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JAMAICA:
**MACRO-SOCIO-ECONOMIC ASSESSMENT OF THE DAMAGE
DONE BY FLOOD RAINS AND LANDSLIDES
MAY 2002**



ECONOMIC COMMISSION FOR LATIN AMERICA AND THE CARIBBEAN
Subregional Headquarters for the Caribbean
CARIBBEAN DEVELOPMENT AND COOPERATION COMMITTEE

PREFACE

This assessment was prepared for the Government of Jamaica following the significant damages to social and economic infrastructure and productive sectors as a result of a period of sustained and unusual rainfall associated with the convergence of a tropical wave over Jamaica and an area of high pressure to the north of the island resulting in periods of heavy and sustained rainfall over the period May 22 – June 2, 2002.

A request for technical assistance was directed to the Economic Commission for Latin America and the Caribbean (ECLAC) Subregional Headquarters for the Caribbean, on May 31, by the Planning Institute of Jamaica. In view of the recent training provided by the ECLAC Caribbean team in the use of the ECLAC methodology to a multi-disciplinary group of 58 persons spanning several sectors, it was felt that this event, while most unfortunate, nonetheless provided an opportune moment for the Jamaican “trainees” to utilize the skills transferred and to apply the methodology which had been taught. Consequently, ECLAC fielded a team of five persons a few days after the request had been made, to give the Jamaican counterpart team the opportunity to collect data of the type and using an approach well suited to the preparation of assessments such as this.

This study was prepared by five members of the ECLAC Natural Disaster Damage Assessment Team. The mission was undertaken over a period of four days from June 16 2002 – June 21 with the singular objective of undertaking the actual assessment through analysis of available data, and pulling this report together.

The report undertakes a sectoral analysis leading to an overall assessment of the damages incurred. It appraises the macro-economic social, and infrastructural effects, identifies weaknesses in physical planning and other tools which would allow for mitigation, and provides guidelines for actions related not only to the recovery process, but most importantly including those essential to reducing vulnerability, both in the short term during the process of recovery and reconstruction, as well as over the longer term. The latter is considered of vital importance to the national interest, given the recurring phenomena of widespread damage to property and loss of life associated with flooding in this country, which could be alleviated through the judicious application of tools such as land use and physical planning and hazard assessment which would serve to ultimately reduce the vulnerability of the country to such events and preclude to some extent, the continuous diversion of financing available for development. This point is reinforced by the fact that the country is still in the process of recovering from the floods of November 2001 which impacted over a smaller area.

The direct and indirect damages have been assessed in accordance with the methodology developed by ECLAC. The study incorporates data and information supplied to the team and evidence collected through site visits and interviews. It is unfortunate however that some critical data input were not available at the time of undertaking this assessment, and some problems remain with respect to the aggregation of data from field sources. It is estimated that the damages and losses sustained exceed the capacity of the government to engage in recovery efforts without dislocation to its development trajectory.

The team is grateful to the Planning Institute of Jamaica (PIOJ) for its invaluable counterpart support and for responding graciously to its various requests for information. The team is

appreciative for the support provided by the Office of Disaster Preparedness and Emergency Management (ODPEM) and for the assistance provided by other agencies including the Ministry of Water Resources and Housing (MoWH), Water Resources Authority (WRA), National Works Agency (NWA), National Water Commission (NWC), National Environmental and Planning Authority (NEPA), Statistical Institute of Jamaica (STATIN), Ministry of Labour and Social Security (MLSS), Central Bank of Jamaica and the Rural Agricultural Development Agency (RADA).

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EXECUTIVE SUMMARY

This study was prepared for the Government of Jamaica following the damage and economic losses resulting from the flood rains affecting Jamaica over the period May 22 –June 2, 2002. The flood was associated with the convergence of a tropical wave over the country and an area of high pressure to the north of the island. As a consequence of the damages a request for technical assistance was directed to the Economic Commission for Latin America and the Caribbean (ECLAC) Subregional Headquarters for the Caribbean of the on May 31 by the Planning Institute of Jamaica.

The Natural Disaster Damage Assessment Team undertook a mission to Jamaica over a period of four days from June 16 to June 21, 2002 to prepare a report on the evaluation and assessment of the damages. A first version of the report was completed and handed in to the Minister of Finance on June 21 (LC/CAR/R.63, 18 June 2002). This report represents an updated and expanded version of the document previously submitted.

This report undertakes a sector by sector analysis of the floods leading up to an overall assessment of the damages. The sectors analysed are grouped into four categories, social, productive, infrastructure and environment. The first includes the housing, education and health sectors. The second comprises agriculture, tourism, manufacture and distribution. The third includes transport, energy, water and sanitation, and telecommunications. The environmental assessment considers among others the analysis of changes to natural watercourses, damage to well fields and aquifers, sediment deposition, ecosystem and habitat damage. In the analyses of each of the sectors the document follows closely the ECLAC methodology by distinguishing between direct and indirect damage. Direct damage refers to losses to assets and stocks. Indirect damage is defined with respect to losses in flows (income and production flows).

The estimates for direct and indirect damage for the economy as a whole are then presented in a summarised format. Their magnitude is evaluated in relation to GDP and other macroeconomic variables. The overall assessment of the damage also includes a detailed macroeconomic assessment of the situation prior to the disaster, the expected situation without the disaster and the estimated performance of the economy taking into account the effects of the floods.

The document ends with a presentation of guidelines for a rehabilitation and reconstruction program. This includes an analysis of issues pertaining to planning policy and mitigation and a tentative list of selected project proposals.

Total damage was estimated at J\$2 471 million or US\$51 million. This represents 0.7 per cent of GDP and 4 per cent of merchandise exports. The bulk of the damage was bestowed upon assets and stocks. That is, it was direct damage representing 86 per cent of the total. The damage was concentrated in infrastructure and agriculture. The estimations undertaken by the mission show that agricultural and infrastructure management represented 3 per cent of their respective GDP.

The effects of the damage on macroeconomic performance are channelled mainly through the fiscal and balance of payments side. The damage will imply greater expenditures and lower incomes and at the same time a higher external indebtedness. It has also affected the traditional export base of the country based on agricultural products. Overall the disaster will have a minor impact on growth performance. The estimated rate of growth of GDP for 2002 without the disaster was estimated by the ECLAC mission at 2.2 per cent and at 1.9 per cent taking into account the effects of the disaster. The interpretation of the estimates and economic performance for 2002 should take into account that, the effects of the May floods are superimposed to those caused by the flood rains in October 2001 and which became visible in the first quarter of the present year.¹ In addition, some sectors have also been affected by unfavourable economic conditions. These considerations should provide a basis to assess the extent to which donors commitments following the October 2001 floods should be reviewed in the light of present circumstances.

The assessment presented in this report should enable the government and the international community to set national and regional priorities in the reconstruction and rehabilitation phases. It should be seen as a basis for enhancing preparedness to reduce vulnerability in the face of external shocks. Jamaica has been exposed to different natural disasters in recent times, particularly hurricanes, floods and landslides (including flooding and landslides associated with hurricane Michelle in 2001).

The country remains highly vulnerable and weaknesses exist in planning, land use policies and building practices. Although disaster planning and response capacity have evolved appreciably in recent years there is still a need to build resilience to flood and other disasters. This points to the need for changes in land use and building practices. In particular, the recent flood rains, coming so rapidly on the heels of those of November 2001, serve to highlight problems at the planning and design stage. It is most likely that the inadequacies in these systems have contributed to the extensive damages that were suffered.

¹ Jamaica, An Assessment of the Economic and Other Damages Caused by Hurricane Michelle, LC/CAR/G.672, December 2001

I. BACKGROUND

1.0 The mission

The Government of Jamaica through its planning agency, the Planning Institute of Jamaica (PIOJ), requested technical assistance to undertake a rapid assessment of damages in the aftermath of the severe flooding and rains which persisted during the latter part of May and the beginning of June. ECLAC responded by fielding a small team of experts to carry out the evaluation.

The mission visited Jamaica from 16 – 20 June 2002. The team's arrival was preceded by the collection of data on the extent of the damages caused by the natural disaster. The PIOJ and its newly established Sustainable Development Department coordinated this task.

The ECLAC team included three ECLAC officials and two external consultants:

Ms. Len Ishmael, Director, ECLAC Subregional Headquarters for the Caribbean
Mr. Esteban Perez, ECLAC, Subregional Headquarters for the Caribbean (Economics Unit)
Ms. Asha Kambon, ECLAC, Subregional Headquarters for the Caribbean (Social Unit)
Dr. David Smith, consultant, infrastructure assessment
Mr. Ivor Jackson, consultant, environmental assessment

This document contains an independent and objective assessment of the disaster, which sets forth the overall magnitude of direct and indirect damages and their effects on the behaviour of the economy as a whole. It is intended to assist in drawing up proposals for reconstruction priorities and needs.

2.0 Description of the phenomenon and its effects

2.1 *The meteorological phenomenon*

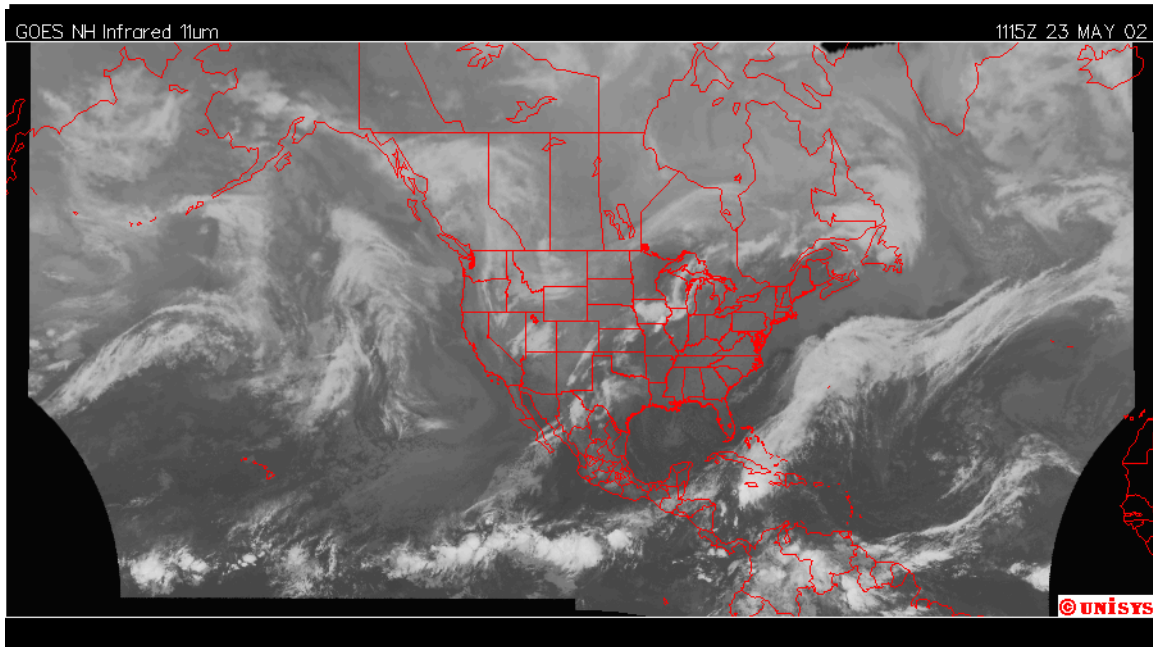
Beginning on Wednesday 22 May 2002 and continuing for a period of almost 10 days, heavy rains resulted in extensive flooding across the island of Jamaica. Damages were experienced in almost all of the parishes of the island, however, five parishes, in particular were declared disaster areas. These were: St. Elizabeth, Manchester, Clarendon, St. Catherine and St. Thomas.

