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EVALUATION OF DAMAGE CAUSED BY THE GRENADA RAINSTORM  
AND ITS IMPLICATIONS FOR ECONOMIC  
DEVELOPMENT PROGRAMMES

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## 1. Background

During the night of Sunday, the 9th of November 1975, Grenada was severely battered by a torrential rainstorm which caused considerable damage to the agricultural and economic infrastructure of the Caribbean nation. According to a government report, during an eight hour period 3.5 inches of rain fell on the coastal areas, 5 and 7 inches fell on the mid-belts while the mountainous Grand Etang forest received a total of 10 inches. This dramatic rainfall caused flooding, soil erosion and landslides; damaged crops and livestock; broke dams and damaged roads, bridges, water mains and reservoirs.

In the face of this natural disaster, the Prime Minister of Grenada, the Honorable Eric M. Gairy, addressed the following cable to the Executive Secretary of ECLA:

"COMMENCING ON THE NIGHT OF SUNDAY 9th NOVEMBER 1975 GRENADA HAS BEEN PERSISTENTLY BATTERED BY TORRENTIAL RAINS WHICH HAVE LEFT BEHIND A CHAIN OF RUIN AND DESTRUCTION THE EXTENT OF WHICH CANNOT BE READILY ASSESSED. THE ISLAND HAS SUFFERED DAMAGE AMOUNTING TO SEVERAL MILLION DOLLARS. A NUMBER OF BRIDGES HAVE COLLAPSED MILES OF ROAD SURFACES WASHED AWAY WATER MAINS BROKEN POWER LINES SEVERED AND LANDSLIDES HAVE NOT ONLY CREATED HAVOC ON PROPERTIES BUT ALSO HAVE RESULTED IN MANY INSTANCES ON CLOSURE OF ROAD COMMUNICATION. HEAVY FLOODING HAS RESULTED IN HEAVY LOSS OF CROPS AND LIVESTOCKS. THE RESULTANT SOIL EROSION IS EXPECTED TO HAVE SERIOUS REPERCUSSIONS ON THE IMMEDIATE AND LONG TERM PROGRAMMES FOR AGRICULTURAL DEVELOPMENT ON THE ISLAND. IN THE CIRCUMSTANCES THIS IS A HEAVY BLOW WHICH HAS JOLTED THE ECONOMY OF THE ISLAND FOR NOT ONLY HAS INFRASTRUCTURE IN GENERAL BEEN BADLY DAMAGED SO TOO ARE ONGOING DEVELOPMENT PROJECTS WHICH ARE NOW SERIOUSLY DISRUPTED. THERE IS NO DOUBT THAT THE ECONOMIC RECOVERY OF GRENADA WILL DEPEND TO A GREAT EXTENT ON THE MEASURE OF ASSISTANCE RECEIVED FROM THE INTERNATIONAL COMMUNITY AND AID AGENCIES. WE NOW SEEK YOUR IMMEDIATE COOPERATION AND ASSISTANCE MOST URGENTLY."

## /2. Action

## 2. Action carried out by ECLA

The work Programme of the Caribbean Development and Cooperation Committee (CDCC) adopted by the Caribbean States at the first session of the Committee (Havana, 31 October - 4 November 1975) sets out the responsibilities of this subsidiary body of ECLA as regards natural disasters. Paragraph III (K) of the Work Programme states that the Caribbean sub-region often suffers the effects of natural disasters, which cause great loss of life and severe damage, and calls on the Committee to endeavour to promote assistance within the United Nations system. In addition, ECLA resolution 358 (XVI), which established the CDCC, provides that the Committee should "act as a co-ordinating body for activities relating to development and co-operation".

Based on the above mandate, the Executive Secretary of ECLA addressed a cabled request for assistance to the United Nations Disaster Relief Co-ordinator in Geneva. Subsequently the Executive Secretary sent the following cable to the Prime Minister of Grenada informing him regarding the action which was being taken:

"REFERENCE YOUR CABLE EIGHTEEN NOVEMBER AAA WISH EXPRESS OUR SINCERE REGRETS EXTENSIVE DAMAGES CAUSED GRENADA BY DISASTER BBB HAVE ALREADY COMMUNICATED UNITED NATIONS COORDINATOR DISASTERS RELIEF FAROUK BERKOL CONTENTS YOUR CABLE REQUESTING HE CONSIDER WHATEVER IMMEDIATE ASSISTANCE COULD BE EXTENDED BY HIS OFFICE CONFORMITY WITH PRACTICES FOLLOWED THIS CONNEXION CCC SIMULTANEOUSLY HAVE ASKED SILBOURNE CLARKE DIRECTOR ECLA OFFICE PORTSPAIN PRESENTLY UNATIONS HEADQUARTERS NEW YORK TO TRAVEL SOONEST POSSIBLE GRENADA HEADING EXPLORATORY MISSION WHICH IN CLOSE CONSULTATION YOUR GOVERNMENT SHOULD PREPARE PRELIMINARY EVALUATION DAMAGES AND IMPLICATIONS FOR ECONOMIC DEVELOPMENT PROGRAMMES WITH A VIEW IDENTIFYING MAIN AREAS AND MEASURES REGARDING WHICH INTERNATIONAL ASSISTANCE MAY BE REQUIRED AND SOUGHT. AM ALSO REQUESTING NASSAU ADAMS UN/ECLA CARIBBEAN REGIONAL INTEGRATION ADVISORY TEAM TO COLLABORATE WITH CLARKE IN THIS ENDEAVOUR DDD UNDERSTAND CLARKE TODAY CONTACTING GRENADA MISSION UNITED NATIONS NEWYORK ORDER INITIATE ARRANGEMENTS EXPLORATORY VISIT INDICATED ABOVE EEE ASSUME YOU MAY HAVE ALREADY CONSIDERED ASKING YOUR DELEGATION AT UNITED NATIONS GENERAL ASSEMBLY

/TO EXPLORE

TO EXPLORE POSSIBILITY BEFORE CURRENT SESSION ENDS OF PRESENTING INFORMATION ABOUT EXTENT DISASTER AND CALLING FOR INTERNATIONAL ASSISTANCE WHICH COULD BE PROVIDED BY UNITED NATIONS AND SPECIALIZED AGENCIES. PLEASE ACCEPT ASSURANCES OF HIGHEST CONSIDERATION AND ESTEEM."

At the same time, Mr. Iglesias cabled the UNDP Resident Representative in Guyana, Mr. Joseph Shutzenberger indicating his intention to send a representative to Grenada and asking for the support of the infrastructure experts assigned by UNDP in Grenada.

Subsequently, Mr. Silbourne St. A. Clarke, the Director of the ECLA sub-regional office in Port-of-Spain, was directed to visit Grenada in order to report on damage and make recommendations regarding the international assistance which was needed. Mr. Clarke and a team of experts, including Mr. Ifill of the United Nations Caribbean Regional Integration Advisory Team, Mr. Laurent of the Organization of American States and Grenadan Government technical officers visited the affected areas. The mission greatly benefited from the support of the UNDP and the FAO.

The following report, prepared in consultation with UNDP, represents the findings and conclusions of this mission.

/MISSION TO

MISSION TO EVALUATE THE DAMAGE CAUSED BY THE  
GRENADA RAINSTORM AND ITS IMPLICATIONS  
FOR ECONOMIC DEVELOPMENT PROGRAMMES

The Mission which prepared this evaluation report was instructed to "prepare (a) preliminary evaluation (of) damages and implications for economic development programmes with a view (to) identifying (the) main areas and measures regarding which international assistance may be required and sought".

The Mission visited the island from 26 November to 18 December. Before its arrival, the Ministries of Economic Planning, Agriculture, Communications and Works, and Health and Housing and the Central Water Commission had made preliminary assessments of the damage caused by the rainstorm, and the Government had already begun a road clearance programme. The affected areas had also prior to the arrival of the Mission, been visited by representatives of the Organization of American States (OAS), the United Nations Disaster Relief Organization (UNDRO), the United Nations Development Programme (UNDP), and the World Health Organization (WHO). The Mission toured the islands of Grenada and Carriacou. Since the event occurred at night when people were in their homes, the severe floods did not result in loss of life, but there were minor injuries and some human distress caused by loss of property. These problems were dealt with at the local level, and therefore the emphasis in this report will be on an assessment of the damage to the nation's infrastructure and to its physical and productive resources and on an outline of the steps which should be taken to avert short-term risks to health and promote both short- and long-term economic growth and expansion.

The work of this Mission originated from a natural occurrence which affected the whole island of Grenada and the island of Carriacou, but in the light of the history of natural disasters in this area it would be unrealistic to view the events of 9 November in isolation from the natural characteristics of the islands and the role of Man in his particular ecological setting. The report therefore contains an introduction which presents the main characteristics of the islands that need to be known in order to grasp fully the nature of the events which occurred.



## INTRODUCTION

Two islands of the State of Grenada were affected by the rain-storm. The following are their main relevant characteristics.

### GRENADA

#### Geology

This island is almost entirely of volcanic origin and is composed mainly of pyroclastic rocks and basalt and andesite lavas. The latter occur mainly in the centre of the island, while the pyroclastic rocks - agglomerates and ashes almost entirely composed of andesitic material - occur mainly as a belt along the rim of the island, or as a mantle over underlying lava. Though all the volcanic rocks are of similar constitution, those in the west-central and north-western parts of the island are more intermediate in nature than those in other parts. Ash and agglomerate are often found interbedded. Other geological deposits found in the island are limestone, which occurs in small isolated outcrops and is not of much agricultural significance; tuffaceous shale, which occurs in broken belts along the north-west coast and in some valleys; and deposits of alluvia found mainly in the lower courses of rivers and streams. In the normal course of events geological erosion occurs due to the integrated result of the natural forces of climate and gravity acting upon a landscape and causing all elevated areas to reduce to a base level. By his land use pattern, Man can arrest, retard or accelerate this process of erosion. The important geological feature which should be noted here is the presence of volcanic rocks of an intermediate nature in ash deposits which can cause instability in the event of heavy rainfall.

#### Topography

The island, which is very hilly, covers an area of approximately 75,000 acres. Its greatest length is 21 miles and its greatest width 12 miles. The main mountain mass is in the centre. The highest mountain peak in the north of this mass is Mt. St. Catherine, rising

to a height of 2,756 feet. On the western side the mountains rise steeply from the coast, with four significant peaks of 2,512 feet, 2,412 feet, 2,300 feet, and 2,347 feet. Approximately 50 per cent of the total area of the island is more than 500 feet above sea level. The remainder is a coastal belt of low undulating plains, mainly on the east and south coasts. In the west, mountainous outcrops extend to the sea and there is a very narrow coastal strip. This mountainous compact in such a relatively small acreage results in slopes which are comparatively steep: 19 per cent of the total acreage has a slope between 10 and 20 degrees, 46 per cent between 20 and 30 degrees, and 23 per cent over 30 degrees.

#### Rainfall

The island is in the path of the north-east trade winds and experiences marked dry and rainy seasons. It lies just south of the hurricane zone, but is nevertheless occasionally affected by hurricanes. The island has a rainfall distribution pattern ranging from a minimum of less than 50" to a maximum of over 160".<sup>1/</sup> Average annual rainfall over the period 1926 to 1960 was 96.97 inches. More recent data for the period 1970 to 1974 show that the mean monthly rainfall for each of the five years was respectively as follows: 7.27", 6.44", 5.83", 6.15" and 6.20". These data indicate that rainfall levels have been lower in recent years, but the heavy rain showers, concentrated mainly between July and December and falling on steep slopes with numerous valleys, result in scores of rivers of varying length and rapidity flowing from the central mountain mass to the coast.<sup>2/</sup> In their wake these cause much geological erosion, and their courses are strewn with hundreds of boulders and vast quantities of productive soils.

#### Description of soils

Here attention will be focused only on the soils found on hills and mountains. They are lithosolic soils which are excessively to

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<sup>1/</sup> See Appendix 1, Map 2: Annual rainfall distribution.

<sup>2/</sup> See Appendix 1, Map 3: Major drainage areas.

/well-drained,

well-drained, shallow and highly erodible. They usually occur on steep slopes. Two of these soils, Radix Clay Loam and Woburn Clay Loam (stony and bouldery phase) occur over ash and agglomerate, usually in relatively dry areas. They have poor water retention capacity. The other two, Capital Clay Loam (steep, shallow phase), and Belmont Clay Loam (steep, shallow phase), usually occur over highly weathered igneous rocks and ash and agglomerates. They are found mainly on steep slopes in mountain areas with high rainfall. They are often subject to loss of soil above the parent material due to landslips. These soils are at present forest-covered and they should remain so. The soils normally found on most hill slopes in the higher rainfall areas are also Capital and Belmont Clay Loams. They occur over highly weathered basic igneous rocks and over basic ash and agglomerates respectively. They are both moderately to well-drained, with good water retention, and are only moderately erodible.

These geological, topographical, rainfall and soil characteristics of Grenada indicate quite clearly that Man's role cannot be passive. He must, in electing to live in a territory of this kind, either knowingly or in ignorance influence the natural erosive process. The location of his settlements, the type of house he builds, the kinds of crops he grows and the area where he grows them, his cultivation practices, the location of roads between settlements, the road surface, the provision of drains, culverts and embankments, the location of bridges and their height above watercourses, the steps taken to conserve the island's water supply, these are all criteria which enable the observer to find out the extent to which Man is acting in the full awareness of his ecological responsibility.

#### Land use

A striking feature of the land use pattern in Grenada is that the main economic crops in the island - cocoa and nutmeg - are tree crops and are found mainly in the hilly agricultural areas where precipitation is highest. This tree cover serves as an anti-erosion measure, but in travelling around the country one is struck by the numerous patches of land on mountain sides, some exposed to the elements and others with

/crops which

crops which offer little protection to the soil from torrential rains. It would appear that few farmers have any soil conservation consciousness in their land use, and that where current practices result in conservation it is mainly due to the chance virtues of traditional practices and to economic necessity, as is the case with tree crop cultivation.

#### Water conservation

Given the high rainfall levels of the island in the rainy season, Man has a two-fold function in trying to preserve the land for the use of future generations. There is first the hydrological aspect: to control the flow of water at numerous points from the highlands to the coast so that erosion is reduced to controllable proportions. At present there are dams at strategic points in the mountains, but the fact that the sea around Grenada was brown for days after the rainstorm instead of its usual blue indicates that there should be further examination of the control measures at high elevations. Secondly, control measures should be such as to facilitate high seepage into the soil so that water reserves will be available during the dry season.

