology, expertise and available water resources for agriculture in relation to use of land in the Cayman Islands.

3. Assess the impact of non-agricultural uses and modifications of the natural environment on land degradation and ground water quality and recommend measures to prevent further deterioration.

4. Assess current land use and land use trends.

5. Utilise 1-4 above and make recommendations for land capability in Grand Cayman, Cayman Brac and Little Cayman.

6. Suggest a possible land zoning programme based on determined land capability assessments and all essential needs for use of land.

7. Prepare a detailed report of the findings which would emphasise the following:

    a. The soils, their properties and distribution.
    b. Relative capabilities of the various soil units with justification.
    c. The potential for agricultural production considering the available physical and human resources.
    d. Rationalise future land use in the islands taking into account all demands for use of land but paying particular attention to suitability of lands for agriculture and the need for environmental preservation.

e. Prepare separate maps of the Cayman Islands on scale 1:25,000 showing the following:

   i. Soil distribution
   ii. Land capability

These maps will form part of the report referred to above.

2.0 Features of General Land Capability Classification Systems:

2.1 The USDA System:

A general system of land capability classification was formally proposed by the USDA (Klingebiel and Montgomery, 1961) mainly to classify land for suitability for mechanised agriculture. The scheme as proposed consists of eight classes or categories of land with respect to suitability for agriculture. Differentiation between these classes is based on those particular characteristics and qualities of site and soil that limit land utilisation or impose significant restrictions when the land is being used for modern agricultural production. Within a class, is grouped soils that have the same restrictions, limitations or hazards to agricultural utilisation under any given kind, system or level of land management. Land having the largest number of alternative uses under a given system of management is placed in Class I and land with the least number is placed in Class VIII. Therefore, the number of restrictions, limitations or hazards to agricultural utilisation increases progressively from Class I to VIII. In general, land grouped in Classes I to IV inclusive, is regarded as suitable for mechanical tillage, although it would also be suitable for growing tree crops or timber if necessary. Land belonging to other classes is considered to be unsuitable for mechanical agriculture and capable only of growing pasture crops, tree crops and forest, or, as used throughout the Caribbean, for manual growing of food crops.

The essential features of each Land Capability Class as proposed by the USDA is as follows:

Class I	Suitable for cultivation (tillage) with no limitations.
Class II	Suitable for cultivation (tillage) with moderate limitations.
Class III	Suitable for cultivation (tillage) with strong limitations or intensive practices.
Class IV	Suitable for cultivation (tillage) only with special practices, though best suited to growing pasture grasses and tree crops.
Class V	Not suitable or only marginally so for cultivation (tillage) but suitable for growing of pasture crops, orchard crops or forest.
Class VI	Not suitable for cultivation but suitable for poor pasture and forest.
Class VII	Not suitable for cultivation (tillage); suitable only for rough pasture, wildlife, recreation and water conservation.
Class VIII	Soils and land forms with limitations that preclude their use for commercial plant production and restrict it to recreation, wildlife preservation, water supply or for aesthetic purposes.

Any one of the site and soil characteristics and qualities can constitute a restriction, limitation or hazard to crop growth and production if it is not operating at or near its highest efficiency. These characteristics are given Sub-Class status and each is assigned an appropriate index letter which is inscribed on land capability maps. The index letters with the corresponding limitations are as follows:

Restriction, Limitation or Hazard	Index Letter
Climate	c
Relief, erosion	e
Excessive wetness or dryness	w
Soil characteristics i.e. Shallow profile, infertile soil, salinity hazard, impediments to root growth, etc.	s

For example, land capability Class Ve indicates that the land is just marginal for cultivation (tillage), that the principal limiting factor is severe erosion, but climate or some soil factor such as stoniness may further limit the agricultural use of the soil, thus justifying its grouping in Class V.

Since the classification is intended to grade land for suitability for mechanised agriculture, slope or relief of the landscape is of prime importance. Therefore, in developing countries where mechanised agriculture is not advanced, strict adherence to the system could lead to some anomalous situations. For example, in cacao cultivation, soils highly suited to this crop on slopes would have a much lower rating than if they were being considered specifically for cacao cultivation. Similarly, flat land with no relief which may be highly suited for rice cultivation would be placed in a much lower category for general suitability for agriculture due to implied difficulties in drainage as a result of the relief. In the Caribbean, very steep land (>20% slopes) is used throughout for manual cultivation of food crops, many of the holdings being on a permanent basis, although shifting or rotational cultivation is also practised. In such areas, considerable expertise sometimes exists among farmers in managing such steep areas which is a factor that should be considered in land use recommendations. The farmers involved have little choice of other land in any event.

In a developing country, these are some of the problems in the application of the un-modified USDA system of land capability classification. In proposing the system, the USDA recognises that groupings by use or capabilities should be considered transitory and will need to be changed with changes in technological and scientific inputs which is more likely in new, undeveloped or developing areas. Nevertheless, the basic classification is of utmost importance in any country in assessing the overall quality of the land for agriculture. From it and from a good basic soil survey, specialised groupings can be made for any use, agricultural or other crop farming system, etc. The more specific the grouping or classification, the greater is the need for a good understanding of local conditions and for associated collaborative research aimed at getting more complete understanding of soil behavior and management requirements.

2.2 Features of the FAO System:

FAO (1993), in appreciating the relative inflexibility and specific nature of the USDA Land Capability Classification, proposed a Land Suitability Classification for general application in developing countries. The classification is meant to be even more general than the USDA system, although the two systems can be reconciled. An outline of the system is given in Table 1. The system consists of three levels of classification: Suitable or Not Suitable (S or N), degrees of suitability e.g. highly, moderately or marginally suitable, S1, S2 or S3 and a letter indicating the major land limitation that has led to the class allocation, i.e. S2w indicating water limitation and S2e indicating erosion hazard limitation.

TABLE 1: Structure of the FAO Land Suitability Classification

S	SUITABLE	The land can support the land use indefinitely and benefits justify inputs.
S1	Highly Suitable	Land without significant limitations. Include the best 20-30% of suitable land as S1. This land is not perfect but is the best that can be hoped for.
S2	Moderately suitable	Land that is clearly suitable but which has limitations that either reduce productivity or increase the inputs needed to sustain productivity compared with those needed on S1 land.
S3	Marginally suitable	Land with limitations so severe that benefits are reduced and/or the inputs needed to sustain production are increased so that this cost is only marginally justified.
N	NOT SUITABLE	Land that cannot support the land use on a sustained basis, or land on which benefits do not justify necessary inputs.
N1	Currently not suitable	Land with limitations to sustained use that cannot be overcome at a currently acceptable cost.
N2	Permanently not suitable	Land with limitations to sustained use that cannot be overcome.

Examples of classes in the third category:

S2e Land assessed as S2 on account of limitation of erosion hazard

S2w Land assessed as S2 on account of inadequate availability of water

N2e Land assessed as N2 on account of limitation of erosion hazard.

Note: There is no standard system for letter designations of limitations; first-letter reminders should be used where possible.

According to the system, there are two classes of land which are not suitable for agriculture, these being **land which is currently not suitable but this status can change with improved technologies**, and **land which is permanently unsuitable for agriculture.**

In applying the system, the first and most important decision is to separate land that is suitable, from that which is not. Important criteria for deciding on the suitability of land for a specific use are **sustainability** and **ratio of benefits to costs.** For example, the land should be able to support the land use on a sustained basis which means that the use must not progressively degrade the land. The use should also yield benefits that justify the inputs.

2.3 Suitability of Both Systems for the Cayman Islands:

For small island states, either system of land capability classification is unsuitable. This is particularly so for the Cayman Islands where either system would result in down-grading of the soils beyond reality. The basis for the USDA system, i.e. suitability of the land for mechanised agriculture, is irrelevant and the classes of the FAO system are too broad with imprecise definitions. Clearly, this system is more suitable for the general appraisal of large areas and it is too inflexible in application to accommodate fully, the impact on land use of small differences in the environment or socio-economic conditions. In the Cayman Islands conditions, these aspects are very significant and are duly considered in Section 3 below.

3.0 The Environment, Soils and Agriculture of the Cayman Islands:

3.1 The Environment:

The aspects of the environment which are important with respect to land quality and land use in the Cayman Islands are the geology, land relief and physiography, climate geology and ground water conditions.

3.1.1 Geology:

The geology of the Cayman Islands was studied by Matley (1926) and more recently by Jones (1994). The Cayman Islands were most likely part of Cuba up to about half a million years ago. Prior to the separation due to earth movements, there were intermittent submergence and uplift of the land mass which constituted the Greater Antilles and even part of Central America. Over the last 25,000 years, the islands have first been subjected to minor intermittent elevation and subsidence of the land. Evidence of cracks and faults seen inland and shoreline areas may indicate that there is, at present, slow uplift taking place. There is a major discontinuity in age of the three geological formations of which the islands are made.

The rocks of the islands are all calcareous but there are variations in age, structure and composition. The following are the main characteristics:

Geological Formation	Age	Characteristics
Coastal Formation	Recent (less than 25,000 years)	Chalky or rubbly coralline limestone, often with brown sand; less than 20% impurities.
Ironshore Formation	Pleistocene (25,000 to 100,000 years)	Consolidated sands and marls with abundant coral, average elevation 10-15 feet (3-5 m) asl; Often have hard crusts or caps under which is softer material; lagoon and swamps; shoreline deposits.

Bluff Formation	Middle Oligocene & Early Miocene (25-30 million years)	Hard, massive semi-crystalline limestone resembling the white limestone of Jamaica; pure; cliffs, karsts; honey-combed, sink holes.

The distribution of the geologic formations for Grand Cayman and Cayman Brac can be seen in Figs. 1 and 2.

3.1.2 Relief and Drainage:

Relief and drainage are strongly related to the geology and geologic history of the islands. The islands are extremely low-lying, rising to 60 feet (20m) asl in Grand Cayman but up to 140 feet (46m) in Cayman Brac. There are no streams due to negligible elevation and high porosity of the limestone. The overall relief can be divided into three main regions in descending order of elevation and ascending order of retardation of external drainage:

i. Areas of limestone hills (Bluffs): Water table relatively deep, ranging from 10 to 100 feet (3 - 33 m); large numbers of sink-holes and caves in both Grand Cayman and Cayman Brac; external drainage good and flooding is never important.

ii. Low-lying coastal areas (dry land): Mostly of ironshore geological formation, blown sand and storm beaches; areas poorly drained and affected by sea salts; naturally high and fluctuating water table related to proximity of the sea; the ground water level is affected by tidal movements; subject to temporary inundation following heavy rainfall.

iii. Low-lying coastal areas - swamps and ponds: Cover large part of Grand Cayman and Little Cayman but only small areas on Cayman Brac; swamps vary in depth from few inches to several feet and some contain peaty material; the under-lying calcareous material is usually soft; the water may be fairly fresh, brackish or saline and generally tidally affected; natural vegetation consists of red and white mangrove, button wood, saline grasses, sedges and ferns.

Baker (1974) has presented a distribution of these main physiographic areas in the three islands.

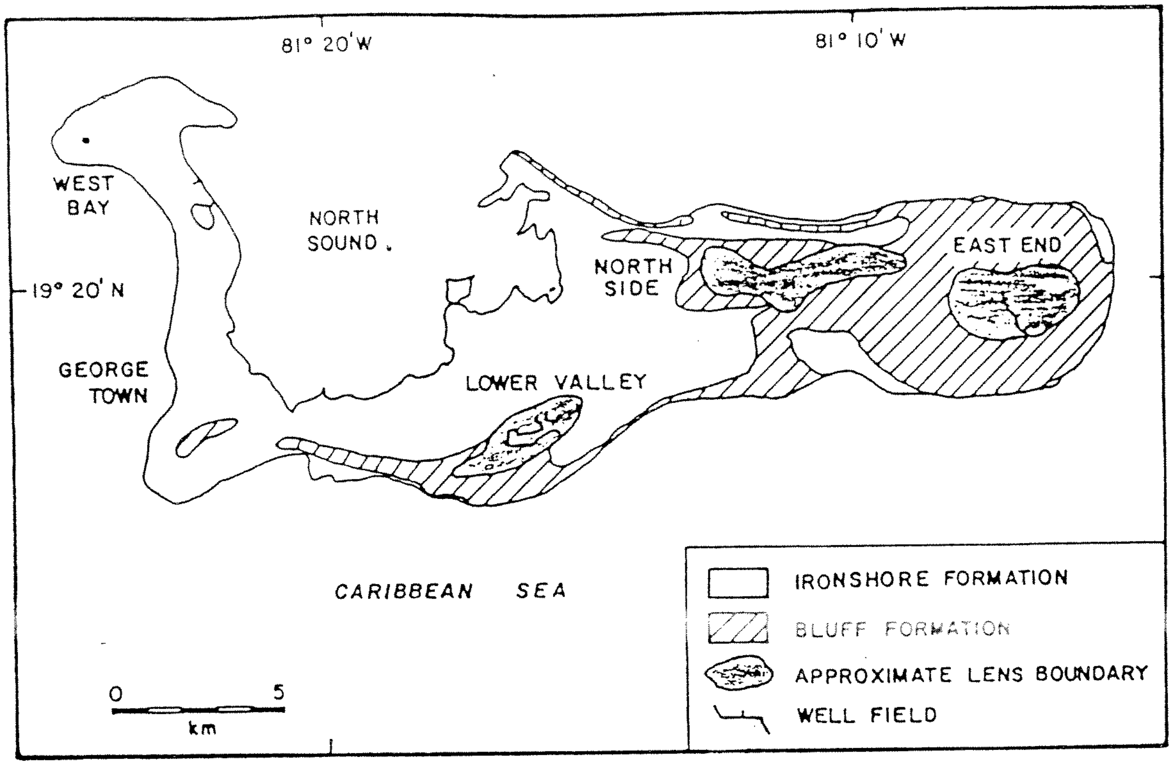


Fig 1. Map of Grand Cayman showing the hydrogeological setting of the major fresh ground water lenses and location of well field. (Adapted from Ng and Beswick, 1994)