This flooding was caused by a combination of factors, which included:

- (a) The passage of high pressure systems in the vicinity of Jamaica during 21 – 26 May 2002;
- (b) The presence of a low pressure system that developed west-south-west of Jamaica on 23 May off the coast of Honduras and which stretched northeastwards over the islands of Jamaica, Cuba and the Bahamas; and
- (c) A broad area of low pressure associated with a surface trough that existed across the region on 26 May 2002.

The flood rains that ensued continued until approximately 2 June 2002.

Figure 1:
Infrared satellite imagery of area taken on 23 May 2002



2.1.1. Historical Background

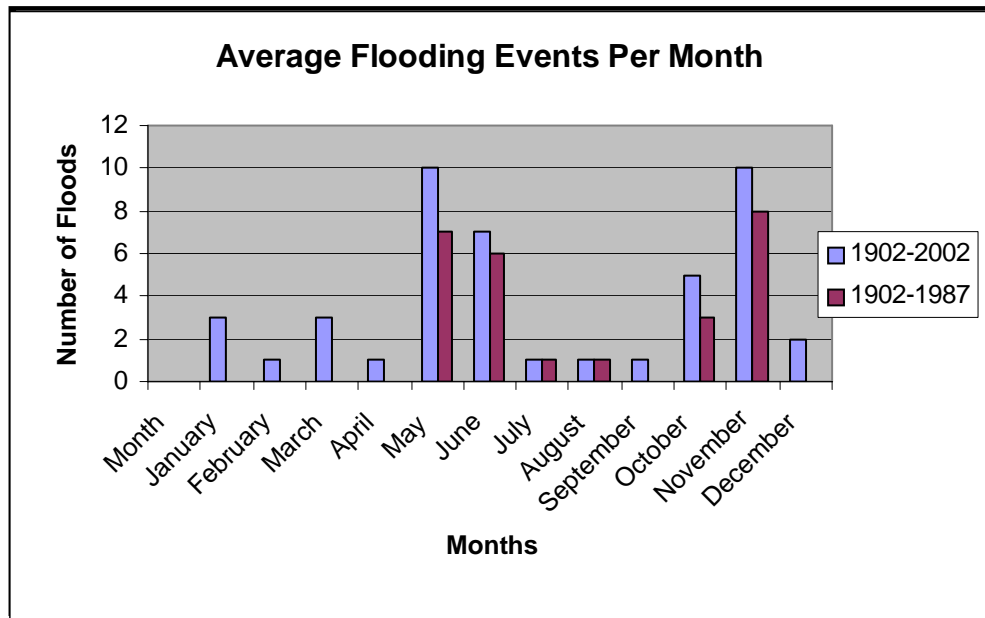
A review of historical levels of rainfall is instructive in developing a proper appreciation of the magnitude of this event. In particular, a review of 100 years of flooding records carried out in 1987 (Review of the Past Hurricane Season, WMO RAIV Hurricane Committee, 9th Session, 1987) revealed the following:

(a) There have been 26 episodes of disastrous flooding during that period, giving an average for these events of one every four years;

(b) Since 1987, Jamaica experienced 19 cases of reported flooding that were not associated with tropical cyclone activity;

(c) For the entire period of review, the distribution of flooding with respect to month was as shown in the following diagram. It is clear that the months of May and November contain the most occurrences. What is of interest is the fact that May is just prior to the start of the hurricane season, and is therefore almost non-exclusively associated with tropical cyclone activity. By contrast, November falls at the end of the hurricane season and the values observed for this month may contain some cyclonic activity;

Figure 2:
Average flooding events per month



(d) It is of interest to note that prior to 1987, flood events were only observed in the months of November, May, June, October, July and August. In addition, prior to this event of 2002, the most disastrous event to occur in the month of May was during the period 20 May – 6 June 1986; and

(e) A review of the 30-year averages (1951-1980) also revealed that the average highest rainfall for the month of May over that period was approximately 250 mm. This month had the second highest average rainfall for the year, being second only to October, which had an average of 270 mm.

2. 1.2. The flooding event

The Water Resources Authority recorded the levels of rainfall at a number of gauging stations that it oversees across the island. For each station, parameters noted included: the total rainfall; the maximum daily rainfall recorded; an estimate of the maximum over a 24-hour period; the date of this maximum occurrence; and an estimate of the return period for this rainfall.

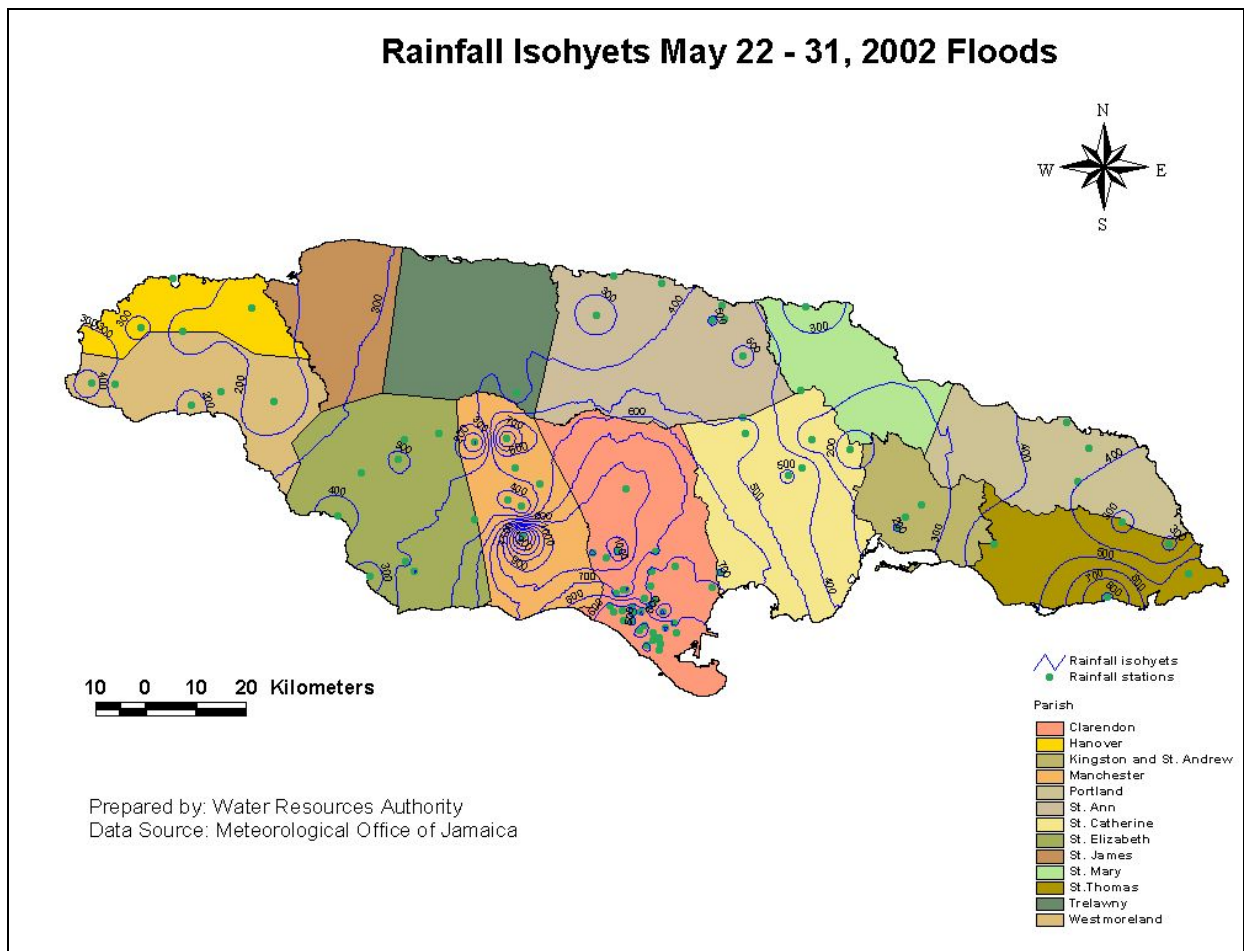
Stations gauged ranged all over the island. The following statistics were obtained:

- (a) Number of stations = 82;
- (b) Of these, four were estimated to have experienced rainfall in excess of the 100-year return period (Cotton Tree Gully, Ebony Park, Osbourne Store, St. Jago and Black River);
- (c) Nine stations experienced rainfall between the 25-50 year return period;

- (d) Ten were between the 10 – 25 year return period interval;
- (e) Eighteen were between 5-10 year return period; and
- (f) The remaining stations (41) received rainfall with a return period of less than 5 years.

The results go on to show that at Osbourne Store for example, the total rainfall received over the 10-day period was 1050.4 mm. This is several times the 30-year average for this location. Isohyets for the period 22-31 May 2002, were computed by the WRA and plotted to show the spatial distribution of the rainfall event for the entire island. This diagram clearly shows the concentration of rainfall in the Parish of Manchester.

Figure 3:



Rainfall graphs for the period of consideration are also shown for two of the five Parishes that were declared disaster areas. These graphs indicate that at a number of the gauge stations, sustained intense rainfall fell for a period of 3-5 days, without abatement. These values provide insight into the extent of the disaster that occurred, since most drainage structures associated with roads are designed to accommodate the 1 in 5 year runoff only. While it is uneconomical to design

for an extreme event such as the 1 in 100 year event, the severity of this particular flooding event and the frequency with which flooding has been observed in Jamaica, speaks to the need to revisit the design criteria used by the National Works Agency.

Figure 4:

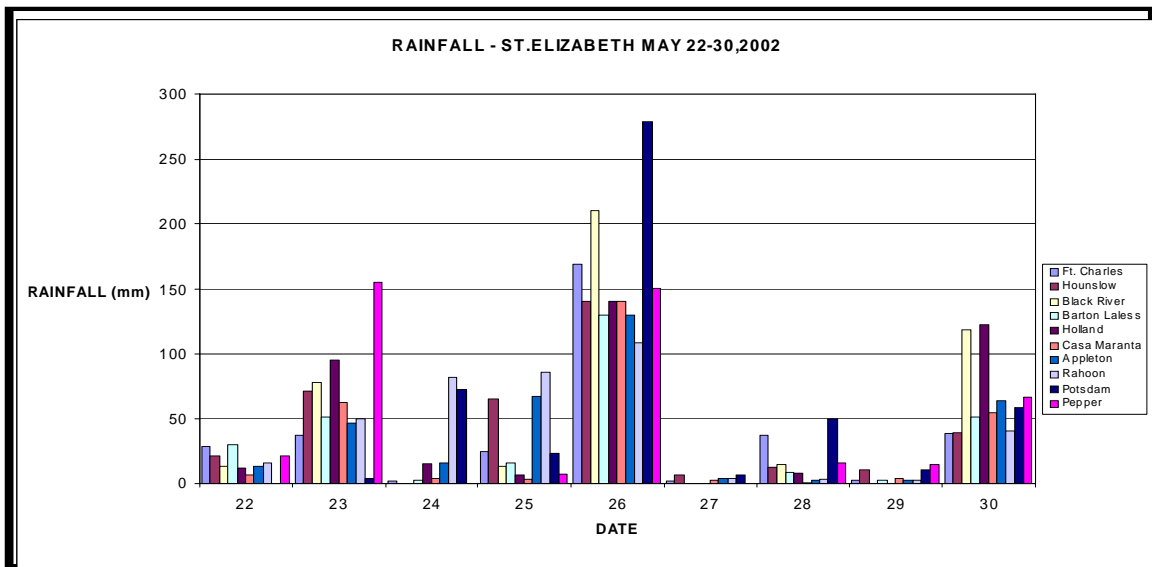
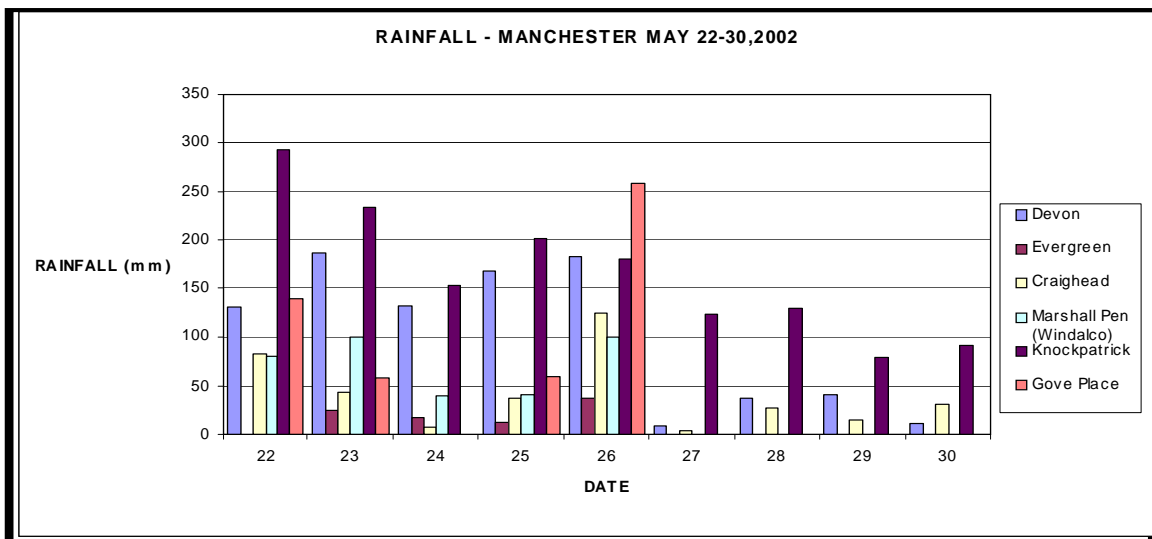