#### Communications infrastructure 3/

If the island's roads and bridges are to play their part in conservation they should be constructed taking into consideration the physical and rainfall characteristics which have already been outlined. But travelling over the roads of the island one is struck by the low levels of roads approaching rivers and by bridges which seem to have been built with a view to impeding the flow of water rather than permitting easy access from one bank of a river to the other. The present road system has developed from tracks which were used traditionally over the centuries and which were widened and surfaced to accommodate horse-drawn vehicles and later motorized vehicles. Undoubtedly there were periods when they served their purpose admirably. But today road alignments and methods of road construction should be

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3/ See Appendix 1, Map 3: Bridge locations.

re-examined to assess their compatibility with the island's natural characteristics and their suitability for the heavy traffic which uses them to transport weighty building materials and agricultural inputs and produce from place to place. By the same token, retaining walls, side drains, culverts and embankments which were adequate in earlier periods need to be reassessed as part of a general programme for a more comprehensive approach to drainage and soil conservation. Furthermore, due to hydrological imperfections the rush of water from the mountains brings down annually large boulders and tree trunks which block river courses when they reach bridges, and these act as battering rams against the bridges in subsequent rainy seasons. The foundations of bridges are therefore constantly being subjected to erosive forces which weaken and destroy them over time. The present infrastructural framework can only be kept serviceable at relatively high maintenance cost.

#### CARRIACOU

This island, situated 21 miles north of Grenada, is approximately 7 1/2 miles long and 2 1/2 miles wide, with a total area of about 8,600 acres. There is a Central Ridge which reaches a maximum height of 980 feet above sea level.

#### Geology

The island is mainly volcanic in origin and is composed largely of andesitic lava. In the north-east of the island, the ash is sometimes coated with a film of limestone. There are large outcrops of hard and soft limestone in the north-east, and small outcrops of soft limestone in isolated patches around the coast. There are no truly alluvial soils in the island, but the lower slopes of steep ridges are covered by ashy or limestone colluvial material.

#### Climate and land use

As in the case of Grenada, the prevailing winds are from the north-east. Rainfall is very variable and averages about 50" per year. This factor, together with drying winds and shallow soils, result in relatively arid conditions on the island. Traditional land use

/practices have

practices have severely denuded vegetation on the island. There are relics of a deciduous forest which, in the past, supplied timber for boat-building and fire-wood. Today there are large areas of land with no vegetation, permanently exposed to wind, water and sun erosion. Uncultivated land is mainly covered by poor thorny scrub cactus plants. The islanders have traditionally raised animals - cattle, sheep and donkeys - which they ship to Martinique, Grenada and Trinidad. This they continue to do despite severe deterioration of grazing grounds from frequent droughts. Watering dams and ponds are therefore essential for animal management during the dry season, and animal losses are high during periods of low rainfall.

#### THE HUMAN FACTOR

It is against this background of physical and climatic conditions that one has to relate the human factor. All the Eastern Caribbean islands have a marked rainy season in the second half of the year, so that heavy downpours of rain are not unusual. One may therefore be inclined to view the Grenada rainstorm as a normal hazard. But the occurrence has to be viewed against the role of Man in this ecological setting. Like St. Lucia and Dominica, Grenada is one of the more mountainous islands in the eastern chain, but its area of 120 miles is only 51.9 per cent and 39 per cent of that of St. Lucia and of Dominica respectively. Though smallest in size it has the highest population per square mile: 773 persons as compared with 433 in St. Lucia and 331 in Dominica.<sup>4/</sup> The island is very well served with roads, tracks and water, all of which have facilitated widespread distribution of population in valleys and on hillslopes. This has led to pressure on marginal lands for both food and export crop cultivation, accompanied by increasing land fragmentation. The following table based on the 1940 census shows the number of farm holdings in different size groups at that time.

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<sup>4/</sup> 1970 census.

<u>Size of group</u>	<u>Number of holdings</u>
0 - 10 acres	18,510
10 - 50	337
51 - 100	66
101 -1,000	124
1,000	1

Since then, family inheritance practices and land policy have led to further fragmentation. In Carriacou, where human pressure on land is also relatively great, the animal population which is released during the dry or "let-go" season to fend as best it can keeps the land bare and inhibits the growth of vegetation.

/DESCRIPTION OF

### DESCRIPTION OF THE DISASTER

On the night of Sunday, 9 November 1975, torrential rains fell for eight hours - from 2000 hours on 9/11/75 to 0500 hours on 10/11/75. Rainfall data from representative stations show that an average of 3.5 inches fell on the coastal areas, increasing to 5 to 7 inches in the mid-belts and to 10 inches in the mountainous Grand Etang Forest Reserve area. The rainfall was not accompanied by high winds, so that this volume of rain in such a short space of time resulted in an intensity of water supply which the hydrological infrastructure was not designed to accommodate. It is likely that there would have been some adverse effects from this high level of precipitation even if land use practices, road and bridge construction, and anti-erosion measures had in the past been determined by geological, topographical and soil structures of the island. But in the present circumstances, where land use patterns and infrastructural construction sometimes conflict rather than accord with Nature, the result of this rare natural phenomenon was both to initiate destruction and to worsen conditions which were already in a state of deterioration.

- Rivers rose to abnormal levels, destroyed roads and bridges, and swept away livestock, food and economically important tree crops, together with some of the facilities for their marketing.
- New watercourses were carved out as flood waters sought their own levels. In the process, road surfaces were destroyed, landslides occurred on both sides of roadways, foundations of roads and bridges were undermined and economically important crops destroyed.
- The sheer weight and volume of water caused shifts of top-soil on sloping lands and destroyed economically important crops.
- Landslides occurred along main and feeder roads, making them impassable, because of lack of proper soil conservation practices and the absence of necessary retaining walls.

/Damage was



- Damage was done to many dams on the island of Grenada.
- Some dams in Carriacou were destroyed and others damaged, and two-thirds of the ponds in the island were silted up from severe erosion wash.
- Water mains and reservoirs were damaged.
- There was severe loss of soil fertility.

#### Action by the Government

Since the rainstorm occurred at night when people were in their homes, it was the damage done to cultivated areas and along watercourses and roadsides which was the main source of concern, and the Government was not faced with a major problem of relieving human distress, though some people suffered minor injuries and there were isolated cases of hardship which were dealt with at the local level. The main immediate aim of Government activity was to visit the affected areas and assess damage. To this end, officers from all the relevant Ministries recorded the location and incidence of damage. All major roads and many feeder roads were impassable, and road clearance was started immediately. Most roads were cleared before the arrival of the Mission, but the evidence of extensive road damage and soil erosion resulting from the rainstorm was very obvious on the Mission's conducted tour (see accompanying pictures). A Planning Officer in the Prime Minister's Office was designated Co-ordinator and Chairman of a Committee comprising technical officers from the Ministries of Agriculture, Forestry and Fisheries, Communications and Works, Health and Housing, and the Central Water Commission.

The Department of External Affairs informed the following international agencies of the disaster: The United Nations Development Programme, through the Resident Representative in Guyana; The Economic Commission for Latin America, through the Executive Secretary in Santiago, Chile; and the Organization of American States, through the Secretary General in New York. The Government received telegrams of sympathy and offers of assistance from member states of the United Nations and the OAS. The following persons visited the island prior to and during the evaluation Mission:

/Mr. S. Clarke

- |                                       |                                                                                                          |
|---------------------------------------|----------------------------------------------------------------------------------------------------------|
| Mr. S. Clarke                         | - Director of the United Nations<br>Economic Commission for Latin<br>America's Office for the Caribbean. |
| His Excellency<br>Mr. Emmanuel Kolade | - High Commissioner for the Republic<br>of Nigeria, stationed in Port of<br>Spain, Trinidad.             |
| Mr. Yoshue Komamura                   | - Japanese Chargé d'Affaires, stationed<br>in Port of Spain, Trinidad.                                   |
| Mr. Josef Schutzenberger              | - Resident Representative, United<br>Nations Development Programme, Guyana.                              |
| Mr. Henry Laurant                     | - Representative of the Organization<br>of American States, Washington.                                  |
| Mr. Julio Silva                       | - Representative of the Organization<br>of American States, stationed in<br>Santo Domingo.               |
| Mr. David Carter                      | - Representative of the United Nations<br>Disaster Relief Organization, Geneva.                          |

#### Preliminary assessment of damage

Indications of the damage caused by the rainstorm are given below.<sup>5/</sup> They do not represent an exhaustive list but are based on submissions by the relevant Ministries, and were verified in discussions with the Emergency Planning Committee by the Mission and the Executive Officer from the OAS. The total estimated damage is in the region of EC\$ 10,000,000.

#### Agriculture

##### Loss of cropland

Approximately 200 acres of cropland have been destroyed. The crops and acreages affected are as follows:

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<sup>5/</sup> Data and maps showing location and extent of major damage are given in Appendices 2 and 3.

Bananas	50 acres
Cocoa	20 acres
Nutmeg	5 acres
Sugarcane	35 acres (24 acres due to flooding)
Food crops	90 acres
	<u>200 acres</u>

The estimated value of this damage is EC\$ 320,000. The vegetable and food crops lost were: yams, cassava, sweet potato, dasheen, tannias, pigeon peas, cabbages, carrots, lettuce, sweet pepper, beet, tomatoes, shallot and onions. Most of these food crops were at the point of maturity and the farmers will therefore suffer loss of income from their destruction. It is anticipated that there will be food shortages in the island in the coming months to the extent of approximately 450 tons of vegetable protein and carbohydrates.

#### Loss of cocoa crop

It is estimated that there will be a drop of approximately 12.5 per cent in the anticipated annual cocoa crop of 6 million pounds. This is 750,000 lbs. of cocoa, valued at EC\$ 750,000, and the loss was caused by the excessive bud and flower drop due to the heavy downpour.

#### Landslides and soil erosion

It is estimated that roughly 40 acres of landslides have occurred on agricultural holdings, causing loss of cropland and blockage of feeder roads. This has destroyed many drains in cultivated fields and has left many gullies unprotected. A programme of soil conservation is therefore urgently required in order to avoid a recurrence. The estimated value of this damage is EC\$ 140,000.

/Loss of

Loss of soil fertility

By far the greatest effect of the rainstorm on agriculture has been its effect on soil fertility. The heavy rains caused the leaching of most of the soil nutrients which had been applied in the form of artificial fertilizers and farm manures. Plant foliage is already showing signs of deficiencies of some nutrients, particularly nitrogen. It is likely that the effects of nutrient loss will be evident for some time, due to the continuing high level of run-off of water. The usual practice is to apply fertilizer three times a year. This request is for the supply of enough fertilizer for one application, which should be made before the end of the current rainy season. The total estimate of fertilizer requirements for a single application, by crops and acreages, is as follows:

<u>Crops</u>	<u>Acres</u>	<u>Fertilizer required (cwts)</u>
Cocoa	16,000	48,000
Nutmeg	10,000	20,000
Bananas	4,000	24,000
Coconuts	5,000	16,000
Oranges	600	1,800
Grapefruit	400	1,200
Limes	240	720
Root crops	665	1,580
Corn and pigeon peas	3,000	15,000
Vegetable	230	2,000
		<hr/> 130,000 <hr/>

Thus, 6,520 tons of fertilizer are required at EC\$ 600 per ton = EC\$ 3,900,000. To this must be added distribution to farmers at a cost of EC\$ 20.00 per ton = EC\$ 130,000.

Banana boxing plant

The banana boxing plant at Birchgrove was destroyed by river flood waters which swept through the plant washing away and destroying

/installations. The

installations. The replacement of losses together with the cost of building a protective river diversion is estimated at EC\$ 30,000.00.

#### Damage to dams in Carriacou

Watering dams and ponds in Carriacou play an important part in the livestock industry in the island. Of ten dams on the island, four were washed away and three were badly damaged. There are approximately 30 ponds on the island, 20 of which were silted up from erosion wash. The replacement and repair of dams and the desilting of ponds is estimated to cost EC\$ 167,500.

#### Infrastructure

##### Roads and bridges

There was extensive damage to the communications infrastructure throughout the island. The worst hit areas were on the west coast between Gouyave and Duquesne, where both main and feeder roads were blocked by numerous landslides. Extensive damage also occurred in the parishes of St. David's and St. Andrew's, in the latter of which the bridge over the River Antoine had to be closed to traffic. In the St. George area there was heavy flooding in River Road, and the undermining of foundations caused washouts which disrupted traffic at the Temple/Mt. Gay bridge and at the relief culvert north of Green Bridge at Queen's Park. It is estimated that surface repairs will have to be done on 120 miles of road. To date 109 locations have been identified where landslides occurred, while eight bridges were damaged as a direct result of flood waters. As a result of the landslides and flooding, many tons of earth have had to be removed to make roads passable, and river beds need to be cleared and retrained.

The total estimated cost of these repairs resulting from the flood is EC\$ 3,630,000.

##### Water

The rainstorm damaged water installations managed by the Central Water Commission, thereby creating the risk of water contamination.

/Approximately 5,000

Approximately 5,000 feet of access roads to Les Avocat Water Works were damaged. Minor repairs and clearing will have to be done to seven dams which were blocked by soil deposits. Fifteen thousand feet of water mains were damaged and many filters were made unserviceable by landslides. In Carriacou the borehole was flooded and some of the equipment, including the diesel engine, was damaged. The estimated cost of the supply of chemicals and repairs is EC\$ 541,000.

#### Health

The Ministry of Health has advised that drugs and laboratory equipment valued at EC\$ 78,000 are required as an indirect result of the flooding to deal with dietary deficiencies due to loss of food crops and possible intestinal diseases from water contamination.

#### Summary

The economy suffered its greatest setback, both in the short and the long term, in the agricultural sector. In the short term agricultural incomes will suffer from destruction of food crops and from the fall of earnings arising from loss of export produce. As regards the long term, there has been loss of cropland and economically important trees in the agricultural export sector have been destroyed. With the exception of bananas, which produce fruit within twelve months, new plantings need between five and ten years to bear fruit. Quite apart from the immediate loss of production, therefore, there will be additional losses over the coming decade, with consequent repercussions on export earnings.

Agricultural land as a productive resource has lost many of its nutrients. At any point in time soil nutrient levels are the result of many years of interaction of natural agents in the soil and the supplementary contribution made by Man's application of artificial fertilizers and farm manure. These nutrients cannot be replaced in the short run, so that the leaching of soils by the rainstorm will continue to affect agricultural performance for some time despite the application of one-third of the annual fertilizer input.

The damage done to both feeder and main roads will also have effects on the agricultural sector. Some feeder roads have deteriorated further from rain damage and are now practically unusable, thus curtailing the flow of produce from the producing to marketing areas. At the same time the further deterioration of all roads has increased the risk of damage to fruit of commercial value in both regional and extra-regional trade - bananas, avocado pears, soursop, sugar apples. Rejects at intermediate points in the marketing chain are likely to increase in number, with consequent increases in the unit cost to the consumer of those commodities not governed by price agreements which reach the final end of the chain.