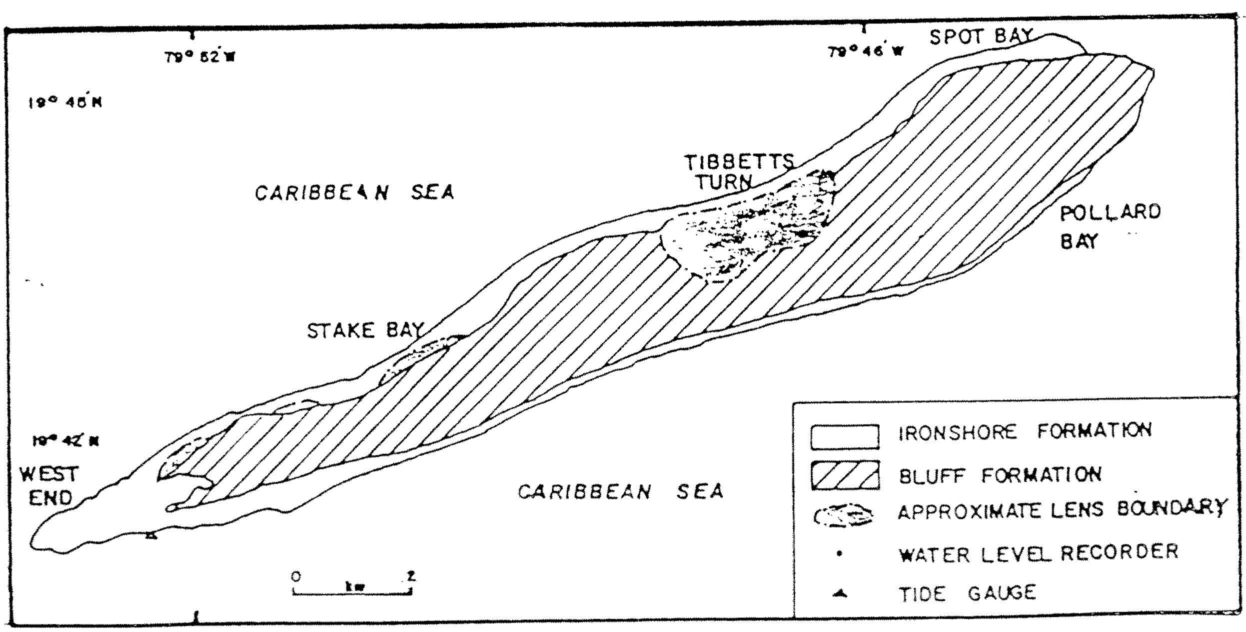


Fig 2. Map of Cayman Brac showing the distribution of the rock formations and fresh ground water occurrences. (Adapted from Ng Beswich, 1994)

3.1.3 Climate:

For flat low-lying islands of the Caribbean, the Cayman Islands are blessed with a good level of annual rainfall. Data on climatic conditions was summarised by Burton (1994); it is not uniformly comprehensive for the three islands and does not go far back in time except for Grand Cayman. The overall climatic pattern for the three islands is generally similar and therefore descriptions of the elements would be based on data from Grand Cayman.

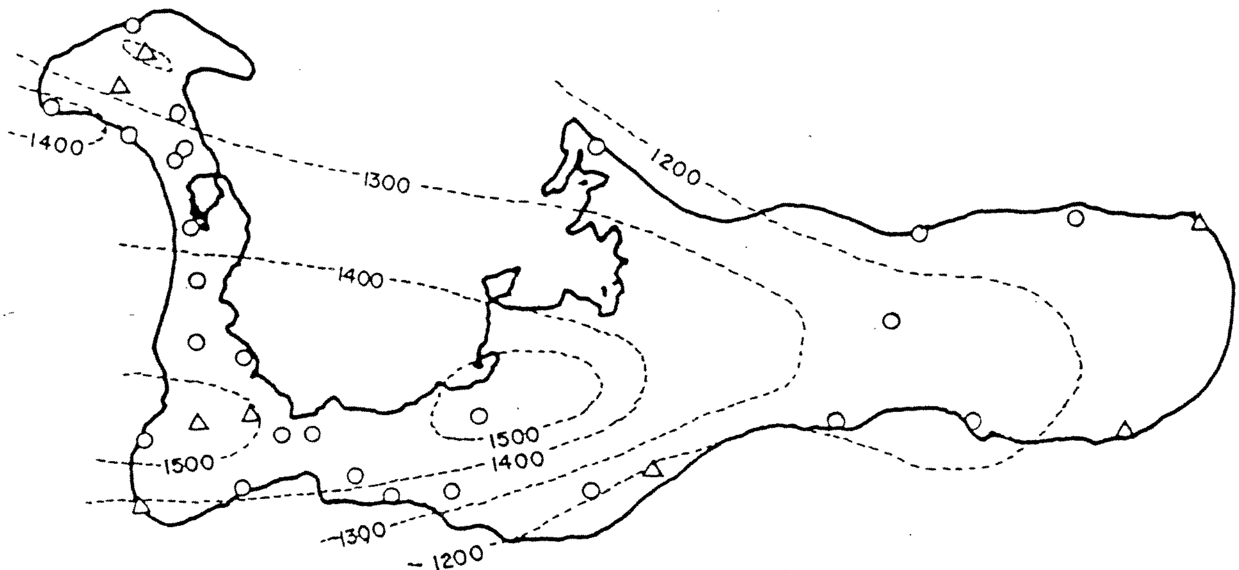
The main wet season lasts from May to October with November and December being intermediate. The true dry season extends from January to April. The rainfall distribution (monthly means) during the year for Grand cayman is shown in Table 2 and in Figure 3 the rainfall isohyets are shown for the period 1967-1987. In Figure 4 the monthly precipitation and evaporation demand for the period 1989-1993 at the Owen Roberts Airport are presented.

The variation of monthly mean precipitation (Table 2) is self explanatory and this can create serious problems for agriculture particularly in rain-fed conditions. A feature of the rainfall received during the wet season is that it comes in heavy downpours punctuated by dry spells which causes periodic flooding in low-lying areas and depressions as well as moisture deficiency which is accentuated by shallow soil depth and low water holding capacities. There is also a tendency for decreasing rainfall with time. The evaporation demand is quite high but the overall conclusion can be made that during the wet season, an excess of precipitation over evaporation can be expected. The erratic distribution of rainfall during the wet season could mean that supplemental irrigation may be needed even during this period.

The rainfall received over Grand Cayman increases from east to west and reaches a maximum in the George Town area (Figure 3) where the annual values average between 1400 to 1700 mm per annum.

TABLE 2: Average monthly rainfall distribution 1970, 75, 80, 85, 88-93 for Grand Cayman

	1970	1975	1980	1985	1988	1989	1990	1991	1992	1993	Average 1988-1989
Annual Total	72.07	53.71	57.37	50.39	57.81	51.22	54.06	59.47	58.58	53.39	55.34
January	2.09	1.74	1.93	0.64	5.96	0.22	0.28	0.55	0.74	4.27	1.21
February	1.10	1.14	1.45	0.64	0.56	2.06	2.78	1.98	5.07	0.45	2.47
March	1.98	0.73	3.59	0.26	1.46	1.10	4.71	0.46	3.39	1.32	2.20
April	0.10	0.96	1.37	6.41	0.13	0.74	0.62	0.75	0.78	0.33	0.64
May	6.59	2.31	2.88	6.78	11.25	10.21	8.10	10.16	3.11	8.12	7.94
June	7.38	1.72	4.65	2.20	4.62	3.28	3.30	3.77	7.68	7.40	5.09
July	26.45	16.07	11.22	5.85	3.25	4.14	5.21	4.46	4.23	3.82	4.37
August	6.61	4.12	8.73	7.34	8.36	5.39	2.86	6.66	9.40	2.41	5.34
September	9.62	5.96	9.27	7.68	9.40	9.13	7.14	14.92	11.62	6.61	9.88
October	6.63	4.44	5.66	5.07	4.67	3.11	5.01	11.20	6.11	6.23	6.33
November	3.06	13.91	1.79	2.52	6.88	6.69	11.02	2.69	1.57	11.02	6.60
December	0.46	0.61	4.83	5.00	1.27	5.15	3.03	1.87	0.37	1.41	2.37
Monthly Avg.	6.01	4.48	4.78	4.20	4.82	4.27	4.51	4.96	4.51	4.45	4.54



Isohyets in millimetres.

Fig 3. Distribution of mean annual rainfall across Grand Cayman, for the 21-year period 1967 - 1987 (after Burton, 1995).

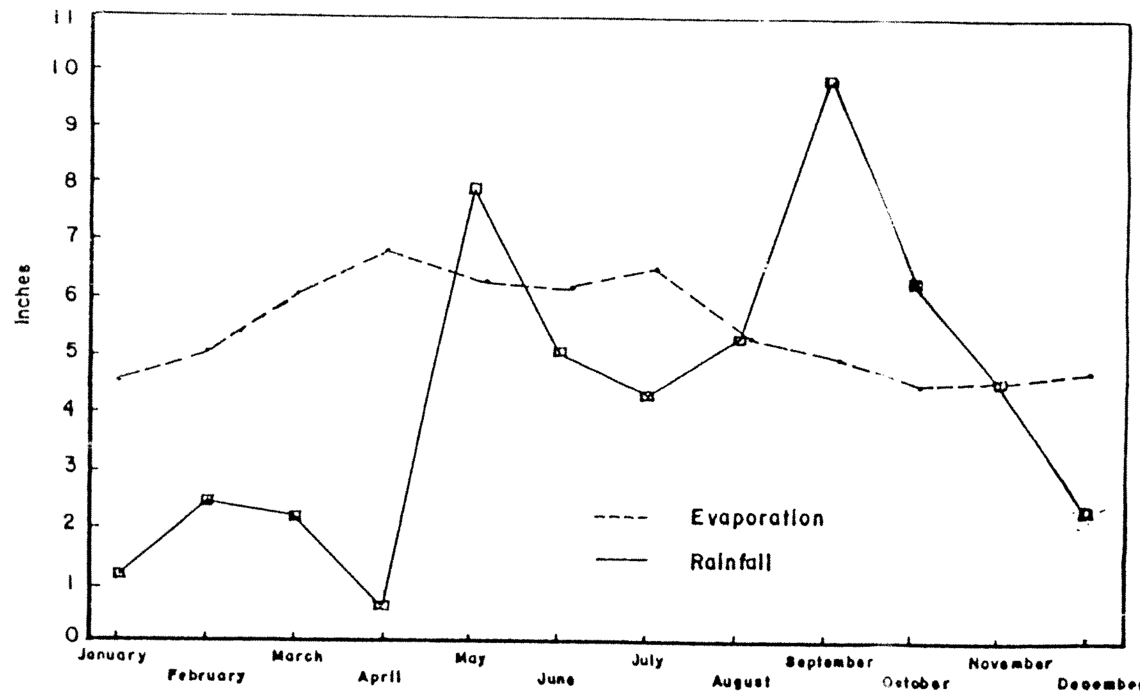


Fig 4. AVERAGE MONTHLY RAINFALL AND EVAPORATION DEMAND GRAND CAYMAN, 1989 - 1993. (Adapted from Civil Aviation Authority, Owen Robert, Grand Cayman)

Data on the evaporation demand for the Cayman Islands is scarce and it is only relatively recently that such data is being accumulated. From what is available (Figure 4), it is seen that at the Owen Roberts Airport, which coincides with the wettest parts of the islands, there is a moisture deficit from November to May.

This makes at least half of the year too dry for crop production without irrigation. Even so, the rains are received during the wet season usually in heavy showers punctuated by distinct dry spells. This may create the need for supplemental irrigation at this time also. This problem is made more important by the low moisture retention capacity of the soils.

As stated before, climatic data for Cayman Brac and Little Cayman is sparse. However, from what is known, less rainfall is received with greater unreliability compared to Grand Cayman. Average annual values are given in Table 3 for the three islands.

TABLE 3: Average annual rainfall for Grand Cayman (1967-1987), Little Cayman (1970-1987) and Cayman Brac (1970-1987)

Island	Rainfall (mm)
Grand Cayman West	1,595
Grand Cayman East	1,107
Little Cayman Central	1,174
Cayman Brac Central	1,174
Cayman Brac East	1,049

After Burton (1994)

The warm season lasts from May to November with a mean daily temperature range of 85 - 90 degrees Fahrenheit and the cool season lasts from December to April during which the mean daily temperature is generally 15 degrees lower than in the warmer months. Relative humidity usually falls within the range 65-100%, rarely falling below 50%. The prevailing winds are usually north-east to north-west in the cool season during which **northers** often bring strong winds and a pronounced lowering of the temperature. During July to November the islands are frequently affected by low pressure systems moving West across the Caribbean: These range from weak tropical waves to hurricanes.