Figure 5



The photographs which follow give a sense of the flooding that was experienced. The first is taken between Clarendon Park and Porus, and shows the erosion of the railway embankment by the Milk River. The debris line and the eroded embankment itself give some indication of the water level achieved by the river during the height of the rainfall event. Restoration activities are seen to be underway at the time of the photograph (two weeks after the most severe rains).

The second photograph shows a different phenomenon, which was experienced in the village of Content. Essentially, the rainfall extensively recharged the aquifer in this area, so that the ground water table was observed to rise by almost 100 metres (personal communication by Mr. Herbert Thomas, WRA). Since the village of Content lies in a depression, the water level has been rising steadily since the cessation of the rains. The levels have now peaked and have started to recede.

**Photo #1:
Eroded bank of railway line by the Milk River**



**Photo #2:
Rising ground water in Content**



2.2 Extent of impacts

The effects of flooding were felt in the countryside on an island-wide scale. However, the most severe effects were centered in the parishes of St. Elizabeth, Manchester, Clarendon, St. Catherine, St. Thomas and St. Ann. Five of these parishes (St. Thomas, St. Elizabeth, Manchester, Clarendon and St. Catherine) were declared disaster areas. Some damages were also reported in Trelawny, Hanover, Westmoreland, Kingston and St. Andrew, although these were not as extensive as in the other parishes.

Due to the nature of the disaster and its geographical concentration, damage was concentrated at the economic sector level mainly in infrastructure (erosion of roads and drainage structures) and agriculture (damage to crops and livestock). Other economic sectors were affected indirectly to the extent that agriculture or infrastructure provided inputs or part of the means to carry out their economic activities. Finally, some sectors such as the manufacturing sector were barely touched by the event.

The floods also had social consequences affecting with varying degrees of intensity half of the population on the island. The most severe effects were localised in the Southern part. The damages were particularly visible in the health sector. The damage to housing and human settlements, and educational facilities was not substantial. The interpretation of the assessment and evaluation of the damages should however take into account that part of the affected population did not report damages and thus the estimation of total damage may be partly undervalued (see photograph 3 and explanation below).

Specifically the effects of the damage were felt in the following areas:

- (a) Road Infrastructure – Both to main roads, Parish Council roads and farm roads;
- (b) Tourism infrastructure. Damage was reported to tourism related facilities, feature roads (Fern Gully) and to beaches.
- (c) Utilities – Damage occurred to water supply systems, electricity generation services and to telephone services;
- (d) Agriculture – Extensive damage to livestock and crops was experienced. Most of the damage was felt in domestic crops.
- (e) Housing – 35 houses were destroyed and several hundred housing units were affected. These included a number of Operation PRIDE housing projects;
- (f) Health – There were six reported casualties resulting from the rains, one in St. Catherine, four in Clarendon and one in St. Thomas. Further, vector control following the rains has now become a priority. Several hospitals were impacted to varying degrees throughout the island; and

(g) Welfare – Shelters have had to be opened in Clarendon to accommodate some of the affected people.

Of the parishes that were worst affected, following is a table giving a distribution of affected communities and the type of effect.

Table 1:
Distribution of flooded communities

Parishes	Flooded Communities	Landslides
St. Elizabeth	26	1
Manchester	6	1
Clarendon	16	
St. Catherine	15	
St. Andrew	3	1
St. Thomas	1	3
St. Ann	10	
Trelawny	1	

Source: ECLAC, from data provided by Government of Jamaica

3.0 Population affected

The heavy rainfall, which was experienced by Jamaica during the period of May/June 2002, affected virtually the entire country. There were nine fatal casualties reported. Hardest hit were the parishes on the Southern coast of the island, Kingston and St. Andrew, St. Catherine, Clarendon, Manchester, St. Elizabeth and St. Thomas. However, parishes on the northern coast of the island, such as St. Ann, also suffered the ill effects.

Of a total population estimated for 2001, that is 2,621,000, some 50 per cent or 1,310,550, comprised the primary, secondary and tertiary population groups that were considered to have been affected directly and indirectly with varying degrees of intensity by the heavy rains and flooding. Half of the population affected was concentrated in the Kingston and St. Andrew parish and close to a third in St. Catherine. Table 2 below, details the population of Jamaica and the affected population.

Table 2
Jamaica: Estimated affected population due to heavy rainfall and flooding

	1991 End of Year Population	%	1996 End of Year Population	%	2001 End of Year Population	Affected Population
Jamaica	2,398,800	100.0	2,527,400	100.0	2,621,100	1,310,550
Kingston & St. Andrew	646,100	26.9	691,500	27.4	719,900	359,950
St. Thomas	85,300	3.6	89,400	3.5	92,700	46,350
Portland	76,500	3.2	78,600	3.1	79,400	39,700
St. Mary	109,200	4.6	111,800	4.4	112,900	56,450
St. Ann	150,600	6.3	158,200	6.3	167,300	83,650
Trelawny	71,400	3.0	72,500	2.9	72,500	36,250
St. James	156,200	6.5	169,800	6.7	182,600	91,300
Hanover	66,400	2.8	67,900	2.7	67,200	33,600
Westmoreland	128,900	5.4	134,800	5.3	141,800	70,900
St. Elizabeth	146,100	6.1	149,000	5.9	148,300	74,150
Manchester	161,600	6.7	177,500	7.0	192,400	96,200
Clarendon	215,980	9.0	223,800	8.9	229,400	114,700
St. Catherine	384,500	16.0	402,600	15.9	414,700	207,350

Source: Table 20.5 Economic and Social Survey 2001

The computation of the affected population includes more than 313,000 persons considered at high risk for health impairment. This has been brought about by the high indices and breeding sites of vector mosquitoes such as the Culex and Anopheline, together with the problems resulting from dead animals that are unable to be properly disposed. Most importantly, the threat of impairment to health will come from the destruction of pit latrines and the contamination of water supply. Table 3 provides details of the five affected parishes with information on the parish of St. Ann as well.

The conditions caused by the flooding are likely to deteriorate the welfare of the most vulnerable households in the five parishes, which have been identified as suffering severe consequences of the flooding. These effects may be exacerbated by the fact that the size of affected households was larger than the national average. This can help to weaken the nutritional wellbeing of the family and undermine its capacity to enhance their resistance to unforeseen shocks over time. Evidence points to the fact that households with small family sizes are better able to equip their children to grasp future chances that may present themselves.

The Parish of St. Ann, though not declared a disaster, was under close watch by the Ministry of Health, as it was feared that the destruction of the main sewerage pump could result in a major health crisis for the communities in that parish. Table 4 below presents indicators and basic information for a sample of selected communities from the affected parishes.

Table 3
Jamaica: Population at high risk for health impairment

Parishes	Total population	Affected population	Population at high risk
St. Ann	167,300	16,730	50,190
St. Thomas	92,700	9,284	27,852
St. Elizabeth	148,300	4,190	12,570
Manchester	192,400	10,940	32,820
Clarendon	229,400	22,940	68,820
St. Catherine	414,700	40,470	121,410
Totals	1,077,500	104,554	313,662

Affected population based on limited data drawn from community profiles. The assumption used is that the affected population could be approximately 1/10 of the estimated population since the main threat facing the population is a threat to their health and well being.
Population at high risk estimated (3x1)

Table 4
Jamaica: Community profiles from selected communities from the five parishes declared a disaster area

Parish		Population	%FHH	Ave HH Size	% 0-14	% 65+	%unemp
St. Thomas		92,700					
	Font Hill	680	31.25	4.25	33.82	7.35	59.2
	Trinity	2,160	49.12	3.78	29.49	8.29	72.4
St. Elizabeth		148,300					
	Brompton	2,850	39.34	4.67	32.71	8.65	37.41
	Springfield	1,340	19.35	4.32	45.93	8.89	28.33
Manchester		192,400					
	Alligator Pond	1,910	40	5.47	35.56	1.11	43.81
	Comfort	2,400	35.9	6.154	28.97	27.59	49.55
	Porus	4,740	47.06	4.6	35.81	7.43	38.49
	Prospect	1,340	54.17	5.583	39.52	1.61	52.17
	Williamsfield	550	8.33	4.58	18.75	15.63	37.93
Clarendon		229,400					
	Lionel Town	3,530	34.29	3.36	31.38	4.11	46.66
St. Catherine		414,700					
	Bog Walk	6,360	39.1	4	31.05	5.01	42.64
	Kitson Town	6,910	36.88	4.86	31.71	5.54	47.69
	Old Harour Bay	1,110	39.13	4.82	38.7	3.6	22
	Linstead	26,090	36.38	4.4	32.38	4.1	35.63

Source: ECLAC from data from the Social Development Commission 1999

General gender analysis indicated that all instances women head more than 30 per cent of households in each community. In at least four of the communities surveyed, women headed more than 40 per cent of the households. And in one community, Prospect, in the parish of Manchester

54 per cent of the households were headed by women. Female-headed households have been considered to be at a disadvantage for a number of reasons, the most glaring being that they usually have to make do with fewer resources than male headed households. Anecdotal evidence suggests that the flood produced additional stress on women household heads as it damaged or destroyed their additional sources of income (livestock and particular chickens).

Overall, it can be concluded that the fragility of the health conditions is the major threat facing the population in the affected area. There has been limited loss of life and evidence of little or no physical trauma caused to the population. More details are required in order to inform social policy regarding mitigation and rehabilitation, which could result in poverty reduction and nutritional well being of the population in the rural communities. However, increased resources should be made available to the Ministry of Health to carry out its prevention and rehabilitation programmes to avoid a further deterioration of the health status of the affected population.

4.0 Emergency actions

4.1 *Emergency actions*

From as early as 23 May, the National Emergency Operations Center was activated and welfare teams were put on standby. The parish operations center for Clarendon and St. Catherine were also activated. The National Works Agency was mobilized to clear several blocked roads, and clear drains to alleviate flooding. Rescue operations were initiated and six shelters were opened in Clarendon housing some 37 families. An additional two shelters were opened in Manchester housing another nine families.

On Sunday 26 May the weather conditions deteriorated severely and all response mechanisms were activated in the country. On Monday 27th the Director General of ODPEM accompanied the Minister of Labour and Social Security on a tour of the affected areas by helicopter and international Donors were briefed.