By the very nature of the damage which has occurred, the relief and rehabilitation measures which are being recommended, important as they are, cannot re-establish the status quo in the near future. Losses to this sector must therefore be seen against a broader background of development planning for the coming decade.

## RELIEF AND REHABILITATION MEASURES

The Mission, in collaboration with the OAS representative, established three broad categories under which relief and rehabilitation measures can be classified. They are:

Category A: Loss or damage of a social character, including that which poses an immediate or short-term threat to the health and nutritional well-being of the population. Items which fall in this category are classified as relief.

Category B: Loss or damage not predominantly of a social character but which poses a short-term threat to the country's economic base, either productive or infrastructural. This requires urgent rehabilitation.

Category C: Loss or damage as under B, but where the threat posed is of medium-term impact. This requires second-line rehabilitation.

The items placed under these categories are all to be found in the Annexes in Appendix 4. These annexes were compiled by Government officials and discussed in detail by the Mission with members of the Planning Co-ordination Committee. Annex references are given in each of the three categories.

/ CATEGORY A



CATEGORY A

While all the items in this category are urgently required for relief, a priority rating has been given to indicate those which are (a) most urgent and those which are (b) urgent.

Summary of relief measures requested by the Government of Grenada, showing priority rating, annex reference, description and approximate cost of relief measure.

Priority rating	Annex Reference	Description	Approx. cost in EC\$ '000		
			In kind	Cash *	Total
a	I	Food supplies to compensate loss of food crops for local consumption: 450 tons	1 134 1		1 134 1
b	II-a	Repair sea heads and drains to combat mosquito breeding	12.0	6.0	18.0
b	II-b	Supply insecticides to combat mosquito breeding	5.0	-	5.0
a	III-a	Supply drugs and medical supplies to combat health threat	40.0	-	40.0
a	III-b	Supply laboratory equipment for use in combating health threat	38.0	-	38.0
<u>To restore water distribution systems to minimal operations</u>					
b	IV-a	Supply chemicals (3 weeks supply)	26.5	-	26.5
a	V	Supply chemicals (first two weeks supply)	15.5	-	15.5
a	V	Supply iron pipe etc. for most urgent repairs	105.2	-	105.2
a	V	Supply cement for most urgent repairs	1.5	-	1.5
a	V	Supply truck for most urgent repairs	17.0	-	17.0
b	IV-b	Repair access road to Les Avocats Water Works	-	150.0	150.0
b	IV-c	Clear seven (?) blocked dams	-	140.0	140.0

CATEGORY A (Cont'd)

Priority rating	Annex Reference	Description	Approx. cost in EC\$ '000		
			In kind	Cash *	Total
b	IV-e	Repair damaged water filters	-	40.0	40.0
a	IXA-1-a	Initial clearing of blocked roads and restoration of traffic	-	50.0	50.0
a	IXA-1-b	Clean up and restore blocked drainage	-	250.0	250.0
<u>Total estimated cost</u>			<u>1 394.8</u>	<u>636.0</u>	<u>2 030.8</u>

Note: Where necessary, exchange rate used is US\$ 1.00 = EC\$ 2.30.

\* Refers to labour, material and transport costs.  
A 10 per cent contingency allowance is not included.

/CATEGORY B

CATEGORY B.

All the items in this category are classed as short-term rehabilitation measures, the deadline being within three months or as noted in the description.

Summary of short-term rehabilitation measures requested by the Government of Grenada, showing annex reference, description and approximate cost of requested assistance.

Annex reference	Description	Approx. cost in EC\$'000		
		In kind	Cash *	Total
IV-d	Repair 15,000 ft. water mains <u>plus</u> pipes, fittings, etc. for same	- 75.0	45.0 -	45.0 75.0
IV-f	Repair Carriacou borehole and related equipment <u>plus</u> replace diesel engine for same ** (deadline: 15/2/76)	-	-	35.0
VII-B	Fertilizer (6,520 tons NPK 12-8-24) to restore soil fertility lost, equivalent to one application to 42,135 acres (deadline: end of wet season - mid-January)	3 920.0	-	3 920.0
	<u>plus</u> distribution cost to farmers at EC\$2000 per ton	-	130.4	130.4
VIII	Repair and replacement of Carriacou water catchment dams and ponds:			
	Replace four dams washed away	-	20.0	20.0
	Repair three damaged dams	-	7.5	7.5
	Desilt twenty ponds (deadline: one month prior to end of wet season)	-	40.0	40.0
IX-A-2	Repair and reconstruct retaining walls, roads and bridges <u>plus</u> 600 tons cement at EC\$5.00 per 100 lb. bag	- 60.0	260.0 -	260.0 60.0
IX-A-3	River bed clearing and retraining	-	20.0	20.0
IX-A-4-a	Underpinning foundations weakened on secondary roads	-	7.0	7.0

CATEGORY B (Cont'd)

Annex reference	Description	Approx. cost in EC\$'000		
		In kind	Cash *	Total
IX-A-5	Road repairs (most urgent: Concord Road surface) plus 20,409 imp. gals. bitumen RS-2 or RC-2 at EC\$1.75 per gallon	- 35.8	114.2 -	114.2 35.8
IXB-1	Road engineer ***			
IXB-2	Two technicians ***			
IXB-3	Two supervisors ***			
IXC	Five (5) four wheel drive vehicles at approx. EC\$15 000 each	75.0	-	75.0
X	Six (6) Toyota Land Rovers at EC\$15 000 each	90.0	-	90.0
	<u>Total estimated cost</u>	<u>4 290.8</u>	<u>644.1</u>	<u>4 934.9</u>

\* As in Category A.

\*\* No provision made for cost of diesel engine.

\*\*\* No provision made for cost.

/CATEGORY C

CATEGORY C

All the items in this category are classed as medium-term rehabilitation measures requiring action within three to six months from now.

Summary of medium-term rehabilitation measures requested by the Government of Grenada, showing Annex reference, description and approximate cost of requested assistance

Annex reference	Description	Approx. cost in EC\$'000		
		In kind	Cash &	Total
IX-2	Repair and reconstruction of retaining walls, roads and bridges	-	390.0	390.0
	<u>plus</u> 900 tons cement at EC\$5.00 per 100 lb. bag	90.0	-	90.0
IX-3	River bed clearing and retraining	-	100.0	100.0
IX-4A	Underpinning weakened foundations of secondary roads	-	73.0	73.0
IXA-4-b	Replacement of River Antoine bridge	-	90.0	90.0
	<u>plus</u> 150 tons cement at EC\$5.00 per 100 lb. bag	15.0	-	15.0
	<u>and</u> 15 tons steel reinforcing rods in assorted sizes.			
	Approx. cost	15.0	-	15.0
IX-5	Road repairs (surface)		1 255.8	1 255.8
	<u>plus</u> 224 591 imp. gals. bitumen RS-2 or RC-2 at EC\$1.75 per gallon	394.2	-	394.2
IX-6	Road diversion at La Sagesse (including river wall)	-	73.3	73.3
	<u>plus</u> 3 808 imp. gals. bitumen RS-2 or RC-2 at EC\$1.75 per gallon	6.7	-	6.7
VI	Seeds to enable farmers to replace lost crops	5.3	-	5.3
VII-A	Landslides and soil erosion	-	140.0	140.0
VII-C	Repairs to retaining wall and banana boxing plant	-	30.0	30.0

CATEGORY C (Cont'd)

Annex reference	Description	<u>Approx. cost in EC\$'000</u>		
		In kind	Cash *	Total
VIII-C	Mechanical equipment for clearing and maintaining dams and ponds in Carriacou	100.0	-	100.0
VII-D	Soil conservation expert	n.a.	-	-
	<u>Total estimated cost</u>	<u>626.2</u>	<u>2 152.1</u>	<u>2 778.3</u>

\* As in Category A.

Summary of expenditure  
for relief and rehabilitation measures  
in Grenada and Carriacou  
necessitated by the rainstorm of 9 November 1975

Category	<u>Approximate cost in EC\$'000</u>		
	In kind	Cash	Total
A	1 394.8	636.0	2 030.8
B	4 290.8	644.1	4 934.9
C	626.2	2 152.1	2 778.3
	<u>Total</u>	<u>3 432.2</u>	<u>9 744.0</u>

Taking into consideration the relief and rehabilitation measures required, the Mission made a preliminary assessment of the capacity of the public sector to cope with this programme within the proposed time span. The main requirements for successful performance are examined hereunder by type of activity.

/Food distribution

#### Food distribution

It is estimated that, as a result of the rainstorm, domestic food shortages in Grenada in the coming months will be equivalent to 450 tons of vegetable protein and carbohydrates. The Government has requested supplies to meet this shortage (see Annex 1).

Most of the food will be required for children of 3 years and under, and between 5 and 15 years. For the first group, distribution will be through the Public Health Clinics, while for the second it will be through a primary school feeding programme. The Government has operated this type of programme in the past. Distribution to persons at the top end of the age spectrum who receive relief regularly will be through the Ministry of Social Affairs. Milk and protein supplies are mainly for children in the 3 years and under category.

#### Combating mosquito breeding and repairing floors and anti-mosquito drains

As a result of the damage done to concrete floors and sea heads of drains, stagnant water has accumulated, thus providing breeding grounds for mosquitos. In addition there are low-lying lands which were flooded and are now mosquito breeding grounds.

Labour is easily available for carrying out repairs and for spraying mosquito breeding grounds. The Ministry of Health has the storage facilities to house the insecticides.

#### Safeguards against disease, dietary deficiencies and water contamination

The preventative measures which the Ministry of Health has advised should be taken against disease and dietary deficiencies can quite adequately be carried out by the medical services.

#### Restoration of water systems

Some of the clearance work required is already in progress. The Central Water Commission has storage facilities for the chemicals and construction material required. It also has personnel with the required technical skills. Unskilled labour is easily available.

/Transport of

Transport of supplies within the island will present no problem if the vehicle requested is supplied promptly.

#### Restoration of soil fertility

The delivery of 6,500 tons of fertilizer will have to be staggered and distribution and application must be properly planned to avoid bottlenecks and ensure completion of the operation before the end of the rainy season. The Mission is of the opinion that the technical staff in the Ministry of Agriculture can cope with these requirements.

#### Repair of dams and ponds in Carriacou

The Ministry of Agriculture can find the labour to do the necessary repairs and construction, but in this exercise it is fighting against time, since desilting of the ponds should be done as quickly as possible to collect water from rain during the remainder of this rainy season. The Ministry has requested that a versatile piece of equipment, like a front loader with a back-hoe should be provided both for immediate and for future use. It is estimated that this piece of equipment will cost about EC\$ 100,000.

#### Repair of Carriacou borehole

This will require the provision of a diesel engine, the specifications of which are given in Annex IX(f). All skills required for the restoration of the water supply are available. The cost of the diesel engine is not known and has been excluded from the items in Category B.

#### Seed distribution programme

The Ministry of Agriculture has the machinery for handling distribution efficiently.

#### Repair of roads, bridges and watercourses

This is the biggest rehabilitation exercise. Road clearance and the restoration of drainage began on the morning after the rainstorm and has continued ever since. But a programme of rehabilitation of roads and bridges will put strains on the present technical and

/supervisory manpower



supervisory manpower in the Ministry, and additional personnel will be required, the details of which are given in Annex IX B. If the rehabilitation programme is seen as the first phase in a national reconstruction road programme which the Mission recommends, then the levels and range of technical assistance and aid required will have to be greater.

Conservation to arrest landslides and soil erosion

The Ministry of Agriculture is equipped to undertake the necessary rehabilitation measures, but this exercise should be seen as part of a long-term adult education programme, with the aid of all available media, to re-create conservation consciousness in the total island population, and particularly in farming communities. The Government will require technical assistance for a soil conservation programme.

Repairs to boxing plant and adjoining retaining wall

Skills and labour for doing these repairs are readily available. This programme of relief and rehabilitation calls for the supply of EC\$6 million worth of food and drugs, medical supplies, agricultural seed insecticides, fertilizers, vehicles and building material by the middle of next year. If the Mission's recommendations with respect to a comprehensive road programme are accepted, then the planned delivery of approximately EC\$0.5 million worth of material for road construction may be altered radically, as also may the delivery schedule. The Mission has examined the capacity of the port to handle the heavy tonnage. Grenada has very good port facilities, and all things being equal, deliveries can be handled with speed and efficiency. There should, however, be some co-ordination of activity between the donor agencies, and deliveries should be staggered to avoid port congestion. This applies particularly to the delivery of such bulky stuff as cement and fertilizers.

## IMPACT ON THE ECONOMY

### National accounts

Estimates of the national accounts of Grenada during the period 1971-1974 indicate that in real terms gross domestic expenditure was at the same level in 1971 and 1972, but showed a decline of 9.7 per cent in 1973 and a further decline of 15.1 per cent in 1974. The contraction of the economy in the second half of the period was due in part to external factors, such as the downturn in the world economy which possibly affected the tourist trade, but on the other hand there were financial constraints which constricted the Government sector and there was also a decline in investments in the private sector. Present indications are that the economy began to pick up during the current year, and mid-year estimates of a 6.8 per cent increase in real gross domestic expenditure in 1975 were realistic. The up-turn was premised on increased earnings from exports and the tourist industry.

### Agricultural exports

There are fundamental weaknesses in an economy which relies on agricultural exports for over 90 per cent of its foreign exchange earnings and is competing with the rest of the world for the tourist dollar. The structural weakness in the island's economy is illustrated in table 1, which shows volume and value of the four main agricultural exports at current prices.

/Table 1

Table 1

VOLUME AND VALUE OF MAJOR EXPORTS OF GRENADA, 1971-1974

Commodity	Volume: lbs (millions)			
	Value: EC\$ (millions)			
Commodity	1971	1972	1973	1974
Bananas				
Volume	31.5	28.0	24.6	19.6
Value	1.6	1.6	2.7	3.4
Unit value (cts)	0.05	0.06	0.11 <sup>a/</sup>	0.17
Cocoa				
Volume	6.1	5.8	5.1	5.6
Value	3.5	3.3	3.5	5.6
Unit value (cts)	0.57	0.69	1.01	1.35
Mace				
Volume	0.6	0.7	0.6	0.3
Value	0.8	0.8	1.6	1.5
Unit value (cts)	1.33	1.16	2.93	4.78
Nutmeg				
Volume	4.0	4.1	3.3	2.4
Value	3.3	3.2	4.9	5.9
Unit value (cts)	0.83	0.78	1.49	2.49

Sources: Original data from Banana Co-operative Society, Grenada Cocoa Association, and Grenada Co-operative Nutmeg Association.

<sup>a/</sup> From May 1973 cost of packing is included. This was formerly borne by importer.