The climatic conditions of the Cayman Islands favour a successful and diversified agriculture with the proviso that for all-year crop or pasture production, supplemental irrigation would be necessary.

3.1.4 Vegetation:

The vegetation of the Cayman Islands has been studied and classified by Brunt (1994) and the flora was described by Proctor (1984). In classifying the vegetation, Brunt adopted the system developed by Beard (1944; 1949; 1955) for the classification of Tropical American vegetation. The classification is based on floristic composition and habitat similarities. Accordingly, the vegetation of the islands falls into three formations i.e. dry evergreen formation, seasonal swamp formation and swamp formation. This last formation is sub-divided into marine and fresh-water. Most of the vegetation on the islands is secondary but there are locations, such as along the Mastic Trail and the Botanic Park, where the natural vegetation still exists.

Already, some relationships of vegetation types with soil and environmental conditions are known. However, with more knowledge about this relationship, it can be used in the evaluation of lands for agricultural potential. More is known about this relationship in the swamp areas (Brunt and Burton, 1994) than in the more upland areas for the reason that these areas remain less disturbed ecologically and have been more intensively studied in the recent past as part of the Mosquito Control Programme.

3.1.5 Ground Water Conditions:

In common with other small oceanic islands, underground fresh water bodies occur as thin lenses floating on denser saline water. This phenomenon achieves prominence particularly in Grand Cayman, where there are several such established lenses of exploitable significance. The fresh ground waters are recharged entirely by infiltration of precipitation not lost to evapotranspiration or surface run-off. The patchy soil cover and the jointing and karst development of the main geologic formation indicate a high infiltration for the aquifers. The lenses developed in non-confined conditions and are characterised by their small size, irregular geometry, limited storage capacity, low water table elevations and rapid re-charge and discharge.

The aquifers are noted for secondary porosity in the form of skeletal moulds, open joints, fissures, solution channels and caverns. The jointing and karst phenomena has led to the development of permeable zones which provide direct channels for hydraulic connection with the surrounding ocean, define lens boundaries and facilitate recharge and carbonate dissolution by mixing of fresh and saline ground water. Due to the highly transmissive nature of the aquifer, low-intensity rainfall has little effect. Detailed monitoring using continuous water level recorders shows that in deeper wells (more than 2m below the water table), when the water table fluctuates in response to ocean tides, rainfalls of low intensity are commonly masked by ground water tides. Measurable effects on the water table occur when the rainfall intensity exceeds 50mm per day. Shallower wells (less than 1m below the water table), which are less influenced by ocean tides, require an intensity of about 25mm per day. Monitoring of water quality in wells indicates rapid rain-water recharge.

Recently, significant knowledge about the ground water resources, their fragility and exploitation has been acquired through research (Ng and Beswick, 1993; 1994; Ng and Van Genderen, 1994a; 1994b). These studies were partly stimulated by saline intrusion caused by over-exploitation of two lenses in densely populated areas i.e. George Town and West Bay. This still leaves three lenses i.e. East End, North Side and Lower Valley with potential for exploitation (Figure 1).

In the past, ground water was the main source of domestic water supply but with the development of desalinisation of sea water and its distribution for domestic use which now reaches over 21% of the households, the ground water resources are progressively being developed for agriculture. This is a significant situation for the possible future expansion of agriculture. The continuous monitoring of the water quality and extraction rate by the Water Authority and the cooperation of farmers, is seen as vital if these water resources would remain sustainable. In Table 4, the important features of these lenses are presented, and internationally accepted water quality parameters and potential uses of water are presented in Table 5 from which the potential uses of the water from these lenses can be deduced.

TABLE 4: Characteristics of fresh water lenses (Grand Cayman)

Lens	Thickness (ft)	Area (sq mile)	Safe Yield (gal/day)	Water-table (ft above sea level)	Conductivity (mmhos/cm)
Lower Valley	<30	~1.3	82,000	<1.5	1.5 - 2.0[a]
North Side	<40	~2.7	335,000	<2.0	1.0 - 1.5[b]
East End	<60	~6.0	790,000	<2.5	0.8 - 1.0[a]

[a] from the Water Authority Annual Report, 1993

[b] from actual measurements

TABLE 5: Classification of water according to salinity levels

Water Class	E.C. mmhos/cm	Salt conc. mg/L	Type of Water
Non-saline	0.7	500	Drinking; irrigation
Slightly saline	0.7 - 2	500-1500	Irrigation
Moderately saline	2 - 10	1500-7000	Primary drainage + ground-water
Highly saline	10 - 25	7000-15000	Secondary drainage water + ground-water Very saline ground-water
Very highly saline	25 - 45	15000-35000	Sea-water
Brine	> 45	> 35000	

Presumably, the designation and delineation of the lenses were based on availability of water in amounts and quality suitable for domestic purposes. Satisfactory agriculture can be carried out with smaller quantities of poorer quality water. In fact, there is at present significant exploitation of ground water for agriculture outside of the recognised water lenses where the supply would normally be considered as restricted. However, the sustainable use of water from these sources requires a higher level of monitoring and management than is presently being exercised, which is an input that can be achieved by the creation of greater awareness of the importance of this among users. The techniques for exploitation via the trench well storage and eventual treatment of ground water obtained from outside a recognisable lens being developed at the

Botanic Park, for example, is interesting in this regard. The relative suitability of water for irrigation with respect to salt content needs close examination since at present it is felt that under some conditions the allowable salinity levels can be increased. Leaching of accumulated salts in the wet season would tend to reduce the danger of salt concentration in the soil; however, it must also be remembered that as the salinity level in the irrigation water increases it would eventually lead to an increase in salt content of the ground water due to the absence of thorough drainage.

In the association of agriculture with known ground water resources, an optimistic view is taken that there may well be agriculturally usable ground water outside of the delineated lenses. Exploitation of these should be carried out in close collaboration with the Water Authority and the Department of Agriculture. With appropriate care and attention, water from those lenses can be satisfactorily used for irrigation.

Unfortunately, due to the size and shape of Cayman Brac and Little Cayman, there may be no significant fresh water lenses in the limestone rocks of those islands and this poses serious limitations for agriculture. In fact ground water conditions and occurrence of fresh water lenses and their potential for exploitation for these islands, are little known at present. In Cayman Brac the only fresh water lens under the Bluff of exploitable significance is located south of Tibbetts Turn (Ng and Van Genderen, 1994a) (Figure 2). Since the ground water table underneath the Bluff is less than 0.5 feet above sea level, regardless of the land elevation, it means that functioning wells must be at least 90 feet (30m) deep. The construction of such wells and the pumping of water in an area where there is no electricity supply, practically precludes the use of water for irrigation. Hand pumps have been installed by the Water Authority for the purpose of watering livestock. Consideration is being given to the use of solar power for pumping to make it easier for farmers to obtain water from these wells. At the present time and for the foreseeable future, crop farming on Cayman Brac would have to be rain fed.

Only recently were there any studies on water resources and quality in Little Cayman (Ng and Van Genderen, 1994b). A survey was carried out of the water quality of all existing domestic wells and ponds and it was found that water from existing wells was of variable quality and generally had salinity levels greater than the maximum allowable limit for potable use but may be suitable for trickle irrigation. The water of the ponds was super saline. It was reported that there are natural wells with fresh ground water over in the eastern interior where the annual rainfall is also higher; however, this has not been verified. Consequently, the availability of ground water suitable for limited irrigation in Little Cayman is a distinct possibility but more investigations are needed.

It is most important for all users of ground water in Grand Cayman to be made aware of the important facts of ground water exploitation and use. In particular, the impact any physical development may have on ground water storage and quality should be carefully considered at the appropriate time in any development programme. A good example of how physical development can impact on ground water quality is the construction of the canals in the mangrove swamp areas of Grand Cayman for mosquito control. According to Burton (1995) and the Water Authority, the construction of the canals coincided with some water quality loss in the Lower Valley lens and perhaps also in West Bay. Further physical development of the area might well include creating more and larger canals which could lead to further damage to the fresh water lens. In this regard it is most important that any excavation in quarrying, fish pond construction, etc. should not extend deeper than the water table level, for the danger this may have in reducing the thickness of the lens. Farmers who have been operating in these areas for a long time are convinced that significant parts of their farms have been secondarily salinised since these canals were constructed. This situation has not yet reached an equilibrium level, if it ever will, and the extent of secondary soil salinisation in areas affected by the canals is variable each year, depending upon the rainfall received.

3.2 Agriculture in the Cayman Islands:

Traditionally, the Cayman Islands were important for the production of sugar cane and cotton and especially the latter, must have resulted in significant soil erosion and degradation. Following this, the islands apparently went through a phase when agriculture was relatively unimportant since the male population preferred to earn their livelihood by serving as seamen. Statistics show (Economics and Statistics Office, 1993) that as recently as 1980, agricultural production was at a low level. From then, however, with an unprecedented increase in tourism and appreciation by the local population of the quality of local agricultural products, the demand for locally produced agricultural commodities increased dramatically especially for food and vegetable crops. By comparison, livestock production has not increased to the same extent in recent years. Among food crops, banana, plantain, bread-fruit and root crops such as yam, sweet potato and cassava have increased appreciably. There has also been a great increase in production of fruit crops such as avocado, mango, papaya, citrus and soursop. Together with an increase in production of these crops, there has been substantial improvements in post harvest handling and marketing. Farmers have developed the necessary skills and technologies necessary to produce and market products of high quality. This trend has been consumer-driven to a large extent.

The main constraining factor which now limits agricultural production in the islands is the high cost of production which makes the products barely competitive with imported equivalents. Profitability is therefore a serious concern among farmers who receive little or no protection from outside competition.

In considering the soil resources of the islands, it is felt that ruminant production for meat should have great potential since many of the soils that would not sustain annual crop production can support a certain level of pasture production with appropriate maintenance. Other environmental factors are quite suitable for this type of agriculture.

It is to be expected that without any clear guidelines for appropriate land use in an environment of rapidly expanding agriculture, the use of land would be out of phase with its particular suitability or capability. This is one of the reasons why this study was commissioned.

The most significant aspect of the unprecedented increase in agricultural production is the use of irrigation based on ground water resources. There have been great advances in techniques of field application of water with trickle irrigation replacing sprinkling with consequent increases in the efficiency of water use. However, significant improvements are still needed in the monitoring of the quantity and quality of the ground water and of the rate and nature of exploitation to keep the use of this valuable resource sustainable. Techniques such as pretreatment and blending of the water before application can extend the amount of water available for irrigation and to increase the efficiency of the system, fertigation can be incorporated to a greater extent.

It is generally realised that while the availability of irrigation was a very great asset, in its absence, agricultural production can still be achieved. The risk would be greater but production of the hardier, short duration vegetable crops during the wet seasons and the more drought resistant orchard crops such as mango, custard apple, sugar apple, soursop, naseberry and guava can be produced. Even at present, substantial amounts of food and vegetable crops are produced without irrigation.

While lack of irrigation may be limiting to agriculture in the dry season, soil drainage is a problem in the wet season. There are no natural drainage systems and therefore most of the precipitation percolates through the soil and rock material and contributes to ground water. In many areas, three factors seriously constrain this process, these being the shallowness of the water table, the thin or non-existent soil cover and the hardness and localised low porosity of the limestone rock. The thinness of the soil cover is important as it limits the absorptive capacity of the layers above the water table. The consequence of all this is that the flat areas and depressions can remain inundated for lengths of time following heavy rainfall which can adversely affect any agriculture in these locations. This condition also makes leaching and removal of accumulated salts a serious problem; salts added in irrigation water can simply be recycled and not removed from the soil/water system.

In livestock farming there has also been unprecedented developments. Pasture establishment and pasture use and management have all been improved. The introduction of African Star grass

(Cynodon plectostachyus) in the more saline and low-lying areas has been positive. The upgrading of cattle by artificial insemination has resulted in the rearing of stock of excellent quality. What is needed in this area is a greater appreciation of the need for weed control and fertilizer use in pastures and more universal adoption of artificial insemination as a means of rapidly upgrading herds. Goat production for meat is also increasing significantly.

Significant developments in agriculture in Grand Cayman in recent years have resulted from mechanisation in aspects such as land clearing and soil tillage. Substantial mechanisation was already in place in the 1960's, the technologies being transferred from the Homestead area in South Florida. Similar developments were also taking place in the Bahamas at the same time. Land clearing by bulldozer, rock ploughing and stone removal were important aspects. These measures were not always successful, since they were sometimes attempted on land unsuitable for the treatment. Over time, a great deal of experience and skills have been acquired in land development to the point where a good level of technology and efficiency have now been achieved. Other significant improvements in agricultural technology which have been introduced more recently are the use of fertilizers, irrigation/fertigation, crop diversification and organised marketing. More developments are still possible in these aspects especially in the vital areas of water use, soil and water conservation and soil management.