As the extent of the widespread flooding became evident, five parishes were declared a disaster. Some J\$8 million dollars have been spent to-date on emergency relief. The following table outlines the expenses incurred in emergency relief efforts. It is expected as the full details of relief efforts become known that this figure might increase.

Table 5
Jamaica cost of emergency relief, June 2002

Type of Relief Service Provided	Cost
Transportation (Ground and air)	2,000,000
Materials	1,616,033
Food Supplies	4,000,000
Sub total	7,616,033
Indirect	
Personnel providing increased social welfare services	696,000
Total	8,312,033

Source: ECLAC from data provided by the Government of Jamaica

II. ASSESSMENT OF THE DAMAGE

This chapter assesses the effects of the damages provoked by the floods, which affected Jamaica in May 2002. The chapter comprises the analysis of the social (housing, education and health), productive (agriculture, tourism, manufacture and commerce) and infrastructure (transport, energy, water and sanitation, telecommunications) sectors, and the evaluation of the damages to the environment. These include, among others, changes to natural water courses, extensive soil erosion, beach erosion, land and rock slips, degraded water quality and impacts on coastal systems.

Following the ECLAC methodology the section distinguishes between direct and indirect damage. Direct damage refers to damage to stocks such as crops, housing or infrastructure. Indirect damage comprises damages to flows, which in this particular case refers to the money value of the interruption to production and income flows.

The data used for the estimates was partly compiled by the authorities and in particular by the Planning Institute of Jamaica prior to the mission and partly facilitated by the relevant institutions during the mission. To attain a better understanding of the consequences of the phenomenon the ECLAC team undertook a field trip to two of the most affected parishes and interviewed several officials dealing directly and indirectly with the effects of the disaster.

The figures used in this chapter were thus provided by official authorities or estimated on the basis of official information. These are expressed in local currency (the Jamaica Dollar) in current units.

5.0 Social sectors

5.1 Housing

At the time of the elaboration of this report a full assessment had not been completed, as a number of communities were still isolated due to flooding. Notwithstanding this limitation, preliminary evidence indicated that damage to the housing stock of Jamaica was not substantial. Some 1402 houses were reported damaged as a result of the flooding, of those 39 were completely destroyed (See Table 6). The quality of housing stock is relatively good and was able, in the main, to withstand the flooding. However, the building codes for low lying areas, and for building in flood plains seems to be followed more in the breach than in the observation.

Table 6
Jamaica: Location and number of houses affected

Parishes	Housing units affected	Repair	Reconstruction
Kingston and St. Andrew	61	61	0
St. Thomas	62	56	6
Portland	4	3	1
St. Mary	3	3	0
St. Ann	122	120	2
Trelawny	4	2	2
St. James	26	25	1
Hanover	54	53	1
Westmoreland	0	0	0
St. Elizabeth	24	24	0
Manchester	50	50	0
Clarendon	918	904	14
St. Catherine	74	62	12
Totals	1402	1363	39

Source: ECLAC from data provided by the Government of Jamaica

The data on housing, as reported in the Jamaica Survey of Living Conditions, 2001, would seem to support the hypothesis presented above regarding the quality of housing. It points to the fact that more than half, 66.9 per cent, of the households in the Rural Areas were reported to live in owner-occupied housing units and that more than half of these units, 55.5 per cent, were reported to be constructed of block and steel.

The SLC also reported that approximately 36 per cent of households still rely on pit latrines and that less than 30 per cent had access to a piped water supply. In the instances where dwelling units possessed flush toilets or water closets, only 18 per cent were linked to a sewer system. Most used absorption or soak-a-ways as the main method of sewage disposal. This high incidence of the use of pit latrines and soak-a-ways has been the main source of threats to the communities' health due to the severe flooding.

Total damage comprising direct and indirect effects, to the housing sector amounted to J\$58 million dollars. Direct costs, accounted for by mainly the damage to the housing stock, represented 97% of the total. Table 7 presents the breakdown of the direct and the indirect costs to the sector.

Table 7
Jamaica Summary effects on the housing sector

		Thousands JA \$
Direct Effects		57,872,000
(i)	Reparation of Damaged Houses	51,116,000
(ii)	Replacement of Lost Houses	4,700,000
(iii)	Furniture and household goods	1,000,000
Imported Component		27,880,000
Indirect effects		
(i)	Removal of debris	1,056,000

Source: ECLAC from data received from the Government of Jamaica

5.2 Education

The education sector registered minor damages. This resulted from good planning on the part of the Ministry of Education, which constructed schools on high ground since many are intended for use as shelters in time of natural disasters. Table 8 presents the details of the physical (i.e., direct) damage to schools by parish and nature of damage. It is clear from the data that most schools damaged were public schools and were located in the rural areas and were concentrated in two of the parishes, which were most severely affected, Clarendon and St. Catherine, accounting for 55 per cent and 21 per cent of the total flood damage to schools.

Table 8
Jamaica: Direct damage to schools caused by flood damage

Total						2,520,000
Parishes	Name of School	Rural	Urban	Type of damage	Estimated Cost	
Clarendon	Leicesterfield Prim. & Jnr High	X		Land slippage threatening building	850,000	
	Alston Primary	X		Latrines collapsed	350,000	
	Portland Cottage all Age	X		Latrines filled and overflowed	60,000	
	Race Course Primary	X		Latrines filled and overflowed	60,000	
	Salt Savannah Primary	X		Latrines filled and overflowed	60,000	
Manchester	Christiana Moravian Primary		X	Wall collapsed		
				Sewage pit and overflowed	350,000	
St. Catherine	Hartlands All Age	X		School and yard flooded	80,000	
	White Marl Prim. & Jnr. High		X	Land Slippage	350,000	
	Marlie Mount Primary		X	Absorption Pits filled and overflowed	90,000	
	St. Catherine High		X	Absorption Pits filled and overflowed	100,000	
	Polly Ground primary	X		Latrines filled and overflowed	50,000	
	Spanish Town Primary		X	Absorption Pits filled and overflowed	120,000	

Source: ECLAC based on data received from the Ministry of Health.

Indirect damage to the sector resulted, in the main from the destruction of the sewerage systems attached to the schools and, to a lesser extent, from the use of schools as shelters as detailed in Table 9. As can be seen in the table above, many of the schools that suffered damage had pit latrines, which overflowed. The damage to schools caused by use as shelters was minimal as most families opted not to be moved into shelters.

Table 9
Jamaica: Indirect damage suffered by schools as a result from use as shelters

Total						700,000
Parish	Name of School	Rural	Urban	Type of Repairs needed	Estimate of Cost	
Clarendon	Frankfield Primary	X		Clean and repair	150,000	
	Toll Gate All Age	X		Clean and repair	300,000	
	York Town Primary	X		Clean and repair	150,000	
St. Catherine	Kentish Primary	X		Clean and repair	100,000	

Source: ECLAC based on data presented by the Ministry of Education, Government of Jamaica.

Following cultural practices, rural families affected by the floods were for the most part not relocated to shelters, preferring to move in with the extended family and friends or with neighbours until the event subsided. This positive cultural practice can be harnessed for relief and mitigation activities. It could prove harmful however, if the risks to health of the communities are severe and go underreported and become hidden.

Photo #3:



Photo #3 shows one of the flood victims interviewed during the assessment standing in one of the affected areas in the parish of St. Ann. He was a carpenter, who indicated that he walked about a half mile in the water to meet his children after school. He had carried them on his shoulders to a dry spot in the road so that they could continue the journey in the morning and was prepared to do so in the afternoon. He had not reported the flooding of his house nor had he sought any assistance from the health authorities although a clear risk to health was present.

The estimated damage to the education sector was in the vicinity of J\$3.2 million dollars. Table 10 presents the summary damages to the education sector, J\$2.5 Million accounted for direct damage and 700,000 accounted for indirect damage.

Table 10
Jamaica: Summary damages to the education sector

		Jamaican dollars 000
Total		3,220,000
Direct effects		
	i. Reparation of schools without improvement	2,520,000
	ii. Replacement of school materials and furnishings	
	Imported component	
Indirect effects:		
	i. Damages for use as shelters	700,000

Source: ECLAC, from data provided by the Government of Jamaica

5.3 Health sector

The health sector recorded the most visible and pronounced damages. The Ministry of Health has reported a wide-scale destruction of and damage to latrines, with resulting contamination of the environment, in particular of springs, streams, and rivers. The Ministry estimated, with its technical assessments yet to be complete due to the constraints of floodwaters, that 1,200 latrines needed replacement. Over 1,000 of these latrines were discovered in 22 communities in one Parish, Clarendon. Because of the clear and present danger to health, which this situation presents, the Ministry is seeking to cover total replacement costs for the indigent and partial assistance for others.

The floods have also increased the exposure of the population to infectious diseases as the breeding of vectors, mosquitoes and flies have increased. The Ministry reported that the Aedes household index, that is the percentage of households positive for the mosquito, which transmits dengue fever, has risen from 56 per cent to over 80 per cent since the start of the rains. In addition to the increase in dengue fever exposure two cases of typhoid were reported, but the Ministry reports that there have been no disease outbreaks or increase in the diseases under surveillance.

Estimates of the direct damage to the sector is in the vicinity of J\$32 million and the indirect damages amounts to some J\$10 million as outlined in Table 11. The Ministry of Health estimated that by the time the reconstruction costs were fully tallied the summary effects to the health sector would be in the vicinity of J\$80 million.

Ranked in order of economic value is the damage caused to the pit latrine systems in the affected areas, followed by the cost of insect vector control activities (46 per cent and 20 per cent of the total). These two costs alone account for more than half of the estimated damage to health sector. The other major costs derive from the damage to the health facilities and child health facilities, in the affected area.

Table 11
Jamaica: Summary of damages on the health sector

<u>Damages</u>				
Total	Total	Direct	Indirect	Imported Components
		42,842,697.00	32,792,000.00	10,050,697.00
Type of Damage				
Partial or total destruction of health infrastructure	5,300,000.00	5,050,000.00	250,000.00	2,650,000.00
Loss of equipment and furnishings	292,000.00	292,000.00		145,000.00
Health community - education material	1,200,000.00		1,200,000.00	
Extra spending on drugs and medication				
Vector control /environmental sanitation	8,600,697.00		8,600,697.00	
Damages in rural sanitation systems (latrines)	19,500,000.00	19,500,000.00		8,750,000.00
Damage to child health facilities	7,950,000.00	7,950,000.00		3,890,000.00

Source: ECLAC, from data provided by the Government of Jamaica

In its reconstruction and rehabilitation efforts the Ministry has attempted to meet the needs of the affected population by increasing its activities regarding source reduction and has hired private contractors to assist with the control of maggots and flies. Also routine services were offered at all facilities, except for intermittent closure of a few Health Centres due to leaks and flooded compounds. Solid waste remains a major challenge as the weather conditions and the saturated soil prevents burial of dead animals. The Ministry reports that over 100,000 chickens remain wet and in an advanced state of decomposition and contribute to the fly and odour nuisance.

The priority areas for health remain the environmental health issues, such as vector control, removal of dead animals, excreta disposal and ensuring safe treated water. Special public education programmes have been implemented focusing on water safety, diarrhoeal diseases, vector control and general sanitation.

6.0 Damage in productive sectors

This section provides an assessment and evaluation of the damages, both direct and indirect, to the productive sectors. The analysis focuses on the agricultural sector (crops and livestock), which due to the nature and spatial location of the natural disaster suffered most damage. A detailed analysis by parish and crop and by parish and livestock losses is presented. The assessment includes estimates of damages to agricultural infrastructure.

The main crops affected were those destined for domestic consumption. Export crops were also damaged but to a lesser extent. However, the macroeconomic effects of the latter are more visible as these translate in a reduced export capacity. The crops that were most susceptible to the

event were the small and underground crops. Losses in the livestock sub-sector were concentrated in poultry.