There were mild fluctuations in the volume of exports of cocoa, mace and nutmeg, but the trend is downward in each commodity. That this was accompanied by increased earnings was due to rising commodity prices in world markets throughout the period. Despite these increasing

/prices, Grenada

prices, Grenada was unable to increase on its 1971 volume of exports. It is important to note that because of its minor contribution to world production of bananas and cocoa Grenada is a price taker. In the cases of nutmeg and mace the rise in unit prices may in part be attributable to the fall in production, since Grenada is the second largest producer of these commodities in the world, but these two crops contributed 44.1 per cent, 40.4 per cent, 47.8 per cent and 43.5 per cent of earnings from domestic exports between 1971-1974, while cocoa and bananas contributed 54.8 per cent, 49.5 per cent, 45.5 per cent and 52.9 per cent. The strength of the island's economy therefore depends on the extent to which the agricultural sector can be organized to maintain a high level of exports of bananas and cocoa under present world conditions. If, for example, banana exports in 1974 had remained at the level reached in 1971, earnings in 1974 would have been EC\$5.3 million instead of EC\$3.4 million.

Optimistic mid-1975 estimates of banana exports had projected a volume increase of 65 per cent over 1974 exports, thereby forecasting a level of exports in excess of 1971. It was estimated that there would be a fall of 5 per cent in the volume of cocoa exports, thus projecting a continuation of the trend since 1971. In the light of the recent disaster, export earnings from these two crops will be lower than was anticipated.<sup>6/</sup> The implications for the rest of the decade and beyond are serious, for the agricultural sector has first to recover from loss of soil, crop and fertility, and secondly to reverse the output trend of its two major agricultural commodities.

Assuming no further major natural disasters for another decade or so, there will be time to recover from the losses of tree crop production. But this will require a massive programme of land use control and the enforcement of soil conservation practices. It will also require a re-examination of the country's land reform policies to ensure that national interests take precedence over private, and that individuals who are entrusted with the scarce natural resource of land

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<sup>6/</sup> See Appendix 5, Agricultural Supplement.

are conscious of their duty to put it to optimum use and preserve it for future generations. In short, the resuscitation and expansion of the agricultural industry calls for planning to achieve well-thought-out national goals.

#### Domestic food production

With respect to food production for local consumption, the island showed a high capacity for flexibility when short-term food production expanded in 1974 to meet shortages in imported food supplies. Losses of food crops through soil erosion and flooding have been heavy, and since the damage has occurred towards the end of the rainy season new plantings cannot be made until the approach of the next rainy season. But if the agricultural rehabilitation programme is carried out during the next six months, short-term agricultural production will recover next year.

#### Relief and rehabilitation payments

The recommended cash payments of an additional EC\$ 3.4 million for labour and local material are likely to have some inflationary effect on the economy. It is estimated that in 1974 as a whole the prices of imported foods increased by over 50 per cent due to interruption of foreign supplies, though they showed a decline in the first half of 1975. It is probable therefore that some increase in food prices may occur in the short and medium term due to local food destruction, despite the provision of overseas relief food supplies. There may also be some increase in the retail prices of non-food items. Since most of these items are imported, it is likely that this inflow of funds, which would be equivalent to 14.5 per cent of estimated recurrent expenditure for 1975, would not only stimulate the internal economy, but also yield some slight advantages to other regional economies.

#### Tourism

This industry plays a minor role in the economy as a whole, but its contribution to urban employment, though marginal, is important.

The indications are that the industry is getting out of its 1972-1974 recession, and this trend, hopefully, will continue if the North American economic recovery gathers speed. Nothing has happened to date to indicate that this sector will be adversely affected in any way by the rainstorm disaster, but the precautionary measures advised by the Ministry of Health should be acted upon immediately so as to nullify risks of contamination of the water system. In the very short run the economy may not reap full benefits from the tourist industry because of the destruction of food crops, but this is only a short-term disadvantage, and all things being equal, tourism should grow over the rest of the decade and beyond.

#### Central Government financing

Since 1970 the Central Government has had to keep a stringent watch on its financial affairs. It has run a deficit on its current as well as on its overall operations. In the period 1971 to 1973 revenues were on the average 28.5 per cent of the GNP. In 1974 they fell to 18.5 per cent. In absolute terms revenues were fairly constant from 1971 to 1973, but fell by 23 per cent in 1974. Expenditure, while showing mild fluctuations in the first three years, dipped significantly in 1974. As a result, the Government's overall deficit, which was equal to 4 per cent of GNP on average between 1971 and 1973, increased to 8 per cent in 1974. In its 1975 estimates the Government budgeted for a 26 per cent increase in revenue over 1974 - from EC\$14 million to EC\$17.6 million - and a 30 per cent increase in total expenditure (capital and recurrent) - from EC\$24 million to EC\$31 million. Revenue and expenditure at these levels will result in an overall deficit of EC\$7.5 million, which is equivalent to approximately 8 per cent of the GNP. The rainstorm has necessitated expenditure in areas which were not envisaged when the budget was prepared, and it is therefore likely that the deficit will be greater than that budgeted for unless there are cutbacks in other areas.

### Expenditure on the economic infrastructure

With stagnant or falling revenues in an era of rising prices, the Government has had to keep shifting its priorities in expenditure so as to keep its day-to-day operations afloat. Estimates of current expenditure on "Maintenance of Roads" fell from EC\$0.7 million in 1971 to EC\$0.5 million in 1974 and 1975. "Grants, subsidies and contributions" to the Central Water Commission were EC\$0.25 million in 1971 and rose to EC\$0.3 million in 1972, but there was no provision under this heading in 1975.

Estimates of capital expenditure through the Central Road Authority rose from EC\$1.0 million in 1971 to EC\$1.7 million in 1975. "Road construction" or "Reinstatement" accounted for 50 per cent of this expenditure in 1971, 39 per cent in 1972 and 38 per cent in 1975. Expenditure on replacement of bridges rose from EC\$90,000 in 1971 to EC\$0.5 million in 1972 and EC\$0.6 million in 1975. The Central Water Commission estimates of capital expenditure rose from EC\$1.5 million in 1971 to EC\$1.8 million in 1972 and further to EC\$3.8 million in 1975. All capital expenditures by these two Commissions were made from loans with the exception of EC\$10,000 from local revenue.

### Roads and bridges

Although the Government had been spending money on maintenance prior to the disaster, the roads and bridges are, from the point of view of construction, so inadequate for the country's needs that this expenditure did nothing to improve fundamental structural weaknesses. In travelling through the country the Mission was able to identify damage to road surfaces and bridges which was a direct result of the flood, but most roads and some bridges which were not affected were in very poor condition. The natural disaster has therefore exacerbated a previously had condition. The implications for an almost stagnant economy which is predominantly agricultural are far from encouraging. These poor-quality roads have to be used by vehicles to move farm inputs and produce to and from ports and internal markets. The depreciation rate of these vehicles is very high, and so too are the

losses to agricultural produce.<sup>2/</sup> Furthermore, the damage to the road system which was evidently caused by the flood waters is likely to be only part of the total damage. By the nature of the catastrophe, subsequent normal rain showers may cause more landslides and boulder movement because of geological erosions which occurred during the rainstorm and have not yet made themselves evident.

While therefore, on the face of things, it might appear that repairs to road damage will reinstate infrastructural communications to the previous level, and that this would be satisfactory for economic recovery, it may well be that a massive injection of capital to give the country a proper road system would in itself be the best way to create the conditions for long-term economic recovery, and may also be a more economic approach to the problem in terms of long-term cost/benefit analysis.

#### Water supply

Much of what has been said about the need for an in-depth comprehensive approach to road development can be repeated with respect to water. In fact the two programmes are complementary for the creation of an infrastructural base which can stand up to climatic conditions and lay the basis for long-term economic growth. Water control measures which will reduce the incidence of flash floods are essential. River courses need to be dredged and properly maintained as a conservation measure and also to lessen the risk of disasters such as the recent one. In the Government's 1975 Budget provision was made for the expenditure of EC\$3.8 million as part of a long-term water development programme, financed by a C.D.B. loan and Canadian aid. The whole programme, estimated to cost EC\$6 million, is to provide water supplies for five towns. It may be advisable, from a development point of view, to weight this expenditure against the obvious need for better water control measures. The net socio-economic returns to the country might prove to be greater in the latter case.

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<sup>2/</sup> See Appendix 5, Agricultural Supplement.



The economic development programme

The rainstorm disaster has necessitated a re-examination of existing priorities in the Government's Development Programme. While there is damage in the agricultural sector which calls for immediate rehabilitation measures, concentrated effort on agricultural expansion at this stage would be, as it were, building a house on sand. Highest priority in the immediate future, from the point of view of creating a sound base for the economy, should be given to road, water and irrigation infrastructural developments. In the Government's project priority listing, provision is made for feeder roads in Number One priority "Agriculture", but a "Roads Reconstruction Programme" is rated as Number Three Item.<sup>x/</sup> The Mission is of the opinion that road construction (main and feeder) should be regarded as Number One Priority. The Mission had an opportunity to study the "Report on a Feasibility Study for the Improvement and Reconstruction of Roads and Bridges" in Grenada, which was commissioned by the British Overseas Development Administration in 1972. This report substantiates much of what has been said in this evaluation on the condition of the roads before the rainstorm, and puts forward concrete proposals for improving the island's communications infrastructure. Its recommendations have not yet been implemented. A re-examination of its proposals may prove to be a suitable starting point if the Mission's view that a programme of road reconstruction is a more economic investment than one of road rehabilitation is accepted.

It is appreciated that this re-ordering of the nation's priorities will necessitate giving increased weight to infrastructural technical assistance, but this shift in emphasis is very important if the agricultural experts are to make their maximum contribution to economic expansion. What is required is not a reduction in agricultural experts but a significant increase in infrastructural experts.

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<sup>x/</sup> See "Proposals for external assistance presented by the Government of Grenada".

In the re-ordering of priorities agriculture should come next on the list, but here the operation has to be at two levels. In the first place immediate steps should be taken to rehabilitate the soil, to repair as much of the erosion damage to cropland as possible, and to resuscitate food crop production. But at the second remove, it is possible that a re-thinking of the whole agricultural programme which was presented by the Government in October 1975 will yield attractive dividends. The Mission thinks that land use pattern should be rationalized before determining crop promotion. For example, "Banana rehabilitation" is a justifiable and commendable agricultural priority of great economic importance to the country's future, but it should not be undertaken without a clear demarcation of the areas where such cultivation will be permitted. This type of approach to the resuscitation of the sugarcane industry is also highly recommended. Again, soil conservation and reafforestation policies should be laid down prior to, or at least in conjunction with a crop cultivation programme. This is of prime importance in the light of projected plans for livestock development and crop diversification. Tree crop cultivation - cocoa, nutmeg - must for ecological and economic reasons remain the country's main source of foreign currency, and therefore an adequate balance has to be struck between this and other types of cultivation. Agriculture is thus another sector in which existing priorities need to be re-examined.

In summary, what is really required is a comprehensive development planning exercise embracing the physical, economic and social perspectives of the country, out of which specific projects can be chosen for external assistance. Any such exercise will, however, endorse the view already expressed: namely, that the economic infrastructure should be a number one priority. Action in this field need not therefore be conditional on the preparation of a national plan.

/CONCLUSIONS

## CONCLUSIONS

The rainstorm disaster which struck Grenada and Carriacou has been evaluated against a background of the natural characteristics of these islands and the extent to which Man, in fashioning his environment, has given weight to these characteristics. Soil erosion in Carriacou is much worse than in Grenada because at least in the latter island the extensive development of economic tree crops on hills and hillslopes has protected the soil from water, sun and wind erosion, while in Carriacou the economic activity of boat-building has led to the removal of forest cover and exposure to the elements, and animal rearing has compounded an already bad erosive situation.

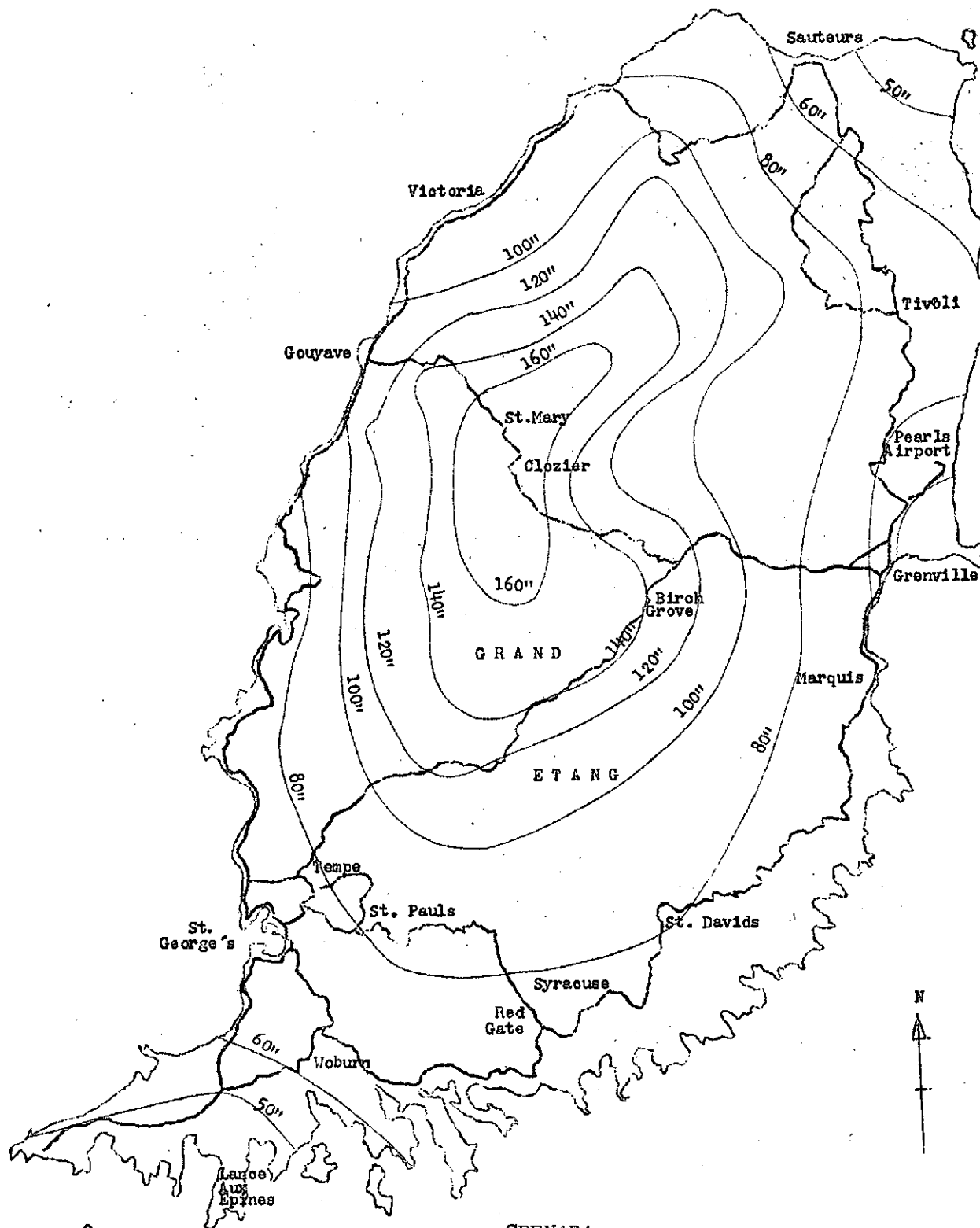
In both islands the damage done by the rainstorm would have been much less if there had been a tradition of proper conservation practices and an infrastructural framework conditioned by the islands' natural phenomena. This realisation has made the Mission look beyond the immediate events which caused the catastrophe, because relief and rehabilitation, while of immediate value, will do little to prevent further deterioration of the agricultural potential of the islands and to lessen the impact of the type of natural disaster to which the area is prone. Again, since the economies of both islands are agricultural, net national yields from agricultural investment will depend largely on the strength of the infrastructural base which supports such investment. At present this is weak, and attempts at patching rather than reconstructing will, in the long run, be more costly. The Government's financial position is such that it cannot undertake either the former or the latter and it therefore has to depend on international assistance which must be seen not as an end in itself but as a means by which the nation stimulates its economic expansion through a planned programme of development. Such a programme must give such great weight to land use and conservation practices that the Mission recommends the establishment of a specific Department of Government with continuing

responsibility for the subject of Environment, for the long-term viability of the economy depends not on production as such, but on preservation and judicious use of the country's natural resources.