3.3 The Soils of the Cayman Islands:

3.3.1 Historical Review of Soil Studies:

At the present time, there is little soil material over most of the Cayman Islands. This is largely due to the very slow rate of soil formation from the relatively pure calcareous materials. The rocks of the Bluff Formation are pure and in many respects are like the white limestones of Jamaica with respect to the quantity and nature of impurities. Weathering by solution leads to different surfaces with varying effects on surface soil accumulation. Where the limestone is dense there are relatively few cavities and minor karsts. A very hard surface crust develops from re-precipitation of calcium carbonate which cements other impurities and fine grained sediments. In other areas where the limestone is less dense and variable, solution results in very irregular surface features. The rock surface is typically jagged and honeycombed rock pinnacles, fissures and sink-holes are common surface land forms; caves are common in the sub-surface. In the first case, the soil formed from weathering accumulates on the surface, while in the latter it is washed into the cavities formed in the limestone by solution. On the hard limestones, the soil which is formed is similar to the Jamaican type bauxites (red and brown) (Ahmad and Jones, 1969). Roots of trees are able to exploit these sub-surface pockets of soil which result in the somewhat anomalous situation of trees seemingly growing on solid rock. Soil formation on the Ironshore and Coastal material is faster than on Bluff material but in-filling of cavities also occurs and in any event there has not been the time for much soil to form.

Accelerated soil erosion at any time is not considered an important reason for the shallow soil depth. The lack of relief, the good structure and high permeability of the soil which is formed and the occurrence of rock crops and stones on the surface to impede run-off, are factors ensuring this. Soil movement occurs but this is simply a movement from the higher areas and crusts into the depressions where it accumulates as soil pockets.

The scientific study of the soils of the Cayman Islands is recent. In response to a request from the Department of Agriculture of the Cayman Islands in 1967 to the Department of Soil Science, UWI, St. Augustine, Trinidad, arrangements were made for a small team of soils scientists to pay a brief visit to Grand Cayman to make a rapid assessment of soil conditions on the islands. In 1970, another visit was made by a scientist from the Department of Soil Science of UWI to investigate the effects of land clearing for agricultural development in the West Bay area (Payne, 1970). A significant finding was made by Ahmad and Jones (1969) at about this time which showed that the dusky red soils of the Bluff formation was similar to the bauxite soils of Jamaica and other soils over limestone in the Bahamas.

In response to a visible increase in interest in agriculture in the islands from that time, at a subsequent visit to the islands by N. Ahmad, Head of Department of Soil Science of UWI, it was strongly recommended that a comprehensive soil survey of the islands, similar in scope and detail to those carried out by the Department in other Commonwealth Caribbean islands, should be done. This was considered necessary to provide data to facilitate the proper use of the soils. In a cooperative programme, between the Ministry of Overseas Development of the United Kingdom, the Cayman Islands Government, the Government of Jamaica and the Department of Soil Science of UWI, the survey was undertaken in 1971 (Baker, 1974). The Cayman Islands Government solely financed the publication costs for the report which was published as Volume 26 of the Soil and Land Use Survey Reports of the Commonwealth Caribbean.

3.3.2 The Soil Series of the Cayman Islands and Their Main Features:

The essential features of the soils which are particularly important in their agricultural use, are summarised below (the map symbols for each of the soils used by Baker (1974) are also used here).

Map Symbol & Soil Series Name	Features of the Soil
Soils over Hard Limestone (Bluff Soils)	
13* - Further Ground Clay	This is found mainly in the Hutland area in Grand Cayman and it is widely used for agriculture. It is one of the dusky red soils which may be bauxitic and is neutral to alkaline in reaction and well supplied with plant nutrients; the soil is shallow and occurs in pockets; it occurs on cap-rock which is thick and hard and is difficult to break; the topsoil is well structured but at depth the structure is weakly developed and

* Numbers before soil names refer to soil series numbers (see soil maps)

the soil is compact; the soil occurs on flat topography and therefore there is little erosion hazard; the limitations to agriculture include shallowness, stoniness; usage of the soil should exploit the pockets of soil and soil material which infills the cavities in the limestone.

78 - Kitty Clover Clay

This is a red-brown to dusky red clay to 25cm over dark red clay with stable structure to depth varying between 60 and 90cm; it occurs over hard white limestone with which there is a sharp transition. The soil has many features similar to Further Ground Clay except that it occurs in even flatter relief and generally it is deeper; in places the depth of soil is enough for crop planting even of tree crops, and there is no need for any ripping of the underlying cap rock. There could be only the occasional boulder or rock on the soil surface. The soil is fertile and can be productive; there are stony and shallow phases which have less potential for agriculture. In its typical occurrence in Grand Cayman, this soil has wide suitability for agriculture and much of it is over ground water of good quality.

2 - Snipe Point Clay Loam

This is a dark brown clay loam with few nodules in the 0-15cm layer over strong brown compacted clay. This soil occurs in Little Cayman only and it is developed on flat land; the surface is well structured but the sub-soil can be compact; there is slight erosion hazard; the limitations to agriculture are water availability, rockiness and compact subsoil; it is comparable in many respects to Kitty Clover Clay in Grand Cayman; one important difference is that it may suffer from periodic poor drainage in wet seasons.

6 - West Bay Sandy Loam

This is a minor soil which occurs only in the West Bay area in Grand Cayman and it is almost entirely residential in usage; it is dark brown in colour and usually very shallow; it occurs on flat topography with slight erosion hazard; it is well supplied with plant nutrients but free lime in the subsoil can cause nutrient uptake imbalances; it is subject to wet season flooding; it satisfactorily supports house-site plants i.e. ornamentals and fruit plants.

8 - Hutland Clay Loam

This is a dark grey/brown clay loam to loam over yellowish brown clay; it is a minor soil which occurs at North Side, Grand Cayman; much of it has been developed for residential purposes but there are also important areas which have been cultivated and since abandoned, probably due to soil degradation caused by erosion of the top soil. The most important agricultural use at present is as pasture but they are all poorly maintained. The planted grass is usually African Star but with overgrazing, broadleaf weeds and the grass Sporobolus sp.

compete successfully; the soil may also be subject to periodic inundation.

The main constraints for agriculture consist of shallowness of soil, stoniness and rockiness and sometimes high water table.

11 - Herberts Turn Clay Loam

This is a dark reddish brown clay loam with occasional nodules; it is a very minor soil which occurs only in Cayman Brac; it occurs on flat topography and it is characterised by free drainage; it is well supplied with plant nutrients; the main limitations are shallow soil, stoniness and rockiness and water availability.

19 - Spot Bay Clay Loam

This soil occurs only in Cayman Brac; it is a brown to strong brown clay loam to sandy clay loam with medium depth; it is developed on flat topography and has rapid internal drainage; it is well supplied with plant nutrients but has limited suitability for agriculture due to rockiness and limited availability of water.

23 - Pedro Castle Fine Sandy Loam

This is a minor soil which occurs mainly in the Pedro Castle area and in West Bay in Grand Cayman; it is a shallow, dark reddish brown sandy loam over hard, white limestone and presently most of it is undeveloped for agriculture and is a potentially good soil resource.

The soil has formed on flat

topography and in cultivation, erosion is a problem since it exposes the underlying hard limestone; it has suitability for a limited range of crops but may be more suited to pasture production.

73 - Cotton Tree Land Clay Loam

This is a brown clay to clay loam over yellowish red clay on hard white limestone; it is a very minor soil occurring in Cayman Brac only; it is developed on flat land and has high plant nutrient status. There is only slight erosion hazard; the chief limitations to agriculture are rockiness and unavailability of water.

74 - Newlands Clay

This is a dark brown clay with good structure over compact strong brown clay and then changes to a less compact layer over limestone; it occurs widely in Grand Cayman on flat land and therefore has little erosion hazard; the soil is well supplied with plant nutrients; it has a high water table especially in the wet season and crops can be produced year round with only little supplemental irrigation; in addition to drainage problems, deep ripping in preparation for planting can expose marly material which can lead to plant nutrient imbalances.

1 - Hell Stony Loam

This soil or land type occurs in many parts of Grand Cayman and Little Cayman; it consists of hard coralline and dolomitic limestone, usually on flat topography with small amounts of soil occurring in cavities left from solution. The limestone rock presents an unusually craggy appearance with sharp spines and irregularly shaped cavities; this type of landscape invariably results when the hard limestone has weathered in a saline swampy environment or in areas adjacent to saline swamps. It is of no agricultural importance but can be levelled for construction; the landscape is unique enough to have touristic appeal.

77 - Bluff Stony Loam

This is the most dominant soil in the three islands and there are many variations; the colour can vary from brown, reddish brown or dark grey to black; it is loam to clay loam in texture and very rocky and stony. The rocky and stony phases grades into Hell Stony Loam. Due to its widespread occurrence, all types of agriculture are developed on it. It is well supplied with plant nutrients and therefore depth of soil and availability of water are the important factors which are related to agricultural development. Natural pastures based on Guinea grass and forage legumes are easily established once the land is cleared by light bulldozing.

Soils over Soft Limestone (Ironshore Formation)

9 - George Town Clay Loam

This soil occurs mostly in the George Town district of Grand Cayman and it is dark brown to black in colour. The Smith Road Agricultural

Station is located on it. Since it occurs on soft limestone, it is easily rippable; also, it occurs in the highest rainfall zone of the island; consequently there is a fair depth of soil; reasonably good quality ground water for irrigation purposes is available which adds greatly to the potential of the soil for agriculture. There are many depressions with intrusion of salt to brackish water. As suitable as the soil is for agriculture, there is very little scope for this use since most of it is occupied by urban development and the international airport. What land is still undeveloped, can be more intensively used for specialised types of agricultural production.

91 - Botabano Clay Loam

This soil occurs mostly in the West Bay area, near Spotts and, to a lesser extent, at Newlands. It is a shallow soil mostly very dark grey to brown to black clay loam over marl with a high water table; it occurs on gently rolling landscapes and the depressions, which do not have natural drainage outlets, can be deeply flooded after heavy rainfall and salinity can encroach into these areas in the dry seasons. The soil has good suitability for pastures but limited suitability for other agricultural use due to flooding, high water table and sometimes salinity. In the West Bay area, secondary salinity resulting from the Mosquito Control Programme has developed.

5 - Old Bush Clay Loam

This soil occurs only at Old Bush in West Bay and in the George Town area. It is a dark brown clay loam with good structure over brown to strong brown clay and it is underlain by marl or soft limestone. There are depressions in the landscape in which salinity is a problem. The soil is rippable and so attractive for agricultural development; however, in the areas with some relief from which the topsoil has been eroded over time, this treatment can incorporate too much marly material in the root zone which can lead to induced nutrient imbalances. There is a high water table and soil drainage can be inadequate; if great care is exercised, under the best conditions, the soil has the potential to support a varied agriculture; however, rural and urban development is rapidly expanding on it.

12 - Mt. Pleasant Clay Loam

This soil occurs in small areas in the Mount Pleasant area along the main road and near North West Point in West Bay. It is a minor soil which is almost entirely in residential occupation. A few vacant house sites are still used for livestock grazing; on clearing, Guinea grass colonises with a range of broadleaf weeds and forage legumes including _Teramnus_ sp; _Desmodium_ spp. and _Leucaena leucocephalla_. In low-lying areas it is prone to flooding following heavy rainfall; the relatively soft limestone can be excavated for planting holes for fruit trees and other ornamental plants around homesteads.

17 - Old Man Bay Sand Clay Loam

This soil occurs in the vicinity of Old Man Bay, North Side and Mount Pleasant (West Bay) in Grand Cayman. It is a thin soil over marl or soft limestone. The soil is dark brown in colour, well structured and adequately supplied with plant nutrients. Most of it occurs adjacent to swamps and there are salinity complications. There is often a high water table and the ground water can have a high salt content. When cleared Guinea grass proliferates with a good admixture of forage legumes. A well developed pasture based on African Star grass was seen in the Old Man Bay area.

With great care in the use of water, other crops in addition to pasture may be successfully grown.

3 - Jackson Bay Clay Loam and
4 - Charles Bight Clay Loam

These soils occur in Cayman Brac and Little Cayman, mostly in association with Bluff Stony Loam. They are a dark brown, very friable shallow soil over rubbly limestone, well supplied with plant nutrients and high in organic matter. Jackson Bay Clay Loam is differentiated from Charles Bight Clay Loam by the absence of small black pellets in the former and their presence in the latter. The soils have a fairly wide suitability for agriculture except that unavailability of water is an important constraint.

7 - Round Key Clay Loam

This soil is distributed at Round Key, near Morritts Tortuga Club, Gun Bay Village and in Little Cayman; it is variable in colour being dark brown to yellowish brown, generally shallow and stony and rocky; the natural vegetation consists mainly of logwood which indicates closeness to swamps and the possibility of periodic inundation during the wet season. It is naturally well supplied with plant nutrients but soil salinity can be a problem in the lower areas and in the periphery of swamps. When cleared, Guinea grass may grow in the higher areas with admixture of legumes such as Desmodium spp. and Leucaena leucocephalla; Clitoria sp is common in locations where soil has accumulated.

The soil has good suitability for agriculture in locations where soluble salts are not a problem. For pastures, African Star grass or Coastal Bermuda grass (Cynodon dactylon) may have more overall suitability than Guinea grass. The occurrence near Morritts Tortuga Club is too exposed and the rainfall too limiting. Windbreaks are needed here; ground water conditions may be unsuitable due to its closeness to Collier's Pond.

14 - Half Moon Bay Loam

This soil occurs at Half Moon Bay and near George Town in Grand Cayman. The natural vegetation is mainly logwood which indicates periodic flooding and fresh to near brackish ground water conditions. It is a thin, dark coloured soil rich in organic matter over hard limestone. Due to its closeness to swamps and large and small depressions, soil salinity and salt affected ground water are problems in its use for agriculture.

On clearing, Guinea grass does not colonise; other grasses and salt tolerant weeds are dominant; also, only few legumes grow naturally. In a few pastures, African Star grass has shown some promise and Coastal Bermuda may also be tried. Reasonably good pastures can be maintained on this soil and it is reckoned to be its best use.