This section also includes estimates of damages to the tourism sector. These include those that affect infrastructure and the reduced flows of income derived from the decrease in visitors and in particular visitor expenditure. In the particular case of Jamaica the tourist infrastructure affected by the floods was exclusively direct, that is, beaches and attraction parks. Indirect damages were negligible.

Finally, damages to the other sectors (manufacturing and distribution) are of an indirect nature. These are caused mainly by the interruption or losses in the provision of inputs from the agricultural sector for further processing which causes a disruption in the productive chain. In turn, a decrease in the production of agricultural based manufactured output materializes in a reduction in the flow of income to the producers. Direct damages in these sectors were minimal, if any, and were not reported.

6.1 *Agriculture, livestock and fisheries sectors*

The agricultural sector suffered important damages as a result of the floods that affected Jamaica at the end of May 2002. The direct effect of the floods was reflected in the destruction of agricultural assets, livestock, crops and agricultural infrastructure (see Tables 12-17).

The estimated direct loss to livestock amounts to J\$99 895 000 (see Table 15). It includes losses of chicks, pigs, goats, layers, cattle, fish and donkeys. Most of the damage is concentrated in the poultry industry in the Clarendon parish with 362,050 chicks lost as a result of the floods. That of crops was estimated to have covered an area of 2,423 hectares reaching a total value of J\$419,241, 000. If to this total the damage to roads is added the grand total direct damage is estimated at J\$578,163,895. The total farmer population affected is estimated to be 17,974.

The indirect effects comprise the reduction in productivity and future output losses due to the disaster damage. These are computed at J\$205 million. Thus total direct and indirect damages are estimated at J\$1,013 million (see Table 17).

Twelve out of the existing 14 parishes experienced losses of crops and livestock with varying degrees of intensity. The parishes of Clarendon, St. Elizabeth and St. Catherine registered the most severe losses of crops and livestock (\$251, \$97 and \$28 million, respectively) bearing 88 per cent of the estimated total. These parishes contribute 9 per cent, 24 per cent and 4 per cent, respectively, to total agricultural production. The number of affected farmers was concentrated in the parishes of St. Ann, St. Elizabeth and Clarendon (30 per cent, 20 per cent and 8 per cent, respectively) (See Table 12).

The Parish of St. James was the most intensely affected as it recorded the highest monetary loss per unit of hectare damaged followed by Clarendon and St. Mary. Clarendon also suffered the biggest productivity loss. The ratio of value lost per farmer affected by the floods was highest in that parish reaching J\$123,000 with St. Catherine following with an estimate of damage equivalent to

J\$41,000. Finally, St. Ann, St. Mary, and St. James showed the largest concentration of farmers affected by the natural disaster per damaged hectare. (See again Table 12).

In terms of damaged hectares per hectares reaped (obtained the reaped hectares for April 2001- March 2002) the damage was most severe in Clarendon, St. Thomas and St, Catherine (23 per cent, 19 per cent and 11 per cent, respectively).

Table 12
Flood damage indicators per parish

Parish	Total Hectares damages	Hectares damaged as percentage of total Hectares reaped	Value In \$J	Number of farmers affected	Value per Hectare in \$J	Value per Farmer \$J	Farmer per hectare
St. Andrew	51.5	6.4	1,204,000.0	715.0	23,378.6	1,683.9	13.9
St. Catherine	152.0	11.0	25,410,000.0	620.0	167,171.1	40,983.9	4.1
St, Thomas	168.3	18.8	13,254,000.0	1,328.0	78,752.2	9,980.4	7.9
St. Mary	39.8	3.6	10,145,000.0	600.0	254,899.5	16,908.3	15.1
St. Ann	163.2	7.1	33,202,000.0	5,015.0	203,443.6	6,620.5	30.7
Clarendon	628.0	22.9	185,130,000.0	1,504.0	294,793.0	123,091.8	2.4
St. Elizabeth	650.0	6.0	8,220,000.0	3,558.0	12,646.2	2,310.3	5.5
Manchester	341.0	9.2	30,802,000.0	1,968.0	90,328.4	15,651.4	5.8
Trelawny	34.5	0.6	5,933,000.0	330.0	171,971.0	17,978.8	9.6
Hanover	32.0	3.1	5,137,000.0	300.0	160,531.3	17,123.3	9.4
St. James	37.5	0.3	12,324,000.0	542.0	328,640.0	22,738.0	14.5
Westmoreland	124.9	3.3	14,500,000.0	1,494.0	116,092.9	9,705.5	12.0
Total	2,422.7	5.1		17,974			

Source: RADA and ECLAC estimates based on official figures.

The crops affected include mainly domestic crops and also export crops. The totals include pulses, vegetables, condiments, cereals, fruits, bananas and ground provisions. The loss of stock in the aggregate is greater for vegetables and ground provisions with a direct damage estimate of 138 and 114 million and 1,057 and 456 hectares affected respectively. (See, Tables 13 and 15).

The crops affected were at various stages of maturity. At the early stages of growth the damage is considered to be less significant than at the mature stages when crops are reaching harvesting time. In the early stages it is mostly a question of replanting the land whereas in the latter stages the efforts and costs carried out to obtain the produce are expended in vain and have to be replicated. In the particular case of the May floods, in terms of value per hectare lost bananas, fruit and cereals were the most severely affected crops (J\$645, J\$468, J\$200, respectively, per hectare damaged). This responds to their vulnerability when exposed to the type of phenomenon that affected Jamaica at the end of May.

Bananas are crops susceptible to be damaged by wind and rain. Condiments are also likely to be affected by floods since these are not tall plants and are susceptible to be affected by flooding. Ground provisions are in principle less prone to be damages by floods as these are underground

plants although they are affected when water remains without draining for a significant period of time.

Table 13:
Estimated of flood damage to crops by parish

Parish	Crops (hectares)							Total
	Pulses	Vegetables	Condiments	Cereals	Fruits	Ground Provisions	Other	
St. Andrew	8.2	20	4	10.7	3.8	4.8		51.5
St. Catherine	10	600	15	8	5	38	16	152
St, Thomas	29.9	52.2	7.3	2.5	9.4	21	26	168.3
St. Mary	2	12	3	8.8	2	7	5	39.8
St. Ann	6.5	106.5	15.2	9		26		163.2
Clarendon	43	221	31	57	3	201	72	628
St. Elizabeth	164	276.3	153.5	12	7	37.2		650
Manchester	25	146	48	12	8	102		341
Trelawny	2	13.7	2	2.5		14	0.3	34.5
Hanover	4.5	5	5	8.5	0.5	6.5	2	32
St. James	3	19.5	2	3	2	.....	8	37.5
Westmoreland		124.9	.....	.....	.....	.....	.....	124.9
Total	298.1	1057.1	286	154	40.7	457.5	129.3	2422.7

Source: RADA

Table 14
Estimated of flood damage to livestock by parish

Parish	Livestock					
	B/chicks	Pigs	Goats	Layers	Cattle	Others
St. Andrew	6100	18	30			
St. Catherine	6000	30	150			Fish
St, Thomas	4800	118	90	525	95	Donkey
St. Mary	5200	45	50	100	15	
St. Ann	7000	30	50		20	
Clarendon	300000	550	5500	2500	470	Fish
St. Elizabeth	15000	3000	1000		280	Donkey
Manchester	4500	70	760		20	Donkey (4)
Trelawny	1900	20	15		3	
Hanover	1500		17		13	Boats /pots
St. James	2050	78	5			
Westmoreland	8000		5			
Total	362050	3959	7672	4225	916	

Source: RADA

The overall banana losses amounted to 88 hectares, which is equivalent to J\$56.9 million. The effect on the banana sector is particularly important since it represents an important export crop accounting for 12 per cent of total agricultural exports in 2001 and the stock losses will have a

negative impact on the trade balance. Other export crops, sugar and coffee were also affected. In the case of coffee there is no official or comprehensive estimate at the time this report was being finalized. However, unofficial estimations indicate that more than 5,000 boxes have been damaged with a cost of J\$1,800 per box amounting to a figure of J\$10.8 million. However this figure may underestimate the extent of the damage. Coffee production for 2001 was above J\$1,415 which would imply that the damage caused was not significant.

Table 15
Summary of direct damage
Estimates of flood damage by crop, hectare and value

Crops	Hectare	\$J	Value per hectare a/
Pulses	298.1	24582497	82463.9
Vegetables	1057.1	138243840	130776.6
Condiments	286	32830622	114792.4
Cereals	154	30760948	199746.4
Fruits	40.7	19042757	467881
Banana	88.3	56923000	644654.6
Ground provision	457.5	113820731	248788.5
Others	41	3036500	74061.0
Total	2422.7	419240895	
Livestock			
Broilers	36050	58788400	
Layers	4225	1726000	
Goats	7672	20186000	
Pigs	3959	10171100	
Cattle	916	4380000	
Others		4553500	
Fish, pots, boats and rabbits			
Donkey	6	90000	
Total		99895000	
Roads			
	397 Km	59028000	
Farmers	17974		
Grand total		578163895	

Note: a/Calculated only for crops.

Source: Rural Agricultural Development Authority.

Finally, in the case of sugar the damage is mostly of an indirect nature. Water accumulation in the sugarcane fields is absorbed by the sugar cane. This causes a delay in reaping and thus provokes an alteration in the content of sucrose in the sugar cane. This in turn determines the tonnes of cane required to produce one tonne of sugar. The greater is the absorption of water by the cane the greater will be the tonnes of cane necessary to produce one tonne of sugar. This lowers the yield of cane sugar and increases the variable costs incurred in the production of sugar. The ratio of tonne of cane per ton of sugar stood at 11 in 2001 and will increase as a result of the floods.

Agriculture infrastructure damage was concentrated in farm roads. Preliminary estimates indicate that the damage to farm roads exceeds J\$59 million (see Table 16). The parishes of Clarendon, St. Catherine, St. Mary and St. Ann are the worst affected.

Table 16
Summary of direct damage
Estimates of flood damage by crop, hectare and value

Crops	Hectare	Value J\$
Pulses	298.1	24582497
Vegetables	1057.1	138243840
Condiments	286	321830622
Cereals	154	30760948
Fruits	40.7	19042757
Banana	88.3	56923000
Ground provision	457.5	113820731
Others	41	3036500
Total	2422.7	419240895
Livestock		
Broilers	36050	58788400
Layers	4225	1726000
Goats	7672	20186000
Pigs	3959	10171100
Cattle	916	4380000
Others		4553500
Fish, pots, boats and rabbits		
Donkey	6	90000
Total		99895000
Roads	397 Km	59028000
Farmers	17974	
Grand total		578163895

Source: Rural Agricultural Development Authority

Table 17
Direct and indirect damage of the floods to the agricultural sector

Crops	Direct	Indirect	Total
Pulses	24582497	4916499.4	29498996.4
Vegetables	138243840	48385344	186629184
Condiments	321830622	48274593.3	370105215.3
Cereals	30760948	9843503.36	40604451.36
Fruits	19042757	3237268.69	22280025.69
Banana	56923000	51230700	108153700
Ground provision	113820731	17073109.65	130893840.7
Others	3036500	819855	3856355
Total	419240895	183780873.4	892021768.4
Livestock			
Broilers	58788400	11757680	70546080
Layers	1726000	172600	1898600
Goats	20186000	6055800	26241800
Pigs	10171100	1423954	11595054
Cattle	4380000	876000	5256000
Others	4553500	910700	5464200
Fish, pots, boats and rabbits			
Donkey	90000	18000	108000
Total	99895000	21214734	121109734
Grand total	578163895	204995607.4	1013131502

Source: Rural Agricultural Development Authority

6.2 Tourism

The tourism sector also suffered losses as a result of flood damage, albeit minor losses. The damages were mainly direct damages mostly related to infrastructure, and damages to beaches and attractions, and is concentrated in the tourism areas on the south coast. The estimated total amounts to J\$425 000 for the areas on the south coast. A further J\$750 000 has been estimated as damages to tourism attractions (See, Table 18). Indirect damages arising from interruptions or decreases in the flow of tourist incomes due to fewer visitors, lower average expenditure and disruptions of agricultural inputs are negligible.