The Mission has stressed the importance of a comprehensive approach to development - physical and socio-economic planning and programming. It has also outlined in detail the type of relief and rehabilitation measures which should be undertaken, and judging from the ready response of international organizations and individual Governments to the country's appeal for assistance, it is expected that there will be no lack of donors. The mobilization of external assistance, both financial and in kind, will however require special machinery to co-ordinate activities so that deliveries of goods will be managed expeditiously and financial assistance will be channelled to and absorbed in the relevant areas. It is expected that the Government will decide on the machinery which will best meet these requirements. This it may wish to do in consultation with the Caribbean Development Bank, which may wish to consider creating a "Grenada Relief Fund" to which donors may make their contributions.

APPENDIX 1

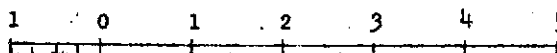




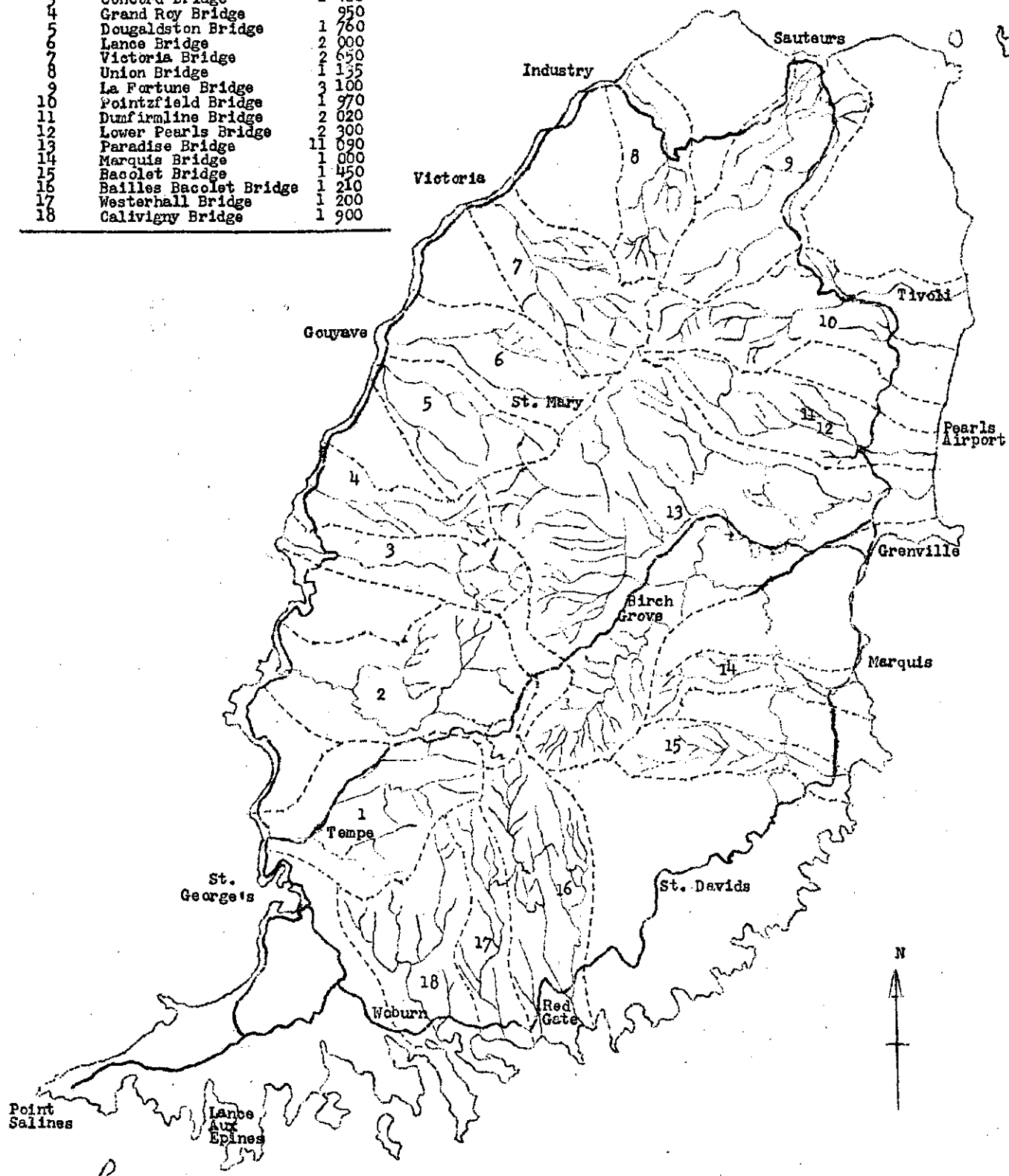
GRENADA

Annual rainfall distribution

Map 1



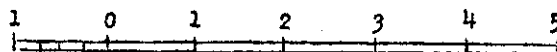
Catchment area No	Name of Bridge	Catchment area acres
1	Queens Park Bridge	3 025
2	Beausejour Bridge	3 565
3	Concord Bridge	1 400
4	Grand Roy Bridge	950
5	Dougaldston Bridge	1 760
6	Lance Bridge	2 000
7	Victoria Bridge	2 650
8	Union Bridge	1 135
9	La Fortune Bridge	3 100
10	Pointzfield Bridge	1 970
11	Dunfirmline Bridge	2 020
12	Lower Pearls Bridge	2 300
13	Paradise Bridge	11 090
14	Marquis Bridge	1 000
15	Bacolet Bridge	1 450
16	Bailles Bacolet Bridge	1 210
17	Westerhall Bridge	1 200
18	Calivigny Bridge	1 900