18 - Barkers Sand

This soil occurs along coastlines at Barkers, Savannah, along Seven Mile Beach and in Cayman Brac. It consists of calcareous sand and cobbly limestone fragments which are littoral in origin. When developed for housing or tourism, there is no difficulty in growing the range of ornamental plants and food tree crops such as breadfruit and coconut.

15 - Bodden Town Clay Loam and 16 - Breakers Clay Loam

These two soils are similar, the main differentiating feature being the presence of soft black pellets in the surface layer of Breakers Clay

Loam. The soils vary in colour from dark grey to orange brown and may even have a bluish grey gleyed colour in the sub-soil in water-logged areas. The soil is generally shallow (<15cm depth) but can accumulate in pockets to over 45cm. They occur on the periphery of swamps and the depressions are actually saline.

Before clearing, the natural vegetation consists of logwood in higher locations and buttonwood and other salt tolerant species in the depressions.

In the rainy season, a problem is periodic flooding for which there is no natural quick relief. From appearance, Bodden Town Clay Loam appears to be better drained and therefore must be considered a better soil for pasture. The soils have suitability mainly for pastures which require careful and appropriate management to remain productive.

Miscellaneous Land Types

These types include saline swamps, beach sand and in-filled land and together constitute almost one third of the land area of the islands. The most dominant are the saline swamps, salinas and ponds. The saline swamps in particular, have characteristic vegetation (Brunt and Burton, 1994) and saline conditions can be easily identified by this means. In their natural condition most are tidal, although there are land-locked ones such as in Little Cayman. The characteristic mangrove and associated vegetation are in equilibrium with the level of inundation and salinity status. When these conditions change, which can be caused by hurricanes, death of the mangrove can result as has occurred in Little Cayman following Hurricane Andrew.

Physical development can also cause blocking of swamp outlets which can lead to high salinisation and death of the vegetation.

There are limited deposits of beach sand in coastal areas which is in demand in the ever expanding construction industry for which the sand is suitable. These deposits should be considered a valuable resource and their exploitation carefully controlled.

3.3.3 Mineralogical and Chemical Properties:

The clay mineralogical components of selected soils/sites are shown in Table 6.

TABLE 6: Clay mineralogy of representative Cayman Islands soils

Soil Series (*)	Soil Depth cm)	Clay Minerals							
		Gibbsite	Boehmite	Kaolinite	Smectite	Mica/ Illite	Quartz	Haematite	Goethite
2	0-10 10-30	++(y) ++	+++ +++	++ ++	+ +	+ +	+ +	+ +	+ +
19	0-15	+++	Tr(y)	++++	++	Tr	+	+	+
74(a)	0-12 12-45	++++ +++	++++ +++	Tr ++	+ +	Tr Tr	+ +	+ +	+ +
74(b)	0-15	+++	+++	++	+	-	+	-	-
78(a)	0-15 15-30 Pellets	+++ +++ +++	Tr Tr Tr	++++ ++++ ++++	+ + +	+ + +	+ + +	+ + +	+ + +
78(b)	0-15	++	++	+++	+	+	+	+	+
78(c)	10-30	++++	++++	Tr	+	-	+	+	+
78(d)	30-45	++	++	++++	+	-	+	+	+

(*2) = Snipe Point Clay Loam, M. Chantilope's farm, Little Cayman

19 = Spot Bay Clay Loam, Cayman Brac

74 (a) = Newlands Clay, A. Bush's land, Lower Valley, Grand Cayman

74 (b) = Newlands Clay, A. Hislop's farm, Grand Cayman

78 (a) = Kitty Clover Clay, W. Ebanks' farm, Hutland, Grand Cayman

78 (b) = Kitty Clover Clay, L. Lazarri's pasture, Cayman Brac

78 (c) = Kitty Clover Clay, roadside pasture, approximately 2 miles from lighthouse, Cayman Brac

78 (d) = M. Johnson's Land, Grand Cayman (compact layer)

(y) + = 10 percent mineral approximately

Tr = Trace

It is of considerable interest that all the red and red/brown soils in the islands are rich in the bauxitic minerals gibbsite and boehmite, and as such, are similar to the Jamaican bauxite; this confirms an earlier observation by Ahmad and Jones, (1969). In these bauxite soils, kaolinite is particularly important in the subsoils and its dominance in this part of the profile usually coincides with an underlying compact layer. Small quantities of smectite and quartz are also present in most of the samples which is also the case with the brown bauxite of Jamaica. The crystalline iron-oxides haematite and goethite are present in the soils in small quantities; however, most of these oxides occur in non-crystalline forms.

Some chemical properties of selected soils/sites of the Cayman Islands are presented in Table 7. The soils are outstanding for their high organic matter contents, ideal carbon to nitrogen ratios especially for the surface soils, and their not too high pH considering their calcareous origins. In a few cases, the nitrogen content is high relative to carbon which results in a carbon to nitrogen ratio of less than 10. The available phosphorus levels are generally low to medium except for the pellets and a sample from a pasture in Cayman Brac which may have been recently fertilised or contaminated by cattle manure. The pellets which are an interesting feature of some Cayman Islands soils are of biological origin as indicated by the high organic matter and phosphorus levels and ideal carbon to nitrogen ratios (data not presented).

The cation exchange capacities are variable, being high in the surface layers due to the high organic matter contents and much lower in the subsoils due to the bauxitic nature of the material. The soils have high exchangeable calcium levels except for the subsoils and this is to be expected. The calcium to magnesium ratios are favourable and the exchangeable potassium levels are quite good. Exchangeable sodium is low and poses no hazards.

Table 7: Chemical properties of selected soils of the Cayman Islands

Soil Series (x)	Soil Depth cm	pH	O.M. %	N %	C/N	P_Z ppm	CEC^Y cmol/kg soil	Exch. cations Cmol/kg			
								Ca	Mg	K	Na
2	0-10 10-30	7.5 6.6	11.68 6.32	0.57 0.40	11.8 9.1	3.4 3.4	34.1 27.8	29.5 16.7	8.35 6.93	1.25 1.44	1.20 0.52
19	0-15	7.1	10.44	0.67	9.0	5.7	30.4	29.9	4.51	0.89	0.60
74(a)	0-12 12-45	6.8 6.8	5.16 2.23	0.35 0.18	8.6 7.2	3.4 1.1	19.5 12.3	12.6 4.5	6.23 3.68	0.32 0.12	0.52 0.27
74(b)	0-15	7.6	14.60	0.62	13.7	3.4	54.7	60.9	23.88	2.15	3.94
78(a)	0-15	7.5	7.20	0.32	13.1	19.6	28.1	24.1	8.04	1.07	0.25
78(b)	0-15	6.6	4.65	0.38	7.1	141.2	26.9	13.3	7.25	3.05	0.98
78(c)	0-15	7.4	7.63	0.55	6.4	5.7	23.8	18.41	9.05	0.32	0.30
78(d)	30-45	6.0	1.74	0.14	7.2	3.4	12.0	4.7	5.06	0.16	4.02

(*2) = Snipe Point Clay Loam, M. Chantilope's farm, Little Cayman

19 = Spot Bay Clay Loam, Cayman Brac

74 (a) = Newlands Clay, A. Bush's land, Lower Valley, Grand Cayman

74 (b) = Newlands Clay, A. Hislop's farm, Grand Cayman

78 (a) = Kitty Clover Clay, W. Ebanks' farm, Hutland, Grand Cayman

78 (b) = Kitty Clover Clay, L. Lazarri's pasture, Cayman Brac

78 (c) = Kitty Clover Clay, roadside pasture, approximately 2 miles from lighthouse, Cayman Brac

78 (d) = M. Johnson's land, Grand Cayman (compact layer)

(Y) = cation exchange capacity (CEC)

(Z) = available P by Olsen's method

In fertility management, the major nutrient which may be needed is nitrogen followed by phosphorus. In their present state, response to potassium may not be expected.

4.0 Methods of Study:

Methods of study were developed to produce a more comprehensive land capability or land use suitability classification than is presently available.

As a basis for proposing this classification, a good understanding of the physical environment, the present state of development and technologies used in farming, the ability of the human resources and socio-economic conditions had to be appreciated. Therefore, the techniques developed in this study were designed to obtain the needed information which was then applied in the land capability evaluation.

4.1 Field Work:

Many field visits were made to wherever there were any serious attempts at farming. The level of farming, the nature of the enterprise whether crops or livestock and soil management practices were observed and the soil series identified. It was thus possible to obtain information on the range of uses possible in the Cayman Islands for most of the soil series. Areas not in farming but in primary or secondary vegetation were visited to observe the ecological conditions and the relationship of the vegetation to its total environment. Insufficient access routes through these undeveloped areas limited this aspect of the field work. An important purpose for the inspection of these areas was to compare the established soil series and phases with the same ones being farmed for properties such as soil depth, loss of topsoil and changes in soil structure.

For pastures, the quality of the sward, the plant species which colonise, the condition of the planted species if applicable and the occurrence of salt tolerant species and palatable legumes, were noted in order to predict the persistence and productivity of the pasture. This was necessary to project the suitability of the particular soils for pasture production.

As part of the work, farmers were interviewed on location mainly to obtain information on soil management problems and other matters related to their enterprises. Special attention was given to land preparation, crop selection and planting, fertilizer use, water quality and its use and management. In this regard, the opportunity to observe the Agricultural Show in March 1995, was most beneficial.

4.2 Land Capability Assessment:

Based on observations made during the field study and knowledge of the soil series and phases and ground water conditions, the soil resources were classified into six capability classes with respect to their relative suitability for agriculture. With the help of the Lands and Survey Department and its Land Information System, the data on the original soil maps of the Cayman Islands was digitised and the resulting maps were used as the base map for showing the land capability. The finished map for each of the islands shows the distribution of the soil series and phases on which is superimposed the capability classification. In order to make this map easily readable, an overlay showing the block and parcel information with place names and cultural features has been provided. From this finished map, therefore, it would be a simple matter to know the soil series and phase and its associated land capability rating for agriculture for any parcel of land delineated on the map. Land capability maps thus prepared, were made for each of the three islands and form part of this report.

5.0 Land Capability of the Cayman Islands:

5.1 Soil and Environmental Factors Related to Land Capability:

In establishing a meaningful and practical land capability classification, it was necessary to emphasise aspects of the soil, environment and farming systems which are relevant. For instance, the two main features which determine the quality of the land in the USDA system, i.e. slope and suitability for mechanised agriculture, are of little or no importance in this case, since all the islands are relatively flat and the constraints to completely mechanised agriculture are uniform throughout. Also, whatever soil material occurs, it is well supplied with plant nutrients although in some cases nutrient imbalances may be a problem. Other factors such as rainfall and its distribution, protection from winds, accessibility and factors leading to land degradation, are not sufficiently different over the islands to have differential influences on land use. In particular, soil erosion is not seen as an important cause of land degradation due to the relatively flat topography, high organic matter content and good soil structure.

In the Cayman Islands, the following qualities of the land are considered of importance in determining its suitability for agriculture:

- Soil depth;
- rockiness and stoniness;
- nature of underlying rock;
- water availability and its quality;
- soil salinity;
- soil drainage and susceptibility to flooding.

The importance of these factors is outlined below.

5.1.1 Soil Depth:

This is considered the most important factor in assessing land quality for agriculture. The deeper the soil, the less would be the adverse influence of stoniness and rockiness. In this regard, the best land would have sufficient soil to facilitate planting of any crop without the need to rip or fracture the underlying rock. It would provide adequate rooting medium to support all crops including tree crops and would be able to store significant amounts of water from rainfall or irrigation. Due to rock outcrops, mechanical tillage and other aspects of land preparation are not possible, however.

5.1.2 Rockiness and Stoniness:

It is obvious that the degree of rockiness and stoniness would impose limitations to the use of the land regardless of the amount and depth of soil in the cavities and depressions. The greater the rockiness and stoniness, the more limitations there are as to the type of crops which can be grown and it reduces the crop producing land surface. Rocky and stony land with deep pockets of soil may be suitable for orchard crops for example but less suitable for food and vegetable crops. In order to reduce the problem, mechanical breaking of the stones and their collection and removal from the site may be necessary, which increases the cost of land preparation.

5.1.3 Nature of the Underlying Rock:

Since the norm in the Cayman Islands is shallow soil depth, the nature of the underlying rock and the possibility of extending the effective soil depth and proliferation of the root systems of crops into it, without at the same time, exposing too much soft calcareous materials, is a critical point. Modification of the underlying rock to extend the rooting depth is done by ripping. In this process, the softness of the rock is related to the degree of pulverization which is achieved and therefore the extent of the surface area of the raw limestone which is available for root contact. If the rock is too soft, ripping leads to too much pulverization and due to the excessive contact with roots, calcium induced plant nutrition problems, such as deficiencies of iron, zinc and manganese, can become serious problems in crop production. The main hazards with ripping are caused by overall rock hardness which is the case with the Bluff Formation and the hardness and thickness of the calcrete crust or cap-rock which forms with time over other softer material. In general, the underlying rock of the soils on the Ironshore Formation may be suitable for ripping if the caprock is not too massive, the rocks of the Bluff Formation may be too hard to fracture in the ripping process, while the ripping of the more recent softer marls and limestones may lead to plant nutrition problems. When done under satisfactory conditions, ripping results in an increasing effective rooting depth, better water relations and it greatly improves the suitability of the soil for various uses.