Table 18
Flood damage to the tourism sector

Flood damages to tourism areas on the South Coast	
Beaches	Estimated direct damage
Great Bay Beach	100 000
Frenchman Beach	50 000
Fort Charles Beach	75 000
Parotee Beach	100 000
Galleon Beach	100 000
Attractions	
Cashoo Ostrich Park	250 000
Apple Valley Park	300 000
YS Falls	200 000
Total	750 000
Grand total	1 175 000

Source: Mandeville Weekly Community Development LTD.

6.3. Manufacturing and distribution

Direct damages to industry and commerce were practically non-existent. The May floods did not affect factories and production facilities. However, indirect damages occurred in these sectors as a result of interruptions to the production and distribution circuits. Total damage was estimated at J\$631,000 (see Table 19).

The production circuit was affected by the damage to crops, which reduced the supply of inputs provided to producers. The distribution circuit was affected by the damage to roads, which disrupted the delivery channels of inputs or finished products. As a result the floods had a negative impact on income. Suppliers of agricultural inputs, the sellers of finished agricultural based manufactures and economic agents involved in the distribution circuit experienced income losses.

It is to be noted that in some cases, income effects were compounded by their interaction with substitution effects in the case of the affected population. Economic agents affected by the floods faced a tighter budget constraint and, following their needs, changed the composition of their basket of goods affecting the income of the producers of these goods.

Table 19
Jamaica Summary of damages in manufacturing and distribution (\$J000')

	Total damage	Direct damage	Indirect damage	Estimate of impact on international trade
Manufacturing and distribution	631	.....	631	450

Source: ECLAC, from data provided by the Government of Jamaica

7.0 Infrastructure

This section provides the assessment of damages to infrastructure. The infrastructure sectors considered are transport, energy, water and sanitation and telecommunications. The most detailed analysis is provided for the transport sector due to the nature of the event (flood) which provoked landslides, road erosion and damage to drainage structures which accentuated the intensity of the damages. Also, damages in the transport sector were of greater significance and intensity relative to other sectors. Finally data was readily available. However, in all cases with the exception of telecommunications the section includes a breakdown of direct and indirect damage assessment and evaluation. In the case of telecommunications damage was mainly direct damage and was concentrated in poles and lines.

7.1 Transport

7.1.1 Direct Damages

The primary cause of damage to the road networks within the affected parishes stemmed mainly from the inability of drainage systems to convey the excessive flows that occurred. Differing forms of road damage that were observed were:

(a) As a result of rivers and watercourses flowing at high water level stages, many sections of roadway or embankment were eroded. An example of this type of erosion is shown below. In this instance, a relatively small drain and culvert (in the Berry Dale community just east of Porus) has been broken off as the floodwaters have eroded the land and road around the culvert. The broken edge of culvert can be seen in the foreground of the photograph;

Photo #4:



(b) To compound the problem experienced with swollen watercourses, an additional problem was due to the fact that some rivers brought down significant quantities of sand and gravel, which had the effect of reducing the conveyance of the waterway areas. This was particularly true of the eastern parishes, such as St. Thomas; and

- (d) In built up areas and along roads where water flow was relatively contained, the typical drainage swales along the verges of the road were totally incapable of conveying the quantity of water that was experienced. In many cases, this resulted in the pavement of the road being eroded, and the sub-base material being quickly carried away. A typical example of this type of damage is shown in the photograph below.

Photo #5



In summary, the damages included:

- (a) Damage to and destruction of retaining walls;
- (b) Blocking and destruction of drains and culverts;
- (c) Damages to bridge approaches; and
- (d) Landslides.

During the initial emergency phase of the disaster response, efforts were concentrated primarily on the clearing of roadways where landslides had resulted in blockages, the clearing of

drains where blocking had resulted in backing up of water and the temporary patching of roads where driving surfaces had been worn away. Emphasis was also placed on the erection of barriers and warning signs where roads had been broken away. One of the main problems encountered was the fact that the ongoing nature of the flood rains (approximately over a period of 10 days) caused multiple re-opening of many roads. This was particularly true in the parish of St. Thomas.

A summary of the direct damages for these affected roads (main roads and some Parish Council roads) is given in Table 20 below. The values are based on estimates prepared by the National Works Agency. The values given in the table reflect the fact that the NWA has allocated preliminary funding to carry out initial repairs that would be sufficient to have the damaged roads re-opened. In addition, the total estimates of damage are given for each parish.

Table 20

Parish	Description	Extent (km)	Costs (J\$)	Totals (J\$)
Westmoreland	Road rehabilitation including drainage works	14		54,900,000
St. James	<ul style="list-style-type: none"> • Flood Control • Patching • Landslips • Clear debris 	37	<ul style="list-style-type: none"> • 600000 • 945000 • 57000 • 43000 	1,600,000
Hanover	<ul style="list-style-type: none"> • Patching • Landslips • Rubble Walls • Gabion Walls • Clear trees 	40	<ul style="list-style-type: none"> • 329000 • 82200 • 576000 • 540000 • 5000 	1,500,000
Trelawny	<ul style="list-style-type: none"> • Patching • Landslips • Replace culverts • Rubble wall 	70	<ul style="list-style-type: none"> • 2660000 • 664800 • 740000 • 2560000 	6,600,000
St. Elizabeth	Road rehabilitation; clearing of slips; clearing of blocked drains; construct drains and walls	60		68,500,000
Manchester	<ul style="list-style-type: none"> • Clear slips • Repair roads • Repair verges • Clear/pave drains • Culverts/walls 		<ul style="list-style-type: none"> • 1781000 • 18665000 • 4470000 • 2152000 • 49413000 	76,500,000
Clarendon	<ul style="list-style-type: none"> • Slips/blockages • Repair roads • Clear drains • Walls 		<ul style="list-style-type: none"> • 9945000 • 24450000 • 4163000 • 23410000 	61,970,000
St. Ann	Repair road pavement; clean, repair and pave culverts and drains; construct walls; construct gabions.			127,000,000
St. Andrew	Clear silt and blocked roads; repair roads; clear blocked drains; construct or reconstruct walls.		<ul style="list-style-type: none"> • 1580000 • 4500000 • 892000 • 300000 	7,272,000
St. Thomas	Clear landslips and blocked roads, repair roads; clear blocked drains and/or repave; construct or reconstruct walls		<ul style="list-style-type: none"> • 92710000 • 25750000 • 20385000 	138,845,000
Portland	Clear landslips and blocked roads, repair roads; clear blocked drains and/or repave; construct or reconstruct walls		<ul style="list-style-type: none"> • 9591650 • 3088000 	12,700,000

Source: ECLAC, from data provided by the Government of Jamaica

Estimates for damages were also done by the Ministry of Local Government and Community Development, for roads and drains that fall under its jurisdiction. Even though they also estimated the cost of an immediate response required to get the roads reopened, their method of assessment did not appear to be completely equivalent with that applied by the NWA.

The total estimate of works to be done, and of the cost of these rehabilitation works, was developed by the NWA on a parish-by-parish basis. A summary of these is given in the following table for 11 of the parishes, which also outlines the type of damage and rehabilitation that was observed (see Table 21).

Table 21
Rehabilitation estimates

Parishes	NWA Estimate (J\$)	MLGCD Estimate (J\$)	Total Direct Roads (J\$)
Kingston	84,300,000.00		
St. Andrew	7,272,000.00	101,555,000.00	193,127,000.00
St. Catherine	121,400,000.00	84,352,000.00	205,752,000.00
Clarendon	61,970,000.00	58,160,000.00	120,130,000.00
Manchester	76,500,000.00	89,950,000.00	166,450,000.00
St. Elizabeth	68,500,000.00	103,755,000.00	172,255,000.00
Westmoreland	54,900,000.00		54,900,000.00
Hanover	1,500,000.00		1,500,000.00
St. James	1,600,000.00	7,400,000.00	9,000,000.00
Trelawny	6,600,000.00		6,600,000.00
St. Ann	127,000,000.00	77,560,000.00	204,560,000.00
Portland	13,600,000.00	17,310,000.00	30,910,000.00
St. Thomas	138,845,000.00	39,000,000.00	177,845,000.00
St. Mary	8,200,000.00		8,200,000.00
TOTAL	772,187,000.00	579,042,000.00	1,351,229,000.00

Source: ECLAC, from data provided by the Government of Jamaica

Table 22 below summarizes the direct damages to roads and associated drains, as recorded by both the NWA and the Ministry of Local Government. This table therefore gives the total figures for this infrastructural sector, on a parish-by-parish basis.

Table 22
Direct damage to roads

	Length (km)	Labour	National	Foreign	Total (J\$)
Main Roads	400	135,132,725	405,398,175	231,656,100	772,187,000
Parochial Roads	Unknown	101,332,350	303,997,050	173,712,600	579,042,000
Farm Roads	400	22,750,000	68,250,000	39,000,000	130,000,000
Total		259,215,075	777,645,225	444,368,700	1,481,229,000

Source: Data supplied by RADA.

Finally, the data for the main and parochial roads were combined with data supplied by the Rural Agricultural Development Authority (RADA). Data from this source include lengths of affected roads only. Estimates were made of the value of repairs based on in-field observations and from unit values developed for the parishes of Portland and St. Mary during the assessment carried out by the ECLAC team in Jamaica last year.

The summary values were then broken down into local, and foreign components, and the labour component was estimated. These ratios were developed taking into account the requirements for road reconstruction and drain rebuilding.

7.1.2 Indirect damages

Three sources for indirect costs in the ground transportation system were identified as a result of damages to highways and roads. These are:

- (a) Inconvenience to users of buses and light vehicles as a result of roads being cut off, as some of these users had to seek alternative methods of transport;
- (b) Increase of vehicle operational cost and time expenses as a result of vehicles having to make alternative and longer trips; and
- (c) Increase of vehicle operational costs as a result of vehicles having to use roads having poorer condition of pavement.

7.2 Energy

The Office of Disaster Preparedness and Emergency Management (ODPEM) reports that the Jamaica Public Service suffered some damage to equipment primarily in the parishes of Kingston, St. Andrew, St. Thomas, Portland, St. Mary, Clarendon and Manchester. At the time of the ODPEM visit, there were approximately 15 areas throughout these seven parishes that were without electricity. To date, costs of direct damages have been made available.

Based on the number of affected persons determined in the social sector, it is estimated approximately 2000 households would have been without electricity during the intense rainfall. In total, this blackout period could have lasted for up to 3 – 5 days. Applying an average rate of J\$7.00 per kilowatt hour, and a typical household usage of 500 kilowatt hours per month, therefore leads to an estimate of the lost revenues during this period, of J\$1,170,000.

7.3 Water and sanitation

The National Water Commission (NWC) systems suffered damage across the island, with Clarendon being the worst affected. The problems encountered included silting of settling tanks and filters, damage to pumps and electrical equipment, scouring of pipelines, blocked canals and flooded well fields and stations. Water quality in many of the distribution systems was compromised, with a resultant threat to public health.

Estimated damages to NWC equipment was J\$48,700,000. Additional estimates were made by the Ministry of Local Government and Community Development, for damage to water supplies across the island. This amounted to J\$3,405,000. Together, these bring the total estimate for direct impacts in this sector to J\$52,105,000.

Direct damage on sewer systems was due mainly to siltation of wet wells. Costs associated with this damage totalled J\$2,700,000.

Indirect costs associated with this sector may be obtained from an evaluation of costs associated with water transportation, increase of chemical treatment, emergency power supply, etc. Many systems were out of water for a period of up to 12 days, and extra trucking of water was done at a cost of J\$4,000,000. Overall, indirect costs amounted to J\$30,000,000. This figure included the effect of reduced income. It was noted that the average income for a five month period (December – April) was J\$392,000,000. This was reduced to J\$361,000,000 in May.