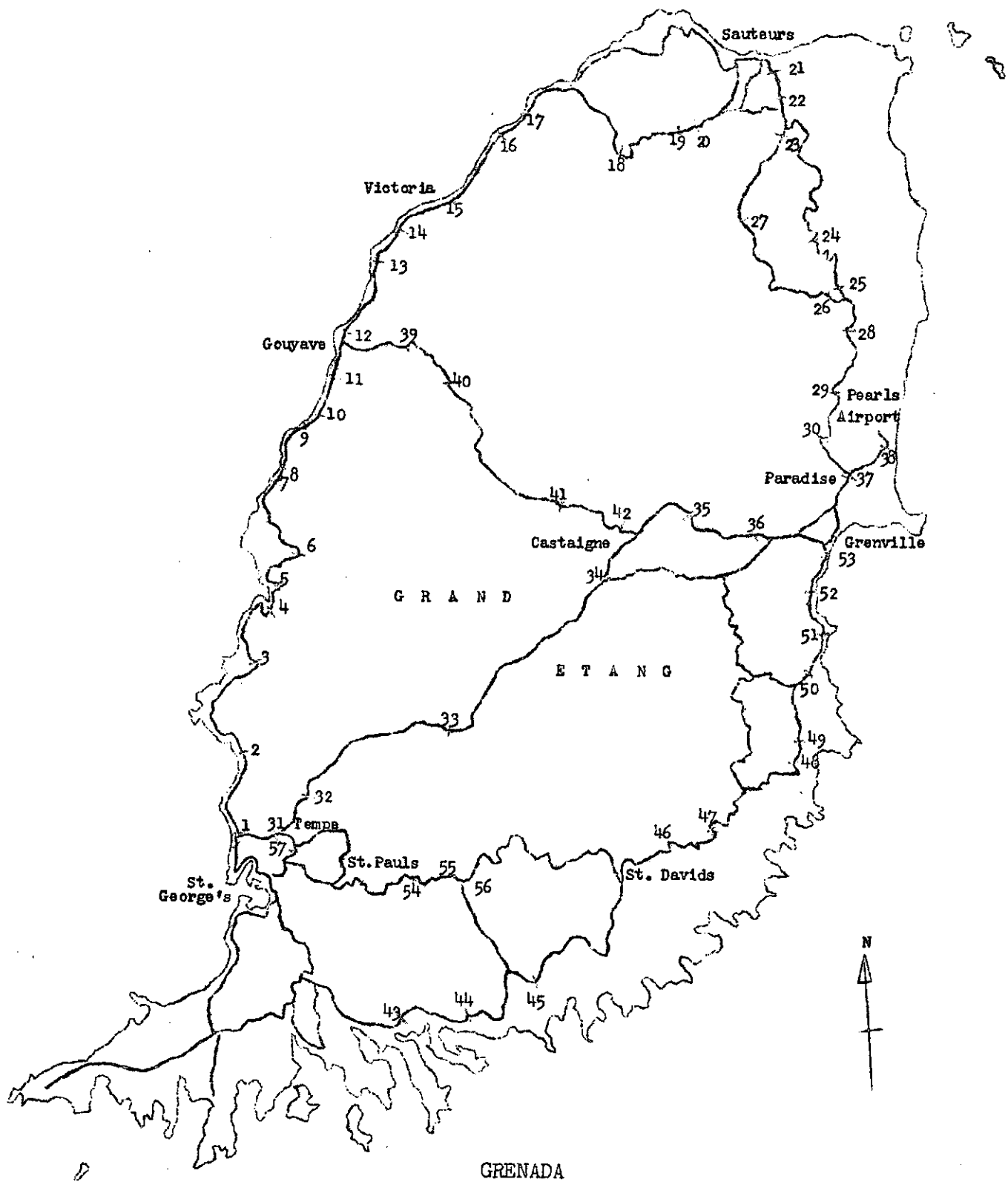
GRENADA

Major drainage areas

Map 2

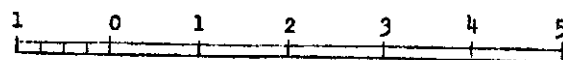






Bridge Locations

Map 3

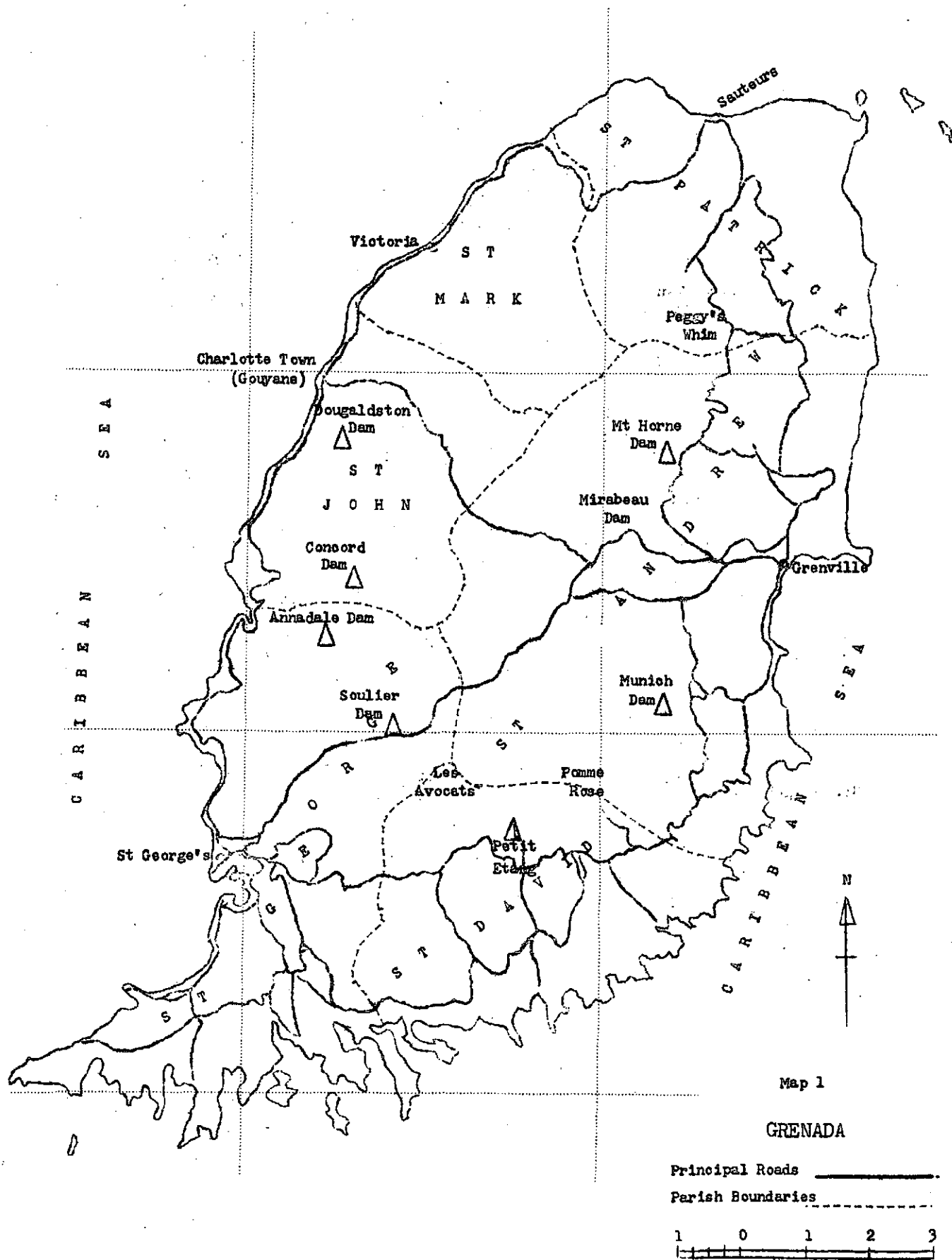




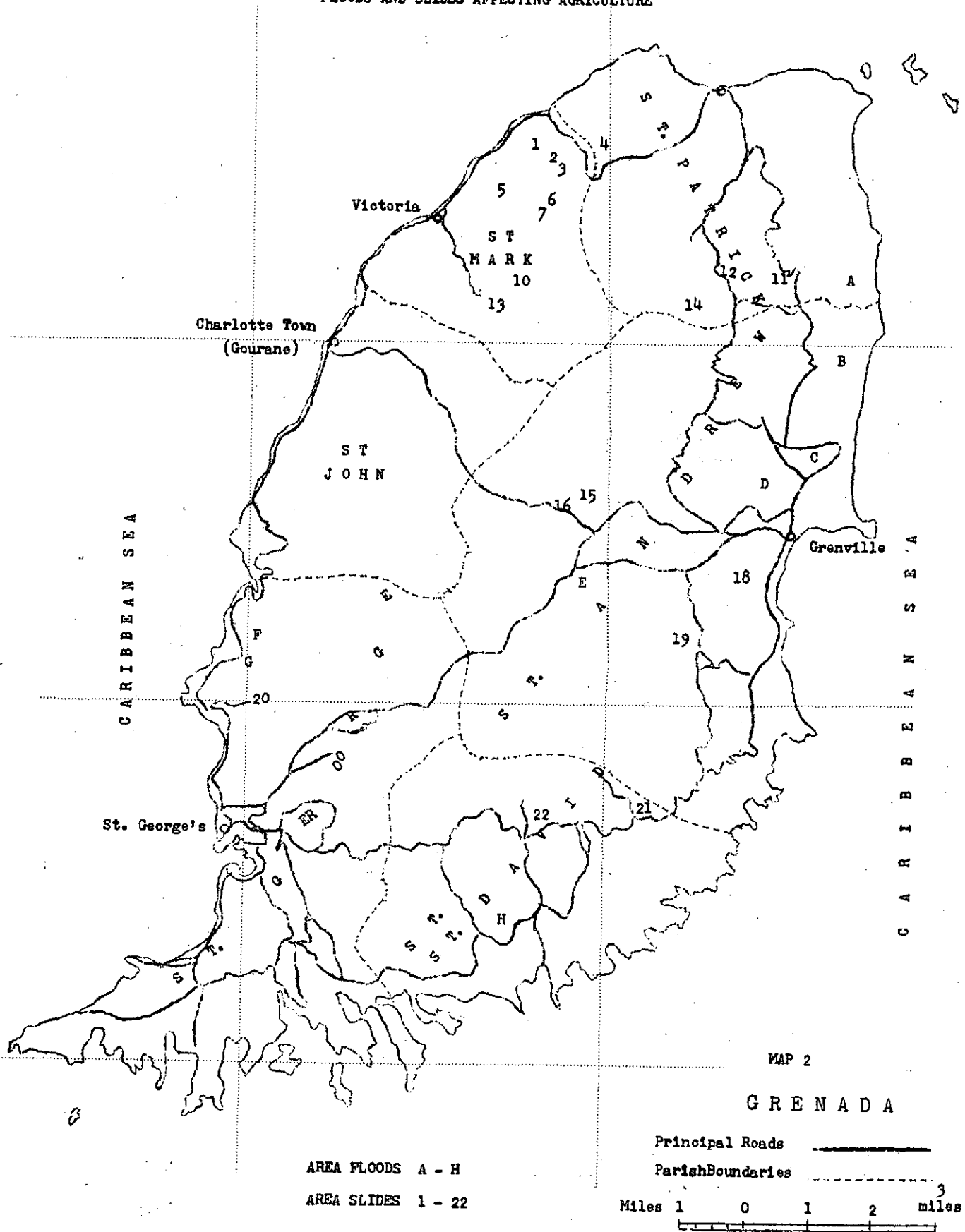
APPENDIX 2



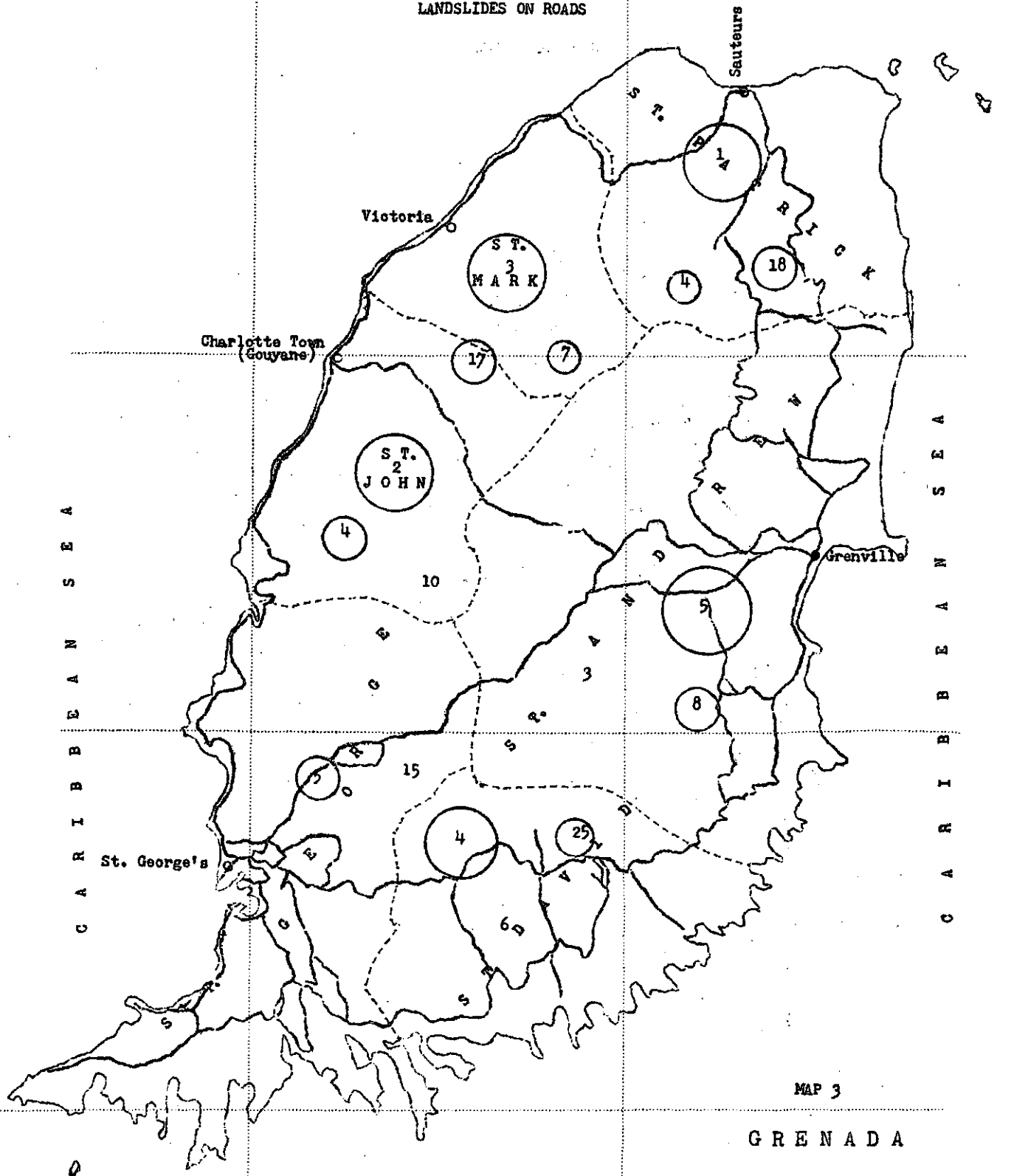
DAMS DAMAGED BY RAINSTORM






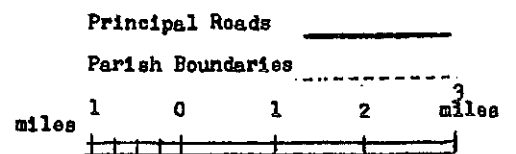
FLOODS AND SLIDES AFFECTING AGRICULTURE



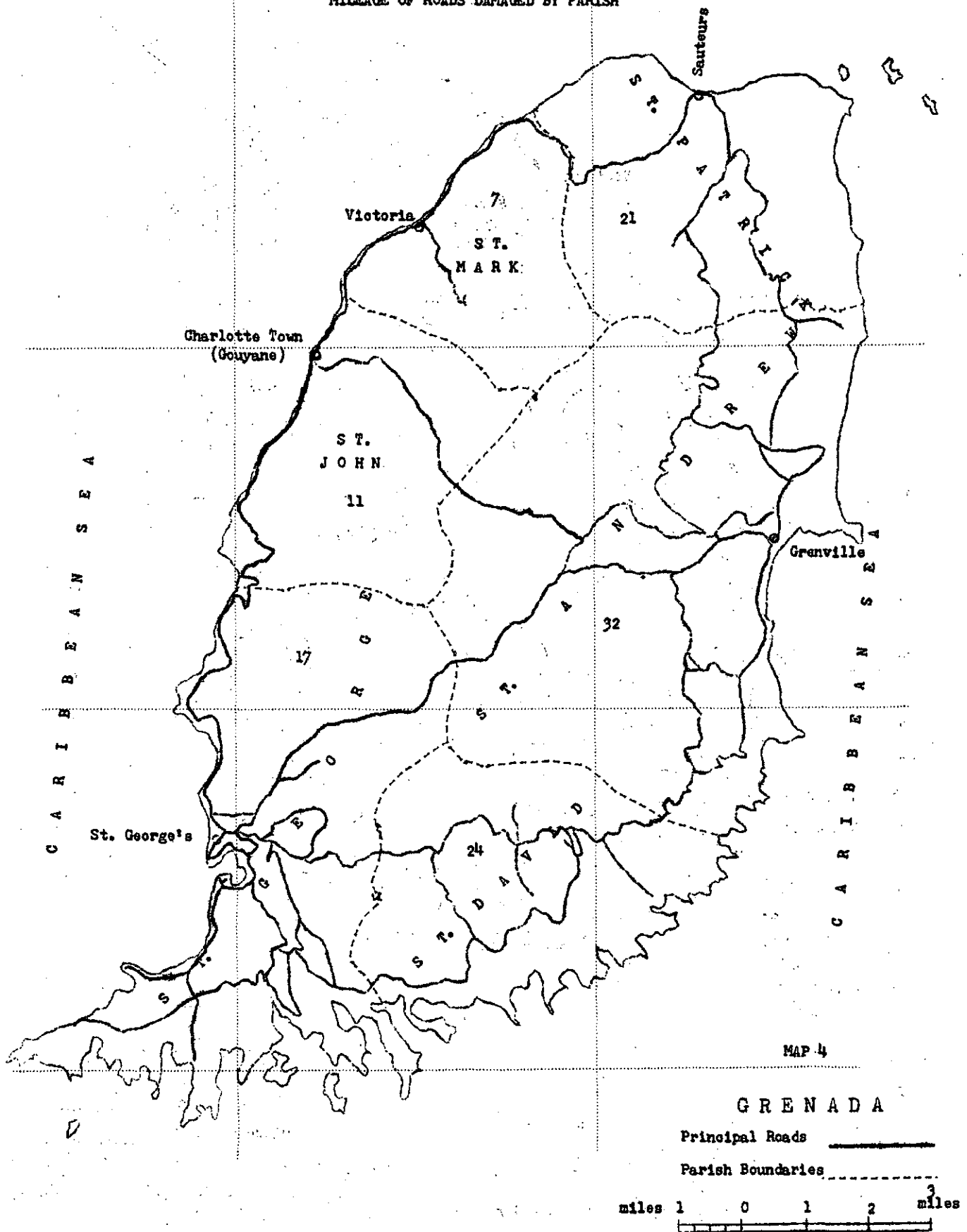
LANDSLIDES ON ROADS



-  Large slide
-  Small slide
-  Retaining wall & land slide



MILEAGE OF ROADS DAMAGED BY PARISH





APPENDIX 3



Annex 1

Flooded areas and locations and acreages of slides  
affecting agricultural land

<u>Flooded areas</u>	<u>Landslide areas</u>	<u>Approximate acreage</u>
A. River Antoine	1. Industry	1 1/2 acres
B. Conference	2. Duquesne	1/2 acre
C. Simon	3. Union	1 acre
D. Paradise	4. Chantimelle	2 acres
E. Birchgrove	5. Walthom	2 acres
F. Beausejour	6. Diego Piece	2 1/2 acres
G. Grenville Vale	7. Red Mud	3 acres
H. Bailles Bacolet	8. Malagon	6 acres
	9. Maman Hill	1 acre
	10. Belair Passee	2 1/2 acres
	11. Zulu Mt.	2 acres
	12. Walthom	1 acre
	13. Tuftan Hall	1/2 acre
	14. Barrack Mt.	2 acres
	15. Windsor	1 1/2 acres
	16. Chantilly	1 1/2 acres
	17. Balthazar	1 1/2 acres
	18. Union Village	2 acres
	19. Hermitage	1 acre
	20. Mt. Mortiz	2 acres
	21. Pomme Rose	2 acres
	22. Vincennes	1 acre
	<u>Total</u>	<u>40 acres</u>

Annex II

Location and mileage of roads which suffered significant  
damage from rainstorm, by parish \*

(mileage in brackets)

First class roads

St. George's

St. George's (2)  
Grand Etang (2)  
Annandale (1/2)  
Tempe-Radix (1/2)  
Richmond Hill-Calivigny (1 1/2)  
Morne Delice-Westerhall (1/2)  
Morne Delice-Hope Vale (1/2)  
Springs-Calivigny (1 1/2)  
Woburn (1)  
Point Saline (2)

Second class roads

St. George's

Snug-Corner-Mt. Parnassus (1/4)  
Bellevue (1/2)  
Mardigras (1/4)  
Westerhall (1/2)

Total mileage in St. George's: 17 miles

First class roads

St. David's

St. David's (3)  
Calivigny-Baillies Bacolet (1)  
Windsor Forest (1 1/4)  
Syracuse (1/2)

Third class roads

St. George's

Sans Souci (1/4)  
Mr. Gay (1/2)  
Donacord (1)  
Clifton ) (1/2)  
Mt. Airy)  
Hope Vale-Westerhall (1/2)

Fourth class roads

St. George's

Welcome (1/2)  
Fontency-Bellevue (1/4)