5.1.4 Water Availability and Its Quality:

It is already well recognised that for successful all-year agricultural production water for irrigation is necessary, which, in the Cayman Islands, must come from ground water storage. The characteristics of the ground water resources have already been discussed. With the increasing availability of desalinated water for domestic use, ground water should become more available for agriculture. The availability of agriculturally usable ground water outside of the recognised water lenses in Grand Cayman and the identification and quantification of ground water conditions in Cayman Brac and Little Cayman are important factors. As stated earlier, an optimistic view is taken of this problem that more usable ground water would become available with time. As an important adjustment to this premise, the expertise and skills of farmers in exploiting, managing and using water for irrigation would have to be improved as well as their awareness of the consequences of not adopting the proper measures.

5.1.5 Soil Salinity:

This problem is related to water availability and its quality. There are two categories of soil salinity; the first is natural salinity which is associated with the occurrence of saline swamps and localised depressions and the other is secondary salinity caused by faulty irrigation practices and the canalisation of the swamps for mosquito eradication. The farmer has some control on the salinisation caused by faulty irrigation, through adoption of proper irrigation practices and attention to water quality. The problem is made more serious by the absence of drainage and controlled leaching of the salts from the root zone. While there is very adequate rainfall to leach salts which would have accumulated during the dry season through irrigation, considering the shallow soil depth and its permeable nature, the lack of thorough drainage results in the movement of salts up and down, from and to the ground water. Although there is an improvement in salinity in susceptible areas in the wet season, this problem poses a constraint to land use for agriculture. In the worst situation, it may limit agricultural activity to the wet season or as long as ground water of good quality is available for irrigation. Using too saline water for irrigation would eventually lead to increased salinity in the soil/water system which may not be possible to control.

5.1.6 Soil Drainage and Susceptibility to Flooding:

The problem of poor external and internal drainage especially in Grand Cayman, has been discussed in different contexts but its relationship to the level of the water table and incidence of flooding in the wet season, is of significance in land use. This constraint does not occur in Cayman Brac where the main agricultural soils are associated with the Bluff and the equilibrium water table is deep (Ng and Van Genderen, 1994). Natural depressions become deeply flooded, sometimes for long periods in the wet seasons since there is no lateral drainage and the flooding must be relieved only by percolation through the soil and rock material and by evaporation. In the low-lying areas, the water table can be very high causing saturated conditions throughout the soil which cannot be relieved through internal drainage. These conditions exist for periods too long for some crops. Since it is not possible to achieve some relief from water-logging through land layout, i.e. the ridge and furrow layout, the occurrence of this problem must be considered a constraint to land use for agriculture. Some soils of the Coastal and Ironshore Formations are susceptible to this problem.

In some instances, the high water table is an asset in the dry season if the water is of good quality, since there are farms in which some crops do not need irrigation because of it.

5.2 The Land Capability and Its Classes:

As stated earlier (Section 4.2), it was decided after careful consideration, to establish a land capability classification system with some similarity to the USDA system (Klingebiel and Montgomery, 1961) but greatly modified and perhaps simplified. Six capability classes, as suggested by Baker, (1974) were adopted. It was decided not to include sub-classes as proposed as part of the USDA system. Each soil series and its erosion and slope phases as identified and mapped were considered as independent land units for agricultural capability so that any given soil series can occur in one or more capability class, depending on its phases and how these may influence land use. For example, the most frequent soil on the islands, Bluff Stony Loam, can occur on variable slope positions and degrees of erosion and also as a complex with other soils such as Kitty Clover Clay and Snipe Point Clay Loam. In the capability classification, each of these occurrences as identified in the soil survey, is considered on its own merits and included in the appropriate capability classes.

The occurrence of usable ground water was also taken as a major factor in capability classification. Thus, the same soil with and without usable ground water is put in different classes.

With respect to the agricultural importance of water lenses, it is important to note that almost the entire Environmentally Significant Woodland Area and the Mastic Trail (see land capability map) is over the North Side water lens and should this area be formally declared a Nature Reserve, it would accordingly reduce the amount of land of high capability for use as agricultural land.

The six capability classes and the respective soils and their phases and land units which are included, with justification, are presented below.

5.2.1 Class I:

By definition, this type of land is widely suitable for all agricultural purposes and it is amenable to the application of all technologies applicable to the Cayman Islands. Usable water is available for supplemental irrigation so that agricultural production can be achieved on a continuous basis. High soil or water salinity is not a problem and almost all of the land surface can be used since there are only few stones and rock outcrops. The soils occur in inland areas or on the leeward sides of the islands and therefore they are not susceptible to salt spray. The topography is essentially flat so there is little soil erosion hazard. These soils have the deepest sola on the islands and indeed have an almost complete soil cover. The underlying rock material in most cases is rippable if needed but there is normally enough soil cover to provide adequate rooting volume for most crops on the assumption that limited irrigation is available. The natural fertility level of the soils is high and nitrogen is usually the main nutrient which may be needed although a mixed fertilizer is generally used. The soils and their phases included in this class, with the rationale, are as follows:

Kitty Clover Clay (78)* - Grand Cayman	This is the most versatile soil in the Cayman Islands and it is being successfully used for the whole range of agricultural enterprises which are current in the Islands.

* Numbers in parenthesis after soil names - refer to soil series numbers (see soil maps)

The soil is deep, with an average depth of about 45cm, although there are pockets which are much deeper since it in-fills the karst surface of the parent limestone. Successful use of the soil for crop production can be seen in the Lower Valley area, at Captain Charles Kirkconnell's farm at East End and Mr. William Ebanks' farm at Hutland. Its potential as pasture land can be seen at Big Winter's Land where there is prolific growth of Guinea grass, ideally mixed with pasture legumes.

In most cases, the soil is over established and productive water lenses and irrigation is possible with good quality water. The depth of soil is such that there is adequate rooting volume and ripping of the underlying rock is not necessary. The soil has high natural fertility and nitrogen is the only nutrient which must be applied for high production.

Since the soil occurs also ininland areas, there are significant tracts still available for agriculture but, at least in the Kitty Clover area, housing development has encroached on most of the land occupied by the soil.

George Town Clay Loam (9)

This soil is distributed in the George Town area and environs including the Smith Road Agricultural Station. The developed soil is medium in depth (average about 30cm) but the underlying rock is relatively soft and easily rippable. After the soil has been agriculturally worked for some time, a satisfactory seedbed can be prepared for planting of almost any crop and the depth of the soil can accommodate the ridge and furrow land layout. Ground water is normally available and the soil occurs in the highest rainfall area in Grand Cayman. Water relations are therefore good throughout the year. In excessively heavy rains, short duration flooding can occur. The whole solum remains friable and so the profile is exploitable by roots of crops. The fertility level of the soil is very good and as with the other Class I soil, only supplemental nitrogen may be considered essential for high production. Where a shallow phase of the soil occurs, ripping can incorporate too much of the soft calcareous material which can lead to lime induced nutrient deficiencies which are more visible in the dry seasons.

At present, most of this soil is occupied by urban and housing development; the international airport is also built on it. There are small areas, however, which are still being used for agricultural production.

George Town Clay Loam/
Kitty Clover Clay (9/78)

This complex occurs as a small inclusion in the region of Jackson

Point, George Town. Both components are Class I and since some possibilities exist for limited irrigation also this complex is classified as Class I. The area is, however, intensely developed for housing and tourist accommodation and it is of no agricultural importance except for the cultivation of fruit trees and ornamental plants around building sites, for which there are no serious constraints.

Kitty Clover Clay/Bluff Stony Loam (78/77) (over East End water lens)

This complex occurs as variants within Bluff Stony Loam areas over the East End water lens and its periphery. It is characterised by pockets of deep soil within the rock outcrops; the soil can be used for all the agricultural enterprises which are practised in the area; it is particularly suited to orchards crops and plantain and banana production.

5.2.2 Class II:

Soils included in this Class are considered generally good for agriculture but they all have one important limitation compared to the Class I soils, which require somewhat special management. They either have a deep enough solum for growth of most crops and pastures or the underlying rock is easily rippable to increase root-room. The limitation is other than soil depth. The fertility level is good and agricultural production can be accomplished year round if water is available. The soils and land units of this Class are as follows:

Bluff Stony Loam/Kitty Clover Clay (77/78) (over North Side water lens)

This complex consists of rocky land with pockets of deep, good soil which can be used for a range of crops including orchard and food crops. Due to rockiness, pastures are not particularly suitable. Good irrigation water is available. A constraint for more intensive agricultural development is the delineation of the Nature Reserve in the area.

Bluff Stony Loam/Kitty Clover Clay (77/78) (over East End water lens)

This complex occurs as a small inclusion in areas in which either one of the two soils predominate. The complex has the same features as where it occurs over the North Side water lens. However, this area has less constraints for agricultural development and therefore the potential is greater.

Bluff Stony Loam (77) (Uneroded phase) - Grand Cayman

This type of land occurs on slopes less than 2 percent and it is generally un-eroded. The underlying rock is virtually non-rippable and farming consists of exploiting the pockets of soil. Again, tree crops are favoured since these crops are able to exploit not only the superficial pockets of soil but also the soil material in the many cavities in the rock. Supplementary irrigation is necessary and good ground water is generally available.

Kitty Clover Clay (stony and sloping phases) and Kitty Clover Clay/Bluff Stony Loam (78;78/77) - Grand Cayman

The stony phase of Kitty Clover Clay is quite manageable since it has comparatively large and deep pockets of soil in between stony outcrops. Farmers are able to exploit these pockets of soil for a wide range of crops. Depending on the nature of the crop, the total land surface may not be available for farming due to the stone outcrops. Typically, farmers cultivate food crops on this soil phase and very good yields and high quality produce are obtained.

When it occurs in association with the Bluff Stony Loam soil, stoniness can be a problem but the deep pockets of the Kitty Clover Clay soil is particularly suitable for orchard crop production; however it can also be used for food crops.

Further Ground Clay (13) - Grand Cayman

Although a relatively shallow soil, it has high potential due to availability of water, absence of salinity and lack of proneness to flooding. Due to a high water table, the soil is presently being used for pasture and tree crop production without supplemental irrigation, even in the wet season.

Hutland Clay Loam (8)

This soil has similar land use features to Further Ground Clay and it occurs in the same part of Grand Cayman. Although it has distinct potential as an agricultural soil, much of it is utilised for housing at North Side. The favourable conditions make it especially easy to establish perennial orchard crops and ornamental plants.

Mt. Pleasant Clay Loam (12)

As an agricultural soil, this soil has high capability but it is presently almost completely in housing in the West Bay area of Grand Cayman. Vacant lots are used for productive pastures until the land is needed for construction. Agriculturally usable ground water is available.

Newlands Clay/Kitty Clover Clay (74/78)

This soil complex occurs in a small area just north of Northward. It is a complex of two good agricultural soils and therefore has potential. However, it is on a preferred housing area and its agricultural use is thereby constrained.

Newlands Clay (74) - Grand Cayman

Although much of this soil is presently being utilised for housing, important areas are in farming and it is exploited for the whole range of enterprises common to the Cayman Islands. The underlying rock is rippable if this is necessary, although if there is not enough soil, the ripping can expose too much of the softer limestone material which causes plant nutrition problems. There are saline depressions and ground water requires careful management to avoid salinisation; important areas of the soil occur just outside the established Lower Valley water lens, hence there is a potential water quality problem if management is not efficient. All these features can be seen at Mr. Albert Hislop's farm at Newlands.

Pedro Castle Fine Sandy Loam (23) - Grand Cayman

This soil has good potential for varied agricultural enterprises although there is a small occurrence of it. It has potential for use for food crop and pasture production but sub-division of it for housing development is actively in progress.

Snipe Point Clay Loam (2)	This soil occurs only in Little Cayman and it is akin to Kitty Clover Clay of Grand Cayman in overall capability for agriculture as far as soil quality is concerned. While it is reputed that usable ground water is available, this has not been verified. There are many natural wells but their potential to supply water should be comprehensively assessed. Traditionally, this has been a productive soil for food crops such as yam and sweet potato and there is now a renewed interest in utilising it for a wider range of crops. The progress is good.
West Bay Sandy Loam (6)	This soil occurs in West Bay in a small area. It is a shallow soil and consists of small fragments of coralline material inter-mixed with dark soil. The soil is being used for housing development but on vacant sites good forage (Guinea grass, Leucaena and Teramnus spp) grows naturally and some livestock is produced.
West Bay Sandy Loam/ Bluff Stony Loam (6/77)	This complex represents a small occurrence in the West Bay area which is preferred for housing development. On vacant lots pastures develop naturally and livestock is produced. With care, some irrigation water may be

available but its use must be well regulated to avoid salinisation.

West Bay Sandy Loam/ Old Bush Clay Loam (6/5)

This soil complex occurs in the West Bay area and it is intensively used for housing development. There are naturally interventing depressions which are saline. The quality of ground-water over the area may be good following heavy rains but the salt content can increase if the water is over used. Areas not in housing are used for livestock production. In general, attempts at food crop production have not been very successful due to injudicious use of irrigation and consequent salinisation.