7.4 Telecommunications

Cable and Wireless Jamaica Ltd. Reported that they suffered damage mainly to poles and lines. Mainly damage occurred in the Golden Grove area, where one mile of poles and lines went down. Damages were observed in St. Andrew, St. Thomas, Portland, Clarendon, Manchester, St. Ann and St. Mary. In all, approximately 3,800 customers were without service during and immediately after the event. The estimated cost of direct damage for this sector is J\$4,457,000.

8.0 Effects on the Environment

Following a background description of the environmental characteristics of Jamaica that are relevant for an understanding of the damage assessment, the section provides a description of the environmental impact of the floods. The subsections deal with a series of issues including, among others, changes to natural water courses and flow, aquifers, erosion and sediment deposit, landslide and rock slips, degraded water quality ecosystem and habitat damage and wildlife and biodiversity. Estimates are provided in the relevant subsections and to the extent that data was available.

8.1 Background

Jamaica's environment is characterized by high endemism in bird and plant life, relatively impressive biodiversity, along with contrasting mountainous and flat topography comprising areas of outstanding scenic appeal. It is an environment that owes its existence to natural phenomena and is in part sustained by natural hazards. However, because the natural environment provides a range of goods and services to the populations of various countries, natural hazards are viewed as disasters and essentially inimical to the socio-economic well being of communities.

Direct damage to environmental stocks (forests, reefs, aquifers for example,) can be measured but often with difficulty particularly where data is lacking. Indirect impact on environmental services such as tourism and fresh water supply is easier to measure but also require reliable data. The southern part of the country, including the parishes mainly affected by the rains and floods contain resources of significant socio-economic value including wetlands, natural forests and some of the most important alluvial aquifers, supplying in excess of 50 per cent of the country's water requirements.

The potential direct and indirect damage from the rain and floods of 22 May – 3 June 2002 on environmental goods and services was therefore a concern in approaching this assessment. Unfortunately, environmental impacts were not considered a priority in the work undertaken by local authorities in the assessment of damage. As a result, data to cost direct and indirect impacts is lacking. The environmental assessment is therefore for the most part a description of impacts, with costing only applied where the information was available.

8.2 Environmental impacts

Environmental damage from the rains is grouped in the following categories:

- (a) Major changes to natural watercourses including rivers;
- (b) Damage to well fields and aquifers;
- (c) Extensive soil erosion;
- (d) Sediment deposition;
- (e) Beach erosion;
- (f) Land and rock slips;
- (g) Degraded water quality;
- (h) Ecosystem and habitat damage;
- (i) Wildlife impact;
- (j) Landscape impacts; and
- (k) Impacts on coastal systems

8.2.1 Changes to natural water courses and flow

Stream flow changes resulted from the unusual volume and velocity of storm water generated by the rains. Physical change to natural stream banks was observed and new courses were created in some cases (See Photo 8). In addition to the changes created by flash floods, subsurface water flow, as evidenced by sub-surface to surface discharges were occurring in several areas two weeks after the rains. In the Redberry District of Manchester one of these discharge points was estimated to be generating in excess of 1 gallon of water per second. Hydrological phenomena, such as the rising of water levels at Content in Manchester (see Photo 7) was not seen in most people's lifetime and attracted many visitors.

Photo #6:
Rocks deposited near house in Clarendon.
Floodwaters created new watercourse and altered topography.



Ponding of water occurred throughout the affected areas and in some cases deep enough to allow swimming (Photo 8). As an indication of the severity of the rains, ponding occurred not only in coastal low elevations and low-lying areas but also at higher elevations where depressions in the terrain occur. In some cases the trunks of fruit trees such as mangoes, ackee, and avocado pear and of other mature trees were submerged in water for over two weeks and are likely to remain submerged for at least another week. This is likely to have adverse effects on plants susceptible to prolonged water inundation.

Photo # 7:
Evidence of water table that rose above grade at Content, Manchester.
Several Houses including this one were flooded.



Photo # 8:
Temporary lake created at River Bottom/Water Mouth in the Redberry District of Manchester. Note the young persons swimming.



8.2.2 *Impact on aquifers*

Jamaica's alluvial aquifers constitute a major environmental resource, as indicated in the number of wells existing various sites listed in Table 24. Of the five major affected areas, water produced by extensive alluvial aquifers of St. Catherine and Clarendon are critical to domestic, irrigation and industrial water supplies. The National Water Commission reported among damages to its systems, the flooding of well fields. Flooding of well fields was to a large extent the result of water tables that rose beyond levels seen in recent times.

Table 23
Approximate number of wells in major disaster areas

Parish	# Wells					
	Domestic	Irrigation	Irrigation/ domestic	Industrial	Public	Stock
St. Thomas	8	5	-	13	5	-
St. Catherine	6	85	-	14	44	3
Clarendon	41	117	1	12	-	-
Manchester	10	1	-	1	-	-
St. Elizabeth	6	5	-	2	22	-
Total	71	213	1	42	71	3

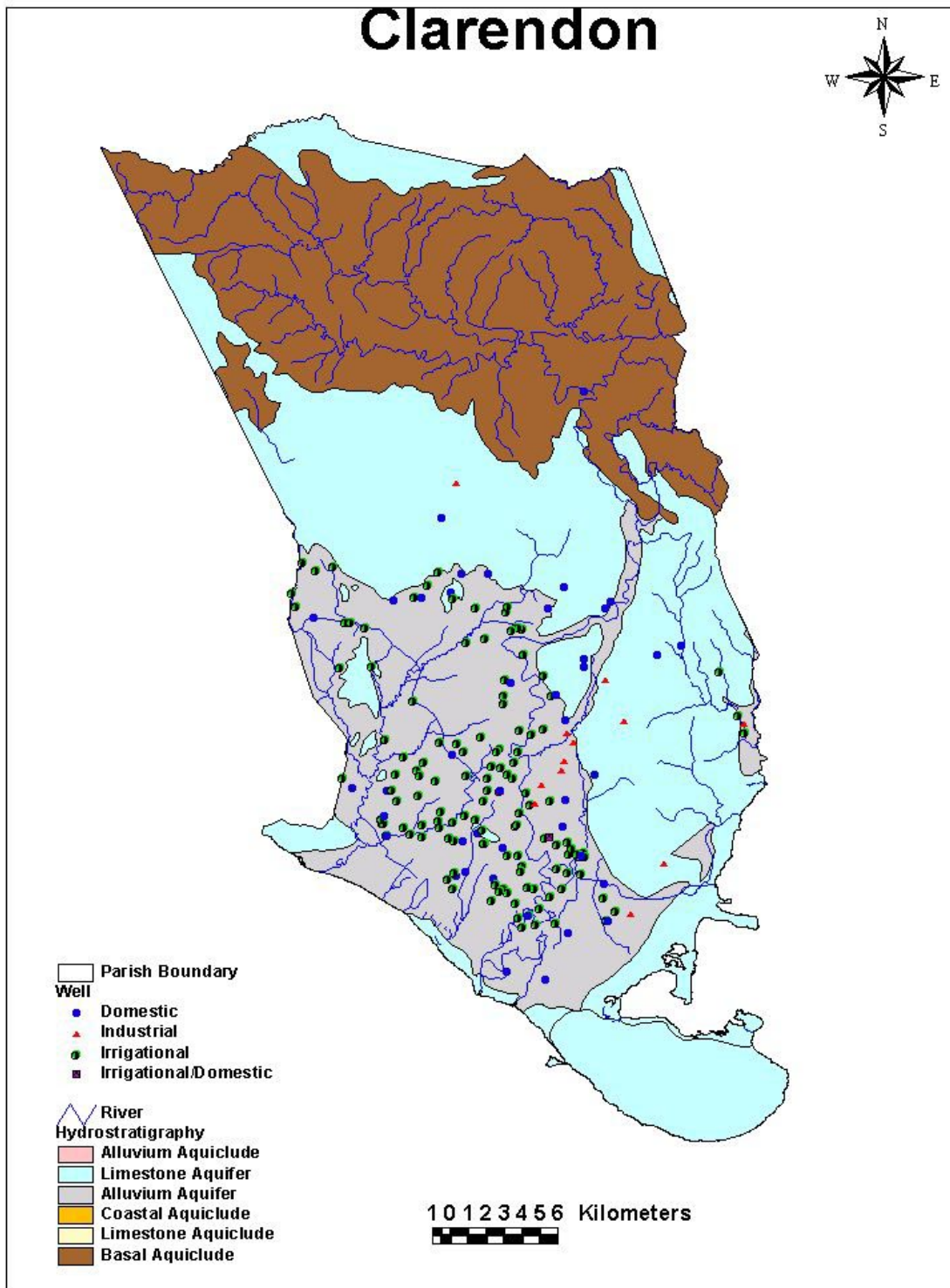
Source: Calculated from maps provided by the Water Resources Authority

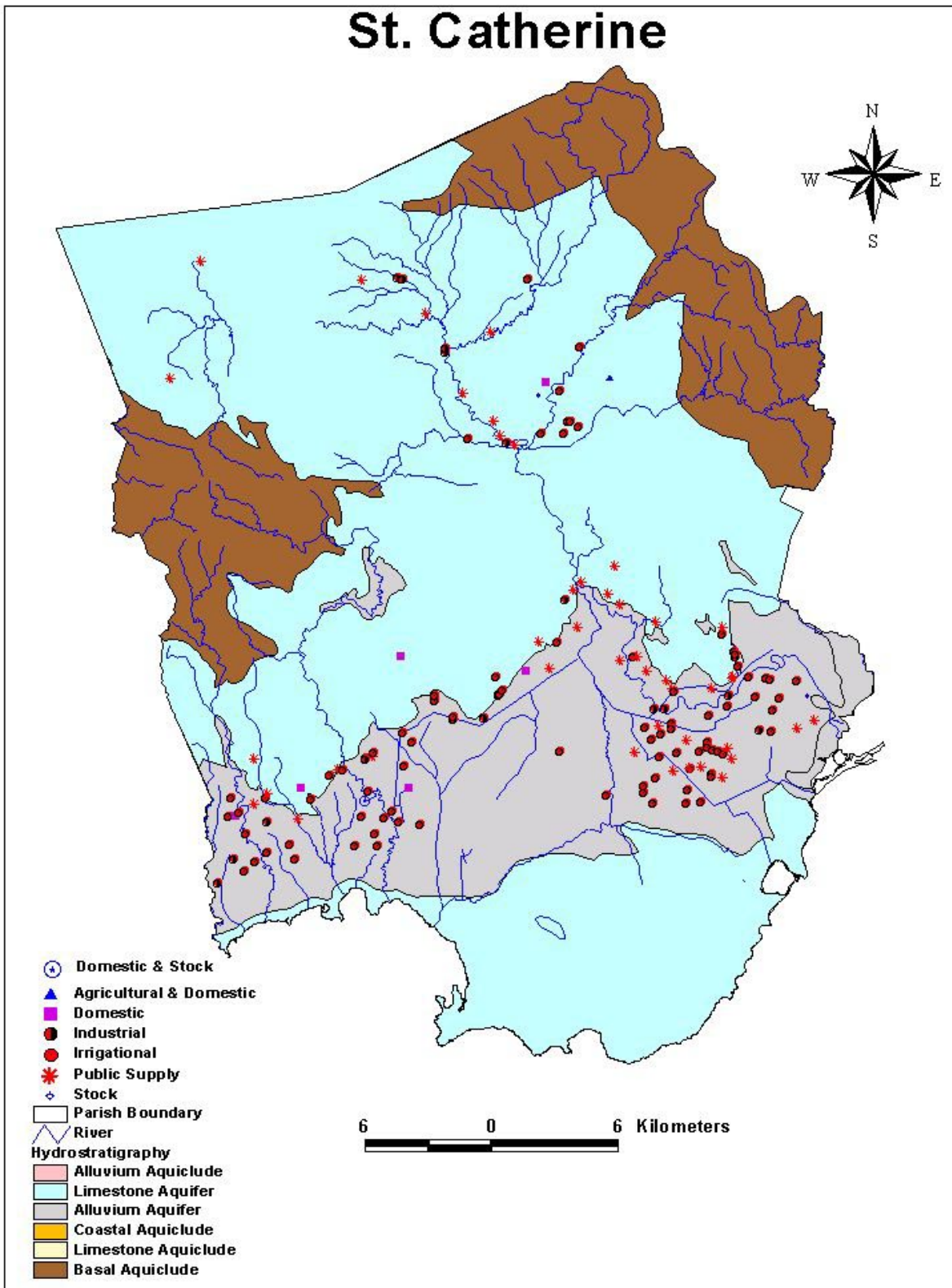
According to the Water Resources Authority a 900 feet well in the Content area of Manchester rose 300 feet as a result of the rains. An indication of this was the temporary pond of water next to the main road in Content that over 2 weeks after the rains had not subsided (Photo 00)

The direct cost to water infrastructure including wells is covered elsewhere in the report. The effect on aquifers is however considered an environmental impact and therefore requires attention by resource managers. The increased cost of improving water quality is an environmental related cost but could not be determined at the time at which this assessment was being undertaken. Indirect cost associated with the temporary loss of water supply could not be determined.