Second class roads

St. David's

Thebaide-Bellevue (1/4)  
Crochu-Windsor Forest (1)  
Petit Etang (1 1/2)  
Morne Delice-Westerhall (1)

\* Totals are rounded

Third class roads

St. David's

La Pastora (1)  
Requin (1/2)  
Providence-Corinth (1/2)  
Lower Halliday's Hill (1/2)  
Beaton Place (1/4)  
Epping Forest-Charlotte Vale (1/2)  
Marlemount (1/2)  
Stewarts Cottage (1/4)  
John Dick Hill (1/4)  
Chamfleur (1/2)  
Mt. William (1)  
Morne Cocoa (1/2)  
Upper La Tante (1/4)  
Lower La Tante (1)  
Terre Canne-Mt. Jouel (1/4)  
Mt. Agnes (1/4)  
La Fortune (1/4)

Total mileage in St. David's: 24 miles

First class roads

St. Andrew's

St. Andrew's (3)  
Grenville (2)  
Cementery (1/2)  
Belmont-Tivoli (1/4)  
Noel's Hill (2)  
St. Cloud (1/2)  
Mr. Carmel (1/2)  
L'Esterre (1/2)  
Pyrennes (1/2)  
St. Cyr-Mirabeau (1)  
Richmond-Grand Bacolet (2)

Second class roads

St. David's

Pomona-Crochu (1/2)  
Laura (1/2)  
Windsor Castle (1/4)  
Minorca-Mirabeau (1)  
Fourth class roads  
St. David's  
New Providence (1/4)  
Megrin Harbour (1/4)  
Harmony Hall (1/4)  
Rose Vale (1/2)  
Rose Hill (1/4)  
La Bou (1/4)  
Woodlands (1/2)  
Mt. Pleasant (1/4)  
Bellevue-Hythe (1/4)  
Crochu (1/2)  
Alepson (1/4)

Second class roads

St. Andrew's

Poterie (1)  
River Antoine (1)  
La Filette-Boulogne (1/2)  
Castigne-Belvidere (1)  
Windsor-La Force (1/2)  
Mt. Cassell (1/2)  
St. John (1/4)  
Dunfermline-Paraclete (1)  
Moya-Carriere (1/2)  
Tivoli-Carriere  
Hardford's Village

First class roads

St. Andrew's

Paraclete (1/2)

Third class roads

St. Andrew's

Union (1)

Soubise (1/2)

Bellevue-Richmond (1/4)

Chuts (1/2)

Cumberland-Carriere (1/2)

Plaisance (1)

Post Royal (1)

Tuilleries (1/2)

Second class roads

St. Andrew's

Hermon (1)

Grand Bras-Cardrona (1/2)

Bellevue (1 1/2)

Fourth class roads

St. Andrew's

Birch-Grove-Adelphi (1/2)

Boulogne Mountain (1/2)

Cafe-Crochu (1/2)

Felix Park (1/2)

Mt. St. John (1)

Pierre Marie (1/2)

Total mileage in St. Andrew's: 32 miles

First class roads

St. Patrick's

St. Patrick's (1)

Morne Fendue-Belmont (3)

Church (1/2)

Levera (1)

Mt. Reuil (1/2)

Second class roads

St. Patrick's

Duquesne (3/4)

Grand Sol (3)

Peggy's Whim (1/2)

Peggy's Whim Lower (1/2)

Lower Celeste (1/4)

Mt. Craven (1)

Third class roads

St. Patrick's

Mt. Rodney (1)

Mt. Sween (1)

Celeste (1/2)

Snell Hall (1/2)

Prospect (1/2)

Chantimelle (1/2)

Hermitage (1/2)

Madeys-Snell Hall (1)

La Fortune-Madeys (1/2)

Fourth class roads

St. Patrick's

Balance (1/2)

Tricolor (1/2)

Belmont Mountain (1/2)

Peggy's Whim Middle (1/2)

Morne Fendue-Broomfield (1/2)

Rose Hill (1/2)

Total mileage in St. Patrick's: 21 miles

First class roads

St. Mark's

St. Mark's (1)

Victoria-Mt. Cenis (1)

Crosby Hill-St. Michel (1/2)

Bonair-Bocage (1/2)

Second class roads

St. Mark's

Bocage-Mt. Cenis (1)

Duquesne (1/2)

Third class roads

St. Mark's

Union (1/2)

Union-Diego Piece (1/2)

Fourth class roads

St. Mark's

Belmont-Coast Guard (1/2)

St. John's (1/2)

Stauton Grove (1/2)

Total mileage St. Mark's: 7 miles

First class roads

St. John's

St. John's (1/2)

Belvidere (2)

Florida (1/2)

Second class roads

St. John's

Chadeau-La Force (1/2)

Brother-Mt. Cenis (1/2)

Concord (2)

Bougaldston-Mt. Granby (1)

Mt. Villiers (1/2)

Third class roads

St. John's

Gouyave (1/2)

Black Bay (1/2)

Richland (1/2)

Fourth class roads

St. John's

Mon Plaisir )  
Joupa ) (1/2)

Bell (1/2)

McIntyre (1/2)

Loretto (1/2)

Total mileage in St. John's: 11 miles

Carriacou - Approximately 7 miles of road.

Annex III

Roads scheduled for construction under current feeder road programme, showing mileage to be constructed and mileage affected by rainstorm

Parish and road	Mileage for construction	Mileage affected by rainstorm	Progress to date
<u>St. Andrews</u>			
Chadeau La Force	2.5	1.0	Nil
Clabany	2.0	0.5	Nil
Peché	1.5	Nil	Nil
Blaize above			
Paraclete	1.5	Nil	Nil
Dry River	1.0	Nil	Nil
Plaisance-Chutz	1.5	0.5	Nil
<u>St. John</u>			
Concord mountain	1.0	Nil	Nil
Gommier Lindo	0.75	Nil	Nil
Mt. Plaisir	0.75	Nil	complete
Mt. D'or Mt. Villiers	1.0	0.5	Nil
Barbay Piedmont	1.0	Nil	Nil
Cottage Rosemont	1.0	Nil	90% complete
Paradise Plaisance	0.5	Nil	Nil
<u>St. David</u>			
Mardigras Fond Perdi	2.0	Nil	Nil
Petit Etang	1.5	1.5	Nil
Mt. William Providence	0.5	Nil	Nil
La Pastora Laura	1.0	1.0	Nil
Terre Cannes	1.0	0.25	Nil
<u>St. Patrick</u>			
Grand Sol Tricolor	4.0	3.5	Nil
<u>St. George</u>			
Mt. Cenis			
Bonaire	1.5	1.5	Nil
Boeage			
Diamond Mt. Stan Hope	0.5	Nil	10% complete
<u>Mileage worsened by rains</u>		<u>10.25</u>	



APPENDIX 4



Annex I

Food supplies requested by the Government of Grenada  
to meet food shortage arising from rainstorm

Commodity	Tonnage	Price per ton EC\$	Total cost EC\$	Particulars
Rice	60	1 000	60 000	Packets and loose
Flour	60	800	48 000	Cooking and baking
Corn meal	55	1 175	64 625	Paper or jute bags
Milk	60	920	294 000	Powdered and canned
Meat	50	4 600	230 000	Canned and salted
Fish	50	4 000	200 000	Dried and salted
Peas	30	1 600	48 000	Pigeon, Split, Black eye (tinned and loose)
Beans	25	1 700	42 500	Red Kidney, Baked (tinned and loose)
Butter	10	3 150	31 500	Cooking and table
Oil	5	1 200	12 500	Cooking and salad (corn, soya and vegetable)
Eggs	5	4 000	20 000	Powdered
Sardines	10	900	9 000	Tins
Corned beef	10	4 200	42 000	Tins
Cereal	5	2 000	10 000	Breakfast (tinned and loose)
Biscuit	5	1 500	7 500	Salt and sweet (packets and loose)
Soups	5	1 000	5 000	Vegetables
Fruit juices	5	2 000	10 000	Tins/cartons
<u>Total</u>	<u>450</u>		<u>1 134 125</u>	

Note: Prices converted at US\$ 1.00 = EC\$ 2.36.

Annex II

Assistance requested by the Government of Grenada to  
combat mosquito breeding resulting  
from rainstorm damage

- A. Extensive damage to concrete floors and sea heads of drains;  
as a result stagnant water has accumulated, with prolific  
breeding of mosquitos.

Location	Assistance required		EC\$ Total Cost
	Materials	Labour	
Tanteen	3 335.00	1 665.00	5 000.00
Grand Mal Sea Head	4 665.00	2 335.00	7 000.00
Gouyave Health Centre	1 335.00	665.00	2 000.00
Grenville Health Centre	2 000.00	1 000.00	3 000.00
Sauteurs Health Centre	665.00	335.00	1 000.00
<u>Total</u>	<u>12 000.00</u>	<u>6 000.00</u>	<u>18 000.00</u>

- B. Insecticides required for low-lying lands now breeding mosquitos.

<u>Description</u>	<u>Value</u>
Baytex 40% W.P.	
or	
Malathion 50% W.P.	
(W.P.=Wettable Powder)	EC\$ 5 000.00

Annex III A

List of drugs and medical supplies requested by the  
Government of Grenada to deal with health  
problems resulting from rainstorm.

Description of items	Volume	Estimated total cost
Diarrhoea mixture with antibiotic or sulfa or both	400 qts	
Piperazine syrups	200 qts	
Vitamin tablets (for children and adults)	100 000 tabs	
Paracetamol tablets	100 000 tabs	
Sulfadimidine tablets	100 000 tabs	
A.T.S. for prophylaxis	100 vials	
Lignocaine 2% without adrenalin	300 x 50 ml	
Lignocaine 2% with adrenalin	50 x 50 ml	
Penicillin 3 mu for injections	5 000 vials	
Penicillin oral tablet	50 000 tabs	
Penicillin paediatric suspension	100 x 60 cc 125 ml	
Vitamins syrup or elixir	200 qts	
Co. Trimoxazole suspension	50 qts	
Co. Trimoxazole tablets	4 000 tabs	
Sulfadimidine suspension	200 qts	
Streptomycin 1 g injection	2 000	
Hypodermic syringes 2 ml	300	
Insulin zinc suspension 40 iu per ml	500 x 10 ml vials	
Hypodermic syringes 5 ml	100	
Dextran in glucose for I.V. use	50 x 540 ml	
Dextran in saline for I.V. use	50 x 540 ml	
Dextrose 5% in water for I.V. use	200 x 1 000 ml	
Potassium chloride crystals	10 kg	
Hexachlorophane lotion or cream	40 qrt	
Gloves disposable	4 000	
Gloves surgical (sterilisable)	500 prs	
Typhoid vaccine	50 x 10 ml vials	EC\$ 40 000

Annex III B

Bacteriological laboratory supplies requested by the  
Government of Grenada for diagnostic purposes in  
dealing with health problems arising from  
the rainstorm

1. Petri dishes 100 x 15 mm size
2. Media: SS, XLD, selenite broth, Brain Heart Infusion, agar
3. Typing sera: S. Typhi O, H, Vi
4. Antigen suspension: Widal
5. Blood culture bottles with: cooked meat, bilebroth,  
glucose broth
6. Microscopic slides 0.1 mm depth  
22 x 22 mm  
50 x 22 mm

Total estimated cost: EC\$ 38 000.00

Annex IV

List of resources requested by the Government of Grenada  
to restore water distribution system  
to minimal operations

(EC\$)

			<u>Total cost</u>
(a) <u>Purchase of chemicals</u>			
(1) Chlorine cylinders (75) of 69 lbs each			\$ 23 275
(2) Aluminium sulphate, 200 x 50 kg bags			2 161
(3) Hydrated lime, 40 x 25 kg bags			504
(4) Sodium fluoride, 20 x 50 kg bags			600
(b) <u>Access road to Les Avocats Water Works,</u> <u>approximately 5 000 ft</u>			
	<u>Labour</u>	<u>Materials</u>	<u>Total</u>
(1) Restoration of pavement and re-establishment of drains	\$ 30 000	\$ 20 000	\$ 50 000
(2) Underpinning of three bridges and rebuilding of abutments which have failed	35 000	47 000	82 000
(3) Erecting retaining wall 30' long, height varying from 9' - 12'	7 000	11 000	18 000
(c) <u>Clearing of seven (7) blocked dams and execution of minor repairs</u>			
			<u>Total</u>
(1) Peggy's Whim ) Hermitage )	St. Patricks	Peggy's Whim Treatment Plant	15 000
(2) Mt. Granby ) Dougaldston )	St. John	Dougaldston Treat- ment Plant	30 000
(3) Mt. Horne ) )	St. Andrew	Mt. Horne Treat- ment Plant	20 000
(4) Mirabeau ) )		Mirabeau Treat- ment Plant	20 000
(5) Annandale ) Vendome )	St. George	Annandale Treat- ment Plant	20 000
(6) Petit Etang ) )	St. David	Petit Etang Treatment Plant	20 000
(7) Pomme Rose ) )		Pomme Rose Treat- ment Plant	15 000

	<u>Labour</u>	<u>Materials</u>	<u>Total</u>
(d) Repairing water mains damaged by slides and failure of supports, random lengths and sizes, totalling 15 000'	\$ 45 000	\$ 75 000	\$ 120 000
(e) <u>Restoration of filters damaged by landslide</u>			
(1) Removal of earth and debris and replacement of sand	12 000		
Purchase of sand, broken stones and gravel		22 000	34 000
(2) Repairing structural damage to concrete walls	2 000	4 000	6 000
(f) <u>Flooding of Carriacou Borehole and damage to equipment including diesel engine</u>			
	5 000	30 000	35 000

Details of pipes and fittings requested at  
(d) in Annex IV

(d) <u>Repairing water mains damaged by slides and failure of supports, various lengths and sizes</u>			
200 lengths	4" dia. ductile pipe with Tyton joints	\$ 130.00 =	\$ 26 000.00
200 lengths	6" dia. ductile pipe with Tyton joints	180.00 =	36 000.00
18 only	4" dia. bends, 22 1/2°, with mechanical joints	105.00 =	1 890.00
20 only	6" dia. bends, 22 1/2°, with mechanical joints	150.00 =	3 000.00
18 only	4" x 4" x 4" dia. tees with mechanical joints	220.00 =	3 960.00
18 only	6" x 6" x 6" dia. tees with mechanical joints	230.00	4 140.00
			<u>\$ 74 990.00</u>

Note: (i) Pipe in 18' lengths  
(ii) Cost in ECC dollars  
(iii) 1 dollar Canadian = 2.20 dollar ECC



Specifications of diesel engine requested at  
(f) in Annex IV

(f) Flooding of Carriacou Borehole and damage to equipment,  
including diesel engine

Diesel engine specification:

Lister Type VA air cooled diesel engine developing 7 1/2 BHP  
at 850 rpm, to be used with 16' x 40' short stroke windmill  
driving K3B powerhead. Originally supplied by  
Messrs. H.J. Godwin Ltd.,  
Queenington, Gloucestershire  
Crown Agents C2H Grenada

5/11839/1 No 350/65 refers

All in accordance with attached drawing  
ref. No 198/65

Annex V

CABLE FROM PAHO WASHINGTON IN REPLY TO CABLE SENT BY  
MR. ANSARI, PAHO EXPERT, GRENADA

LT

ANSARI

C/O CENTRAL WATER COMMISSION

ST. GEORGE'S

CS 1607 REUR CABLE 25 NOV DAMAGE WATER SYSTEMS TELEPHONE CONVERSATION  
OF FRIDAY 28 NOV STOP FOLLOWING QUOTATIONS RECEIVED AAA 8500 LINEAR  
FEET SIX INCH TYTON JOINT DUCTILE IRON PIPE, BENDS, REDUCERS,  
JOHNSON'S COUPLINGS AND SEVEN GASCHLORINATORS TOTAL DLRS 45,740.00  
FAS NEW YORK DELIVERY PIPE AND FITTINGS TWO WEEKS TO USA PORT AND  
GASCHLORINATORS EIGHT WEEKS BBB 300 BAGS CEMENT AND CHLORINE GAS COMMA  
NOT MENTIONED IN CABLE BUT REQUIRED COMMA FOR LOCAL PURCHASE STOP  
CCC ONE LANDROVER TRUCK OBTAINING QUOTATION FROM GENEVA STOP  
DR. QUIROS TAKING NECESSARY STEPS WITH OAS STOP WILL MAINTAIN YOU  
INFORMED.