5.2.3 Class III:

Soils put in this Class are fairly good from a general standpoint and especially in the Cayman Islands context. They all have one major limitation and may also have one or more minor ones. These constraints require that the soils be carefully managed and with this attention they can be used for a range of agricultural enterprises. The soils, or phases of soils, which are included in this category, with justification, are presented below:

Barkers Sand (18) (over Lower Valley water lens)

The classification of this particular occurrence of Barkers Sand in Class III is justified due to the availability of good ground water for irrigation. The soil can be used for low growing high value crops such as melon, canteloupe, other cucurbits and similar food crops assuming that irrigation is used and other management requirements are met. Much of the occurrence is presently in housing development, however.

Botabano Clay Loam (91)
- Grand Cayman

Although a shallow soil, it occurs on soft limestone and it is therefore easily rippable to increase the effective soil depth. There is danger, however, that this can result in exposing too much of the soft limestone and crops in this environment can develop lime induced chlorosis, especially in the dry season. When it occurs in depressions, these areas are subject to periodic flooding in the wet season. Secondary salinisation has also occurred in some locations which has been ascribed to the drains made in the mangrove swamps for mosquito control. Usable ground water is normally available at a shallow depth which is an asset; however, the quality is variable.

Bluff Stony Loam/
Kitty Clover Clay (77/78)
- Grand Cayman

This complex consists of land with deep pockets of soil in-filling small karsts in the surface of the weathering Bluff limestone; soil material has also occupied cavities in the rock which are not visible on the ground surface. If the complex does not occur immediately over an established water lens, good ground water for agricultural use is usually available. Land with this soil complex is well used for agricultural production.

Bluff Stony Loam (77) (over water lenses)	The Bluff Stony Loam soil which occurs immediately above a known, proven and productive water lens, such as the East End water lens, is included in this category. The availability of large quantities of good ground water is a great asset and although the land can be very stony and rocky, it is possible to produce a wide range of crops such as tree crops, banana, plantain, papaya and vegetables. Several permanent farms with a good measure of success can be found on this type of land. Apart from easily available ground water, the natural high level of soil fertility is an important favourable aspect.
Bluff Stony Loam/Pedro Castle Fine Sandy Loam (77/23)	This soil complex occurs east of Old Man Bay. Although the Pedro Castle Fine Sandy Loam component (Class II) is important, it is put in this Class due to limited irrigation possibilities, exposure and proximity to saline areas. Its potential uses include pasture development and some orchard crops.
Bodden Town Clay Loam (15) (over East End water lens)	The classification of this occurrence of Bodden Town Clay Loam (Class V) is rationalised on the basis that irrigation water may be available and salinity interferences may be less compared to other locations of the soil. However, there are only two small occurrences of soil in this area.

Kitty Clover Clay (78) - Cayman Brac

The Kitty Clover Clay of Cayman Brac is as deep as the deepest phase of this soil in Grand Cayman and as such, has considerable potential for agriculture. The outstanding limiting factor is lack of water. As stated earlier, due to the average elevation of the Bluff, ground water cannot be reached shallower than about 30 metres and there is no electrical power in the area. Test wells have shown both excellent and poor quality water so there are prospects that usable ground water exists but its exploitation in present conditions is not possible.

This soil forms the most natural pasture land of the islands. On clearing, Seymour grass (Bothriochloa pertusa) is naturally established and it is quite vigorous. The range of weeds include maiden plum (Comocladia intigrifulia) and prickly pear (Opuntia dillenii); rosemary (Croton linearis) which is characteristic of Grand Cayman's pastures is much more restricted and more of the cleared land remains effectively usable. The lower rainfall and low ground water make Guinea grass a poor competitor. In the pastures, forage legumes grow naturally, the important species being Teramnus, Clitoria and Desmodium. Because of this as well as supplementary feeding, the livestock is in good condition. One farmer maintains a successful small mixed orchard based on water harvested on the site, supplemented by deliveries of water by Water Authority.

Kitty Clover Clay/Bluff Stony Loam (78/77) - Cayman Brac

This soil complex has the same potential as Kitty Clover Clay in Cayman Brac. It is more stony but the pockets of soil can be similarly exploited; they are at least larger and deeper. The soil pockets are perhaps more easily exploited for food crops such as yam and cassava. The soil may also have potential for the commercial production of drought tolerant fruit crops for export such as naseberry, sugar apple, custard apple, guinep etc., all of which grow naturally.

For Kitty Clover Clay and Kitty Clover Clay/Bluff Stony Loam complex soils, the availability of water would greatly alter their capability. It is likely that in the future, economic ways would be found to exploit good ground water. The possible introduction of pumps operated by solar energy is a step in this direction and this quantum leap would also require a change in socio-economic conditions affecting agriculture.

Old Bush Clay Loam/Bluff Stony Loam (5/77)

This soil complex has features of the two components but Old Bush Clay Loam is by far the more dominant. Since it is present in areas of high rainfall and in one occurrence where some potential for irrigation exists, the classification in Class III is justified. Pasture is the dominant use with African Star grass being fairly successful but no example of good management was seen.

Old Bush Clay Loam (5) - Grand Cayman & Little Cayman

This would normally be a good soil since it has a fairly deep solum with underlying soft limestone which is easily rippable. It can be easily made into crop land or pasture. The two main problems with it are the occurrence of saline depressions and periodic flooding in the wet season. Some secondary salinisation may also have occurred. A shallow water table may lead to water-logging in the wet season; on the other hand, water is available for irrigation on an all year basis.

Old Bush Clay Loam/George Town Clay Loam (5/9)

This soil complex occurs mainly in the coastal area of West Bay. It is now largely unavailable for agriculture. Its classification in Class III is justified because of shallow soil depth and exposure.

Old Bush Clay Loam/Half Moon Bay Loam (5/14)

This complex occurs in the George Town area just south of Jackson Point. The whole area is developed for housing and tourism and therefore, there is little scope for agriculture. The comparatively favourable conditions of rainfall and ground water are well suited for ornamentals and other horticultural uses which is quite compatible with its current use for housing and tourism.

Old Man Bay Sand Clay Loam (17) (over North Side water lens)

This occurrence is up-graded for the soil series due to the availability of irrigation water from the North Side water lens. This factor alone makes the soil more usable for agriculture and gives it more flexibility in enterprises which are being developed.

Pedro Castle Fine Sandy Loam/Bluff Stony Loam (23/77)

This complex occurs in the West Bay area only and it typically represents a combination of the better Pedro Castle Fine Sandy Loam (Class II) described earlier and Bluff Stony Loam which has little agricultural potential.

The agricultural use of the soil is based on the Pedro Castle Fine Sandy Loam component; however, the entire area is being developed for housing and only on one vacant lot is any agriculture being practised. The dominant use is for native and improved pasture.

Round Key Clay Loam/Bluff Stony Loam (7/77) (over East End (small) water lens)

In this complex, the Round Key Clay Loam (Class IV, Little Cayman) is by far the more dominant and it occurs over a water lens. The classification of the Round Key Clay Loam soil where it occurs in Little Cayman (Class VI) is due to lack of water which severely constrains the potential use for agriculture at that location. Here there is water and even though the soil may be somewhat rocky, under Cayman Islands conditions, it has fairly wide potential for agricultural uses.

5.2.4 **Class IV:**

These soils are usable for agriculture but they have at least two serious constraints which require careful and dedicated management for sustainable farming. The major soils and land units in this Class are as follows:

Half Moon Bay Loam (14) - Grand Cayman	This soil is shallow on a flat, hard cap-rock which is rippable. It suffers from poor drainage and can be flooded periodically during the wet season. Unlike the more freely draining soils on the islands, on clearing, Guinea grass does not naturally colonise and the palatable pasture legumes are few and restricted in species to *Desmodium* spp. and *Centrosema* spp. A productive pasture can be established, based on African Star grass.
Old Man Bay Sand Clay Loam (17)	This is a shallow soil but since the underlying soft limestone rock is rippable, the rooting depth can be accordingly increased. It occurs in variable drainage conditions from poorly draining in West Bay to somewhat better drained conditions at Old Man Bay. It always occurs in association with saline depressions and while there is sometimes agriculturally usable ground water, this needs to be well monitored and managed for any benefit to be derived. It has suitability for pastures and orchard crops. Housing development is encroaching rapidly on this soil.
Spot Bay Clay Loam (19)	The soil occurs as a narrow strip running almost the full length of

Cayman Brac on the north side of the island, although in this location, it receives some protection from sea blast since there is also a strip of beach sand along the coast which is thickly wooded with sea grape, (Cocoloba uvifera), Casuarina etc. It abutts the Bluff. In many places under the Bluff, there are small food crop and vegetable gardens and fruit trees. There may be limited availability of ground water since there are a few natural wells. More successful wells may be found and if so, this would greatly improve the productive capacity of the soil. There is pressure for urban and rural development on the soil for the full length of the island and this in turn would slowly eliminate agriculture. Home gardens, orchards and ornamental plants on house sites can apparently be established with little difficulty.

Round Key Clay Loam (7)

This shallow soil occurs on flat rock in lower areas; the underlying rock is rippable. It occurs in association with swamps and saline depressions and has probably been affected by secondary salinisation in some places. On clearing, good pasture species colonise. It seems marginal for Guinea grass but African Star grass grows vigorously. In the Round Key area where the best farming conditions exist on this soil, there is competition for its use by urban development.

Charles Bight Clay Loam (4)

This is a soil of medium depth with high natural fertility status. Its high organic matter content ensures good soil structure and drainage features. The underlying limestone is rubbly and therefore not massive so that roots of plants can penetrate fairly easily. The main area of doubt lies in the availability of ground water. In Little Cayman where this soil occurs, there is hardly any information on this important aspect. There is presently no farming activity on the soil, although there may have been in the past. Another problem in its exploitation is accessibility which has to be developed.

Herberts Turn Clay Loam (11)

This soil occurs in one location in Cayman Brac only. It is a shallow soil but rippable. At present, most of it is either in housing development or has been surveyed for sub-division. There is a possibility that good ground water may be available since there are reports of the existence of more than one natural well.

Under existing conditions, the soil is suitable for the production of fruit, food and vegetable crops, either with the use of ground water or harvested and stored water. Accessibility for this soil is very good.

Other Bluff Stony Loam Soils and Bluff Stony Loam Complexes - Grand Cayman (77;5/77;14/77; 77/78;7/77;77/7)

These are soils on the Bluff Formation which occur on slopes of mainly between 2 and 5 percent and where surface soil erosion has been marked to the extent where little soil material can now be seen on the ground surface. The soil has not been lost to the environment, but essentially washed into the numerous vughs and cavities in the underlying limestone rock. At times there can be appreciable pockets of soil which accumulate in the minor karsts. Effective, if not successful, farming can be carried out by exploiting these accumulations of soil for food crop production. Orchard crops would also exploit the soil in the rock cavities. Although established underground water lenses may not be indicated, ground water is likely to occur. In this type of land there are natural wells and cisterns with good quality water already existing.

Snipe Point Clay Loam/ Bluff Stony Loam (2/77)

This land unit occurs only in Little Cayman and it consists of an association of the two soils occurring in no predictable pattern. As with the Snipe Point Clay Loam soil, usable ground water may occur and there are likely to be natural wells. However, more data would need to be obtained before formulating a sustainable extraction policy. Obviously, this land unit does not have the same agricultural potential as the Snipe Point Clay Loam soil due to more rock outcrops and stones on the soil surface. Yet at any time ground water becomes available, the classification should be up-graded.

Another present constraint is lack of accessibility to these areas but again this can be improved, thus affecting the capability of the soil complex.

As far as soil quality is concerned, this complex may be quite comparable to the Kitty Clover Clay/Bluff Stony Loam complex but lack of accessibility, water, farmer expertise and the absence of livestock on Little Cayman are factors affecting the use of this type of land.

5.2.5 Class V:

The soils and land units included in this Class can be used for agriculture on a restricted scale but important constraints would have to be addressed for their sustainable uses. Due to water unavailability in some cases, farming can only be carried out in the wet season. The soils and land units included in this Class are as follows:

Barkers Sand (18)

The first choice for the use of this soil is for housing and hotel construction and other installations of touristic value. However, while awaiting such development, the soil can be used for the production of wet season, high value crops such as vegetables, thyme, chives, melon, cantaloupe and even for low-growing food crops such as sweet potato and maybe cassava. Caymanians recall the production of these crops on this soil but at present there is hardly any agricultural activity on it. In a few places there has been planting of coconut but these are now abandoned due to lack of any economic advantage in growing this crop. It may even be irrigated when water is available. A hazard may be sea blast but only experience would lead to the development of a satisfactory farming system for this soil.

Barkers Sand/Beach Sand (18/BS) - Cayman Brac

This complex occurs as a narrow strip on the coastal areas of Cayman Brac. In some locations, short duration food crops are cultivated but with no reliable water supply, this is quite risky. Householders are able to landscape their properties attractively using adapted plant species. The main purpose of this soil complex is to use it for conservation and the establishment of shelter belts.

Bodden Town Clay Loam (15)

This soil is prone to wet season flooding and drainage is not possible. Pasture based on African Star or Coastal Bermuda grass is the only feasible use to which it can be put. It is claimed that the salinity problem has worsened since the construction of the canals through the mangrove swamps for mosquito control. On clearing and planting of African Star grass, the species is established quite well but on using the pasture, the grass is progressively replaced by salt tolerant species which are unpalatable. Accordingly, the quality of the pasture deteriorates rapidly.

Breakers Clay Loam (16)

This soil occurs in depressed topography and the natural vegetation of logwood in the higher areas and buttonwood in the depressions, indicates saline conditions and wet season flooding. On clearing, African Star grass can be established but it is difficult to maintain it, since, as in Bodden Town Clay Loam, it is replaced by more salt tolerant weeds and grasses with little pasture quality. Under existing conditions, pasture is the only agricultural use which can be recommended and research has to be done to establish the best species and management regime.

Bluff Stony Loam/
Kitty Clover Clay (77/78)
- Cayman Brac

Under existing conditions in Cayman Brac, this soil unit would have lower capability than in cases where Kitty Clover Clay dominates over Bluff Stony Loam. However, with the technologies and expertise available on Cayman Brac for establishing and managing pastures, land of this type can be used for pasture production as well. The efficiency with which it can be used would be lower due to more stoniness and the problem with water would be the same. With appropriate management, the soil unit can also be used for varied orchard crop production.

The present availability of good water nearby at Watering Place, where there is the main occurrence of this soil, would add to its usability for agriculture.

Bluff Stony Loam (77) (north-west of Grand Cayman Yacht Club)	This is a small occurrence of the soil at this location and its classification in Class V is justified due to exposure and lack of irrigation potential. It can be used for conservation and beautification with the planting of appropriate species which are adapted to the environmental conditions.
Cotton Tree Land Clay Loam (73)	This is a shallow soil which occurs in the drier inland areas of west Cayman Brac. When cleared, some Guinea grass self establishes together with a few legumes. The establishment of forage banks is a possibility since cutting of forage and hand feeding cattle is well established in Cayman Brac. There seems to be no possibility of irrigation and since the soil occurs in the drier part of Cayman Brac, water availability is a serious constraint.
Jackson Bay Clay Loam (3)	The main occurrence of this soil is as a narrow strip just inland from the beach sand on the south side of Cayman Brac. There is enough soil for farming and there are several attempts at cultivation of food

crops and certain fruit trees. The main limitation is lack of water; the few natural wells are all saline and there is little hope of usable ground water. Because of this compelling constraint, the soil can only be farmed in the wet season and only certain types of drought tolerant fruit trees can be grown.

Jackson Bay Clay Loam/
Bluff Stony Loam (3/77)

This soil complex occurs on the western part of Little Cayman only. At present, there is much activity in real estate development on the soil complex. Without water for irrigation, the land is suitable for short-term food and vegetable crops in the wet season. On clearing, Guinea grass is naturally established but since there is no livestock on Little Cayman, there is no use for this. There is no doubt that the soil complex has the potential for pasture production. At least one natural and two other wells were seen but the water quality was not known. The only guidance available on this point is the average value of 3,000 micro-mhos/cm for ground water in Little Cayman (Ng and Van Genderen, 1994). Water of this quality can be used for irrigation but its use must be monitored and controlled. Other constraints are lack of communications, accessibility and problems with marketing of agricultural products.

5.2.6 **Class VI:**

This type of land includes soils which have little or no potential for use in agriculture in existing circumstances of human resources, level of technologies and socio-economic conditions. There are many good reasons why this is so. The soils and land units included in this Class are as follows:

Barkers Sand/Hell Stony Loam (18/1)	This complex occurs mainly in Cayman Brac in the south-east end of the island. Its use for agriculture is limited due to lack of water and exposure to winds.
Beach Sand (BS)	This type of land occurs on all the islands as a narrow strip along the ocean front. The soil series has little inherent properties which would make it suitable for agriculture. The material is too calcareous and the soil is too exposed. It supports a vegetation of which sea grape (Cocoloba uvifera) is dominant. The soil can be used to provide windbreaks for more inland areas. However, the sand deposits are considered highly valuable as construction material and are exploited in several locations. These uses, however, should be carefully controlled since the beach sands are also valued as protection from marine influences of more inland areas.
Beach Sand/Old Bush Clay Loam (BS/5)	This soil complex occurs on the south-east coastal area of Little Cayman on generally flat land. The features of the Beach Sand are more

prominent than those of Old Bush Clay Loam so that periodic flooding is not so serious. However, the area is very exposed and has unreliable rainfall; it is also subject to saline intrusions. These factors are responsible for its classification in Class VI. It may have limited use for pasture production but with no livestock on Little Cayman, this potential cannot, at present, be realised.

Beach Sand/Barkers Sand (BS/18)

This complex occurs in coastal areas in the islands and it suffers from exposure and exploitation for building material. It should be used more for protection, cultivation of shelter belts and for horticultural purposes associated with housing and tourism development for which most of the complex is highly valued.

Bluff Stony Loam (77) - Cayman Brac and Little Cayman

From field studies, it would appear that Bluff Stony Loam is even more rocky and stony in Cayman Brac and Little Cayman compared to Grand Cayman. This is to be expected due to the drier climate and more irregular rainfall and consequent slower rate of soil formation. Lack of availability of usable ground water in Cayman Brac and probably to a lesser extent in Little Cayman, is a very important constraint to any form of agricultural use of these areas.

Bluff Stony Loam/ Snipe Point Clay Loam and Bluff Stony Loam/ Hell Stony Loam (77/2;77/1)

These complexes occur in Little Cayman only. These soils are excessively stony and very shallow and at present are inaccessible. The availability of good ground water is also questionable. At the present time very little prospects exist for agriculture on these complexes.

Hell Stony Loam (1)

This soil or land type has little or no soil on the land surface although the soil material which developed has been washed into cavities in the limestone formed by solution of the rock. Enough soil material has thus accumulated to support, in inland areas, the typical dry evergreen woodland/thicket mosaic (Brunt, 1994), which is characteristic of the Bluff Formation, depending upon the extent of previous human interference. This soil series also occurs on the periphery of saline swamps and the composition of the vegetation in these locations reflects this. If cleared by bulldozing, this type of land can be made extremely stony and rocky with literally no potential for agriculture. It can, however, be used for construction. The unique surface features with sharp pinnacles and deep cavities, has touristic appeal and areas of the landscape should be preserved on each of the three islands for this purpose.

Hell Stony Loam/ Bluff Stony Loam (1/77)

This complex is widespread on the three islands and it represents a combination of two extremely stony and rocky soils on which there is little or no accumulation of soil material on the surface. The land occupied by this soil complex supports the typical dry evergreen woodland/thicket vegetation (Brunt, 1994), which exploits the soil that has accumulated in depressions and cavities in the rock.

There are two phases of this complex; one of these is where the Hell Stony Loam soil predominates over the Bluff Stony Loam and the other, the reverse. Both phases are considered too stony and rocky to be of much use for agriculture. On the other hand, there are locations where ground water may be available especially in Grand Cayman and certain types of agricultural enterprises such as nurseries and undercover production of vegetables may be possible.

Hell Stony Loam/Spot Bay Clay Loam (1/19)

This complex occurs in the East End of Cayman Brac and it essentially consists of pockets of deeper Spot Bay Clay Loam with rock outcrops. It is naturally exposed to strong winds. Without protection only very limited grazing of cattle is possible.

Round Key Clay Loam/ Beach Sand (7/BS)

This soil complex occurs in the north-eastern coastal area of Little Cayman on gently sloping land with some degree of erosion hazard. Its classification in Class VI is justified on extreme exposure, shallow soil and unreliable rainfall. Its potential would be much higher for tourist development.

Swamps and Marinas

The swamps represent unique ecosystems of considerable scientific interest but at present are considered of little economic value. In the rapidly expanding physical development on the islands, there is an urge to interfere with the swamps by in-filling for building, draining and for creation of marinas. The ecological impact of these measures is not adequately appreciated at the present time with serious implications (Burton, 1995).

Traditionally, the swamps were dreaded because they formed an ideal breeding environment for mosquitoes which were a great nuisance. However, their control by the Mosquito Research and Control Unit of the Department of the Environment is a highly significant achievement. It is true to say that if the islands' mosquitoes had not been controlled, it is inconceivable that the thriving tourist industry and off-shore banking could have developed. The control measures include flood control of the breeding sites which, as discussed elsewhere in this report, has led to secondary salinisation of what was once considered to be good agricultural land.

At present the swamps have no direct agricultural use. However, with the development of a policy and guidelines for inland fish farming (Parsons, 1994), developments in this area can likely occur.

A listing of the soils and land units of the Cayman Islands and their respective land capability classes is given in Table 8.

Maps of the three islands showing the distribution of the various land capability classes as they relate to the established soil series and ground water lenses, form part of this report. The maps are accompanied by transparent overlays of the respective islands, showing block and parcel information with place names and cultural features, needed for identification and location.

Table 8: Summary of Land Capability Classes for the soils and land units of the Cayman Islands

Soil Numbers	Soil/Land Unit Names	Capability Class
78	Kitty Clover Clay (Grand Cayman)	I
9	George Town Clay Loam (Grand Cayman)	I
9/78	George Town Clay Loam/Kitty Clover Clay	I
78/77	Kitty Clover Clay/Bluff Stony Loam (over East End water lens)	I
77/78	Bluff Stony Loam/Kitty Clover Clay (over North Side water lens)	II
77/78	Bluff Stony Loam/Kitty Clover Clay (over East End water lens)	II
77	Bluff Stony Loam (uneroded phase) (Grand Cayman)	II
78 78/77	Kitty Clover Clay (stony and sloping phases) and Kitty Clover Clay/Bluff Stony Loam (Grand Cayman)	II
13	Further Ground Clay (Grand Cayman)	II
8	Hutland Clay Loam (Grand Cayman)	II
12	Mt. Pleasant Clay Loam (Grand Cayman)	II
74/78	Newlands Clay/Kitty Clover Clay (north of place name Northward)	II
74	Newlands Clay (Grand Cayman)	II
23	Pedro Castle Fine Sandy Loam (Grand Cayman)	II
2	Snipe Point Clay Loam (Little Cayman)	II
6	West Bay Sandy Loam	II
6/77	West Bay Sandy Loam/Bluff Stony Loam	II
6/5	West Bay Sandy Loam/Old Bush Clay Loam	II

18	Barkers Sand (over Lower Valley water lens west of quarry)	III
91	Botabano Clay Loam (Grand Cayman)	III
77/78	Bluff Stony Loam/Kitty Clover Clay (Grand Cayman)	III
77	Bluff Stony Loam (Grand Cayman) (over water lenses)	III
77/23	Bluff Stony Loam/Pedro Castle Fine Sandy Loam (east of Old Man Bay)	III
15	Bodden Town Clay Loam (over west side of East End water lens)	III
78	Kitty Clover Clay (Cayman Brac)	III
78/77	Kitty Clover Clay/Bluff Stony Loam (Cayman Brac)	III
5/77	Old Bush Clay Loam/Bluff Stony Loam (West Bay, east of North West Point and Bodden Town)	III
5	Old Bush Clay Loam (Grand Cayman & Little Cayman)	III
5/9	Old Bush Clay Loam/George Town Clay Loam (West Bay coast)	III
5/14	Old Bush Clay Loam/Half Moon Bay Loam (George Town)	III
17	Old Man Bay Sand Clay Loam (over North Side water lens)	III
23/77	Pedro Castle Fine Sandy Loam/Bluff Stony Loam (West Bay)	III
7/77	Round Key Clay Loam/Bluff Stony Loam (over East End small water lens south of large lens)	III
14	Half Moon Bay Loam (Grand Cayman)	IV
17	Old Man Bay Sand Clay Loam (Grand Cayman)	IV
19	Spot Bay Clay Loam (Cayman Brac)	IV
7	Round Key Clay Loam (Little Cayman)	IV
4	Charles Bight Clay Loam (Little Cayman)	IV

11	Herberts Turn Clay Loam	IV
	Other Bluff Stony Loam Soils & Bluff Stony Loam Complexes - Grand Cayman:	IV
77	Bluff Stony Loam	
5/77	Old Bush Clay Loam/Bluff Stony Loam	
14/77	Half Moon Bay Loam/Bluff Stony Loam	
77/78	Bluff Stony Loam/Kitty Clover Clay	
7/77	Round Key Clay Loam/Bluff Stony Loam	
77/7	Bluff Stony Loam/Round Key Clay Loam	
2/77	Snipe Point Clay Loam/Bluff Stony Loam (Little Cayman)	IV
18	Barkers Sand (All Islands)	V
18/BS	Barkers Sand/Beach Sand	V
15	Bodden Town Clay Loam (Grand Cayman)	V
16	Breakers Clay Loam (Grand Cayman)	V
77/78	Bluff Stony Loam/Kitty Clover Clay (Cayman Brac)	V
77	Bluff Stony Loam (near Grand Cayman Yacht Club)	V
73	Cotton Tree Land Clay Loam	V
3	Jackson Bay Clay Loam (Cayman Brac)	V
3/77	Jackson Bay Clay Loam/Bluff Stony Loam (Little Cayman)	V
18/1	Barkers Sand/Hell Stony Loam	VI
BS	Beach Sand (All Islands)	VI
BS/5	Beach Sand/Old Bush Clay Loam	VI
BS/18	Beach Sand/Barkers Sand	VI
77	Bluff Stony Loam (Cayman Brac and Little Cayman)	VI
77/2 77/1	Bluff Stony Loam/Snipe Point Clay Loam and Bluff Stony Loam/Hell Stony Loam (Little Cayman)	VI
1	Hell Stony Loam (All Islands)	VI

1/77	Hell Stony Loam/Bluff Stony Loam (All Islands)	VI
1/19	Hell Stony Loam/Spot Bay Clay Loam	VI
7/BS	Round Key Clay Loam/Beach Sand	VI
	Swamps and Marinas (All Islands)	VI

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