Annex VI

Vegetable seed requested by the Government of Grenada to  
replace crops destroyed by rainstorm \*

Vegetable	Variety	Quantity pounds	Unit Price EC\$	Total cost EC\$
Tomato	Indian River			
	Walter Floradel	10	43.90	439.00
Cabbage	Early Jersey			
	Wakefield	15	8.00	120.00
Lettuce	Mignonette			
	Iceberg	5	8.25	41.25
Beans	Kentucky Wonder			
	Contender	150	2.00	300.00
Carrot	Chantenay	15	11.50	172.50
Beetroot	Detroit Dark Red	30	5.20	756.00
Onion	Texas Early Grand	25	24.00	600.00
Cucumber	Ashley	30	13.60	408.00
Green (Sweet) Pepper	Californian Wonder	10	42.00	420.00
Hybrid Corn	Obtain from Jamaica	1 000	1.00	1 000.00
Pigeon Peas	Any available variety	500	1.00	500.00
Black Eye Peas	Available variety	500	1.00	500.00
Red Kidney Bean	Mexico	500	1.00	500.00
Water Melon	Sugar Baby Congo	10	13.60	136.00
				<u>\$ 5 292.75</u>

Note: These prices are converted at US\$ 1.00 = EC\$ 2.36.

Add 125% for air freight or 40% for sea freight.

\* Suggested seed source: AS GROW: United States of America except  
where otherwise stated.

Annex VII

Assistance requested by the Government of Grenada  
for rehabilitation of agricultural areas and  
facilities destroyed by the rainstorm

A. Landslides and soil erosion

It is estimated that roughly forty (40) acres of landslides have taken place on agricultural holdings, causing loss of cropland and blockage of farm and feeder roads. This has had a significant effect on the drains in cultivated fields, and has left the gullies unprotected. A programme of soil conservation is therefore urgently recommended in order to avoid any recurrence.

Estimated value of damage = EC\$ 140,000.00.

B. Loss of soil fertility

By far the greatest effect of the rainstorm on agriculture has been the total effect on soil fertility. The total estimate of economically important crops is broken down as follows, with their fertilizer requirements for a single application:

Cocoa	16 000 acres	48 000 cwts fertilizer required
Nutmeg	10 000 acres	20 000 cwts
Bananas	4 000 acres	24 000 cwts
Coconuts	5 000 acres	16 000 cwts
Oranges	600 acres	1 800 cwts
Grapefruit	400 acres	1 200 cwts
Limes	240 acres	720 cwts
Root crops	665 acres	1 580 cwts
Corn and Pigeon		
Peas	3 000 acres	15 000 cwts
Vegetables	230 acres	2 100 cwts

130 400 cwts or 6 520 tons

at EC\$ 600.00 per ton = EC\$ 3 912 000.

The heavy rains have caused the leaching of most of the soil nutrients which had been applied in the form of artificial fertilizers and farm manures. Signs of nutrient deficiencies, particularly of nitrogen, can already be seen from the plant foliage. It is therefore recommended that immediate assistance to farmers be made available in the form of compound fertilizer NPK 12:8:24 to the value of EC\$ 3.9 million.

C. Repairs to banana boxing plant at Birchgrove

Comparatively heavy losses were sustained at the Birchgrove banana boxing plant when the nearby river moved straight through the boxing plant. The estimated cost of repairing the protective wall is EC\$ 20,000.00 and of repairing the boxing plant EC\$ 10,000.00.

Total estimated cost = EC\$ 30,000.00.

D. Soil conservation and irrigation expert

Soil conservation measures were practised many years ago, but skills in this field have more or less died out and the present farming population needs guidance and instruction in this field. The technical assistance expert required must have experience in conservation techniques required for successful contour cultivation; must have experience of tropical and preferably Caribbean agriculture so that he would know the crops and grasses most suitable for countering wind, water and sun erosion; and must have experience in tropical irrigation and also be able to advise on how to use all available media - press, radio, posters, etc., - to communicate with the farming population.

Annex VIII

Statement submitted by the Government of Grenada on damage  
to dams and ponds in Carriacou

The island dependency of Carriacou generally suffers severely from drought for 6 months in the year. The average rainfall over the past years has been in the region of 40" - 45" per annum.

In the month of November, as much as 14" has been recorded, and on the night of the rainstorm 3.34 inches was recorded at a representative station. Significant damage has been done to feeder roads and most of all to watering dams and ponds which play an important part in the livestock industry.

There are approximately 10 dams on the island. Of these, 4 dams were washed away (2 in Dumfries and one each in Harvey Vale and Belle Vue South) while 3 were badly damaged (one each in Bellevue South, Belvidere and Harvey Vale).

There are approximately 30 ponds on the island, of which 20 were silted up from severe erosion wash and, though holding water, require de-silting operations which will cost approximately \$ 40,000.

The repair to the dams is considered an urgent need since the dry season is due to commence in January 1976. The estimated value of replacement is put at \$ 5,000/dam or \$ 20,000 for the four. The cost of repair to the 3 dams at \$ 2,500 per dam is \$ 7,500.

The work which is required is important in both the immediate future and the medium term and would benefit considerably if a versatile piece of equipment such as a "back-hoe" can be made available. The cost of such equipment might well be approximately \$ 100,000.

Soil conservation measures, e.g., storm drains, contour drains and grass barriers, will be essential if this operation is to be carried out successfully.

Annex IX

Assistance requested by the Government of Grenada to  
rehabilitate roads, bridges and rivers damaged  
by the rainstorm

(Thousands of EC\$)

A. Ref- erence	Description	In kind	In cash	Total cost
1	Clean-up and drainage			
	a. Initial clearing of roads and restora- tion of traffic	-	50.00	50.0
	b. Clean-up and resto- ration of drainage	-	250.00	250.0
2	Repair and reconstruc- tion of retaining walls and bridges	150.0	650.0	800.0
3	River-bed clearing and retraining measures, including River Road, Beausejour, etc.	120.0	-	120.0
4	Bridges			
	a. Underpinning of foun- dations etc., on secondary roads	-	80.0	80.0
	b. Replacement of River Antoine bridge	30.0	90.0	120.0
5	Road repairs (surface) 120 miles	430.0	1 370.0	1 800.0
6	Road diversion, La Sagesse, including river wall	6.7	73.3	80.0
	<u>Total</u>	<u>736.7</u>	<u>2 563.3</u>	<u>3 300.0</u>

B. The following technical assistance will be required to carry out this programme of work for 1 year in the first instance (five man-years).

1. Road Engineer with experience in direct labour work.
2. Two technicians for road surfacing with experience in macadam road surface construction and repair and also in constructing gravity retaining walls.
3. Two supervisory staff with experience in high-quality work in concrete, additional experience in gravity retaining wall construction an asset but not absolutely essential.

C. One four wheel drive vehicle for each person referred to in B above.

Five (5) four wheel drive vehicles at approximately  
EC\$ 15,000 = EC\$ 75,000.



Annex X

Request from the Government of Grenada for six Land Rovers  
for use by the Ministry of Agriculture to deal with  
problems arising from rainstorm damage

The condition of farm roads has deteriorated to such an extent as a result of the storm damage that farmers are not only having difficulty in transporting production inputs to their farm and farm products to the markets but - equally important - agricultural extension personnel are unable to service the farms by way of normal transport. The already limited manpower resources of the Ministry of Agriculture in relation to the number of farmers to be serviced (one extension officer to every 800 farmers) would be greatly assisted in the implementation of the rehabilitation programme for agriculture if 6 heavy-duty four wheel drive Toyota Jeeps or Land Rovers could be made available for the use of Ministry personnel.

Estimated cost: EC\$ 90,000.

[illegible]

APPENDIX 5



Supplement on agriculture and  
agro-industrial development

The agricultural sector is and will remain for some considerable time the pivot upon which development will rest. There are three main commodities which play an important part in export trade: bananas, cocoa and spices (particularly nutmeg). The island also grows sugar cane and a wide range of tropical fruit which can be processed both for the internal market and for export.

Cocoa

The Grenada Cocoa Association's projections to the end of the decade are as follows:

Year	73/74	74/75	75/76	76/77	77/78	78/79	79/80
Millions of pounds	5.1	5.2	5.4	5.7	6.0	6.3	6.6

As a result of the rainstorm it is expected that deliveries will fall by approximately 0.5 million lbs due to loss of fruit, blossom and soil nutrients. Cocoa is sold on a futures market, and sales policy has already been affected. The lowest price at which a sale was negotiated in the current year was £ 590 per ton, but in mid-December the Board had to turn down requests for 1,000 bags of cocoa (delivery March-June 1976) at a price of £ 710 per ton, because of the estimated shortfall of 2,300 bags resulting from the rainstorm. The approximate loss in sales is £ 60,000. The loss to the Government was EC\$ 20,000, since it imposes a duty of 2 cents per lb on exports. In 1974 the return to the grower was EC\$ 0.90 per lb; it is not expected to exceed this level this year, and on the whole total payments to growers are expected to fall by approximately 10 per cent.

While cocoa production will most likely show an upward trend to the end of the decade, because of the disease and pest control measures which have been taken, the loss of soil nutrients will result in a 10 per cent loss in production. This anticipated decline can however be overcome in the coming decade by improving the survival

rate of clonal cocoa plants distributed to growers. Present estimates are that losses are in the range of 25-30 per cent.

### Bananas

The Banana Co-operative Society concluded a two-year replanting scheme in September 1975; it is therefore expected that the production trend in the next few years will be upward. There are three countervailing factors however. Output levels depend very much on road improvement, as bananas are delicate and bruise very easily. The level of rejects at boxing plants is 20 per cent due to bad road conditions, and it sometimes rises to 40-45 per cent. In addition there are rejects at the port, approximately 0.5 per cent of the quantities offered. Secondly, topsoil erosion due to the recent rainstorm will have an adverse effect on yields. And finally, loss of suckers caused by landslides will affect production.

At present prices are falling - 9 per cent below what they were at the beginning of November - but this fall is partly seasonal. It is likely, therefore, that with rising production and a level of prices equivalent to those of 1975, export earnings will rise for the next few years. But the Society is faced with rising costs in disease control, because of the increased prices of oil-based insecticides and fungicides. There is also evidence that aldrin is becoming less effective as a control against the borer which attacks the bottom of the plant and a more costly substitute will have to be used. Increased foreign earnings therefore will not necessarily mean increased net earnings either to the Society or the growers.

### Spices

The main spices are nutmeg and mace, which account for over 40 per cent of foreign earnings. Peak prices in 1974 were due to a fall in production in both Grenada and Indonesia. These prices carried over into the first six months of 1975 but the tight money situation in the manufacturing countries led to a fall in demand and the volume of nutmeg sales fell in early 1975. Stocks have now risen to a high level and since July the volume of sales has increased, but at falling prices. Total island production has now risen to the level reached

before hurricane Janet in 1955, and since the trees are young a 50 per cent increase in production is expected. Though there were losses of fruit and trees in the rainstorm, the upward trend has not been seriously affected.

The country also produces minor spices such as cloves, cinnamon, tonka bean, bay leaf and ginger.

#### Livestock

The country has a programme for increasing animal production: cattle, pigs, poultry and black belly sheep, mainly raised in Carriacou.

#### Fruit and vegetables

These are exported mainly to Trinidad, but losses are very high due to poor road conditions and marketing practices.

#### Agricultural Extension Service

The island is divided into four agricultural zones - North, South, East and West - and the total estimated number of farmers is 12,000. The ratio of extension officers to farmers is in the region of 1:800. Considering the terrain of the country, it is likely that farmers are not adequately serviced at present. The high losses in clonal cocoa plants after distribution to farmers may be attributable in part to the inability of extension staff to service all growers. Damage to bananas in the field may also be due to this factor. Some consideration should be given to improving the ratio of extension workers to farmers because of the importance of these two crops to the island's economy. More use can also be made of the media to educate farmers about better cultivation practices.

#### Agro-industrial development

The economy has to look beyond its present position as a supplier of raw material to one of processing for export. Bulk exports of cocoa, bananas and nutmeg will be important in the foreseeable future, but the nutmeg industry possibly offers scope for processing. Some consideration is now being given to this by the Nutmeg Association. Since cocoa is a high-grade product, it may be possible to process the beans to a semi-refined state without any risk of losing existing

markets. Bananas, too, can be the base for an extraction industry. It is estimated that at present over 50 per cent of fruit and vegetable production goes to waste because of faulty harvesting and marketing practices. This is an area which offers scope for industry at the village level. Such an industry can provide canned local fruit for domestic consumption all the year round and reduce the importation of supplies from outside the region.

#### Fisheries development

The seas around Grenada abound in fish, and catches are often far in excess of demand for the fresh fish market. Development of a fish-processing industry can reduce imports of tinned meat and fish and make available a rich supply of protein.

#### Summary

The present weak state of Grenada's balance of payments cannot be improved unless a concerted effort is made to develop export industries based on the island's agricultural production and every effort is made to reduce dependence on foreign supplies of food so as to improve the country's negative merchandise trade balance - one which cannot be completely counterbalanced by earnings from its tourist trade. The fundamental requirement for sustained growth, however, is an improvement in the country's infrastructural base.