8.2.3 *Erosion and sediment deposit*

Erosion was widely reported and observed in several locations. One of the major deposits of sediment occurs in the Yallahs River, St. Thomas. Yallahs River is a major source of sand in the country. The National Environment and Planning Agency (NEPA) reported that several tons of sand and gravel mixed with logs and branches blocked culverts through the Yallahs Fording. Sediment caused a back-up of water that inundated the fording with "several meters" of water. As a result the Yallahs Fording was for the most part "inaccessible to vehicular traffic" (NEPA: Overview of May Rains 2002) from May 23 – June 1 and motorists used the road at their own risk.





Estimates of sediment deposits at Yallahs River and other areas were not available during this assessment. Baseline data on sediment data rates at the Rio Minho and Yallahs Rivers derived from studies by the Mines and Geology Division should provide the basis for estimating sediment volumes. Sedimentation data for other rivers is being assembled by the Forestry Department but was not available during the assessment.

Erosion of riverbanks was a common but unmeasured impact. Loss of agricultural land adjacent to riverbanks resulted from erosion in some areas but estimates of acreage loss were not available. Although erosion was not quantified, volume was assumed to be in the thousands of tons as evidenced from blocked channels, sediment deposited under bridges or re-deposited around buildings, on roadways and in natural drains.

Topsoil loss from slopes and undulating terrain was observed but not measured. On the other hand, some low lying or topographically depressed areas would have actually experienced a net gain in soil, particularly where topography resulted in slow release of water that allowed sediment to settle. Net sediment loss was common for slopes in Manchester where the highest rainfall was experienced between 22 May and 3 June 2002.

8.2.4 Land and rock slips

Landslips are usually determined by physical or environmental factors such as slope angle, vegetation cover, soil, type permeability and rainfall. Landslips were reported or observed in several areas. NEPA reported three major landslides along the Beacon Hill main road, St. Thomas, one of which destroyed a four-bedroom house, leaving a family of seven homeless. Direct and indirect costs associated with the damage to the house are calculated in the housing sector.

Apart from the costs associated with damage to property, and the interruptions to traffic flow and resultant increases in agricultural prices among other impacts, landslips adversely affect the landscape and diminish scenic appreciation and visual values, which are difficult to cost and could not be done for this assessment. Criteria for scenic and visual value should be adopted for future hazard events and would be particularly critical for areas like St. Thomas, which is considered of high risk to landslips.

Reported cases of rock slips were less than landslips but nevertheless threatened property and life. Rocks deposited next to a house in Clarendon close to the boundary with Manchester was an example of energy generated by slope runoff, enough to cut a new drainage (which alters the topography) and to displace and deposits rocks with diameters of 1-3 ft on the property of a relatively large household.

8.2.5 Degraded water quality

Temporary impairment of water quality in rivers and near shore areas from suspended sediment was widespread. This is a normal occurrence from major rainfall events but the intensity and duration of the rains meant that the volume of sediment reaching the coast is believed to have been significantly higher than any time in recent memory. Widespread ponding resulted in the flooding and covering of pit latrines and soakaway systems that contaminated both surface and

ground water. It is speculated that faeces related bacteriological contamination of alluvial aquifers occurred in areas where homes are built in close proximity to well fields. Water quality testing to determine this has unfortunately not been done at the time of the assessment.

The impact from sediment deposited in coastal areas was not determined because data was not available. This should be a consideration for future hazard events because of the known relationship between prolonged turbidity and damage to corals. It is assumed that corals would have had difficulty flushing fine sediments while they remained in suspension. If pre-event baseline data on corals systems exist, an evaluation of the effects related to the rains could still be considered.

Despite the absence of data it is concluded that there were direct impacts on water quality resulting from the floods, namely:

- (a) Sediment pollution (turbidity) of rivers and streams that was temporary and whose visual effect in light of human and other socio-economic concerns was negligible;
- (b) Damage to fish species of rivers and estuaries from turbidity and water velocity;
- (c) Possible damage to coral species and other coastal marine life; and
- (d) Bacteriological contamination of water requiring additional treatment.

A major direct cost is attributed to restoring water quality to acceptable standards but could not be included in this assessment due to the lack of data at the time of this writing.

Indirect costs for disruption of water supply are associated with:

- (a) Loss of revenue to National Water Commission (NWC);
- (b) Costs to NWC for trucking water; and
- (c) Temporary loss of revenue for businesses having experiencing water shortages.

These costs have been allocated to the infrastructure section of this report. In reality however, that portion of the indirect costs associated with disruptions due to substandard water quality should be considered an environmental cost.

8.2.6 Ecosystem and habitat damage

An official assessment of damage to ecosystems and critical wildlife habitats was not done by local authorities. The reason for this is not clear but given the socio-economic value of these areas, future consideration should be given to evaluating direct and more so indirect damage to ecosystems and habitats. Hydrological functions provided by wetlands in flood mitigation and filtering of runoff can be disrupted where excessive sediment reduce their capacity to contain and slowly release water.

The absence of obvious physical evidence does not preclude direct damage by floods or other natural hazards to an ecosystem. The Portland Bight in Clarendon, Jamaica's largest protected

area, with its multiple ecosystems of coral reefs, seagrass beds, salt marshes and limestone forest would be susceptible to rainfall of the magnitude experienced and therefore should be evaluated for related impacts. In consideration of its significant value to fisheries, recreation and tourism a project profile for undertaking an evaluation of the possible impacts from the rain and floods on the various ecosystems of the Portland Bight Protected Area is provided as part of this report.

Some of Jamaica's ecosystems evolve from and may be enhanced by repeated flooding. Impacts of weather adverse or beneficial are difficult to detect where the systems are not well understood or where relatively little baseline data exist. However, given the relatively frequent occurrence of floods, criteria for measuring their impacts on ecosystems in low lying and coastal areas should be established for wetlands and mangroves, riverine forests, estuaries, grasslands, savannahs and coastal forests.

8.2.7 Wildlife and biodiversity

Unfortunately, no official assessments of impacts on wildlife and biodiversity from the rain and floods were undertaken. Jamaica is considered an area of high endemism. The country has 256 species of birds (27 endemic), 2,800 flowering plants and 500 ferns. It is said that 20 per cent of the island's flora is endemic compared to 7 per cent in Trinidad, 12 per cent in the Lesser Antilles and 13 per cent in Puerto Rico (Government of Jamaica & R. Field Associate, Jamaica Country Environmental Profile, 1987). Given the intensity and duration of the rainfall and magnitude of flooding, the potential impact on endemic resources should have been considered to be high deserving some investigation.

Similar concerns were raised about possible impacts on wildlife or plants with actual or potential value for recreation and tourism such as crocodiles, manatees (whose population is less than 100) and orchids. According to one report, flood waters disturbed the Black River Morass, causing some crocodiles to disperse. This could not be substantiated but it raises questions about status of the crocodile population and possible threat to human beings.

8.2.8 Landscape impacts

Adverse impacts to the landscape from landslips and rock slips are considered negligible. Widespread visual and in many cases temporary changes to scenic roadways occurred as a result of sediment deposition and in some instances erosion. Temporary changes in the landscape also resulted from rising waters in depressed areas creating lakes.

III. MACROECONOMIC EFFECTS

This section presents a preliminary assessment of the summary (direct and indirect) of damages and an evaluation of the significance and extent of the damage. It also includes an analysis of the macroeconomic effects of the damage. Following the ECLAC manual, the section provides a description of the economy prior to the damage, the expected evolution of the economy without the occurrence of the event and the expected performance of the economy taking into account the event. Since the floods occurred in the second quarter of the year, the macroeconomic analysis includes the performance of the economy during the first quarter of the year. Estimations taking into account and abstracting from the natural disaster were carried out for the different sectors of the economy and the main macroeconomic aggregates.

All estimations were carried out by ECLAC on the basis of official data and predictions. The macroeconomic effect of the damage was far from significant and the adoption of different scenarios as recommended by the ECLAC methodology would have led to estimates whose boundary and would have been adjacent and without significant differences adding little value to the overall analysis. As a result, and choosing to prioritize relevance over method, the estimations were carried out within the boundaries provided by official sources and sensible macroeconomic analysis.

9.0 Summary of damage: A preliminary assessment

Given the preliminary available information total damage amounts to J\$2,473 million or US\$51 million. This amount is divided between direct damages registering J\$2,472 (US\$45 million) and indirect damages of J\$260 million (US\$5.4 million) (see Table 25-26). These estimates were obtained with very preliminary and raw figures and are also incomplete, as the data for some productive and other sectors was unavailable at the time of the writing of this report. In this regard the figures may actually underestimate the actual impact of the floods.

In terms of the breakdown of the different sectors direct damage is concentrated in infrastructure followed by the productive sectors and in particular agriculture. Both of these account for 97 per cent of the direct damage inflicted upon the economy. The social sector registered direct damage for a value of J\$91 million.

In terms of indirect damage, that is damage to flows of production and income, the productive sectors account for the bulk of the estimate representing 79 per cent of the total.

The magnitude of the disaster is small but by no means insignificant. The damages amount to 0.7 per cent of GDP and 4 per cent of merchandise exports. At the sectoral level the damages to agriculture and infrastructure represented 3 per cent of their respective GDP (see Table 27). The estimates here presented give more than anything else an idea of the reconstruction priorities of the government, which should be oriented towards rehabilitation efforts in agriculture, health and infrastructure.

Table 24
Estimates of direct and indirect damage
J\$

	Direct damage	Indirect damage	Total damage
Productive sectors			
Agriculture, livestock and fisheries	578 163 895	204 995 607	784,965,102
Tourism	1 175 000		
Manufacture and distribution		630,600	
Social sector			
Housing	55 760 000	1 056 000	56 816 000
Health	32 792 000	10 050 697	42 842 697
Education	2 520 000	700 000	3 220 000
Infrastructure			
Transport	1 481 229 000	10 600 000	1 491 829 000
Telecommunication	4 459 000	.....	4 457 000
Energy and electricity	.....	1 170 000	1 170 000
Water and sewerage	48 700 000	30 000 000	78 700 000
Environment			
Miscellaneous			
Emergency expenditure	7 616 033	696 000	1 457 603
Foreign assistance			
Total	2 122 414 928	259, 898,904	2 472, 313,832

Source: ECLAC estimates based on official information

Table 25
Estimates of direct and indirect damage
US\$

	Direct damage	Indirect damage	Total damage
Productive sectors			
Agriculture, livestock and fisheries	11,970,267	4,244,215	16,251,865
Tourism	24,327		
Manufacture and distribution		13,056	
Social sector			
Housing	1,154,451	21,863	1,176,315
Health	678,923	208,089	887,012
Education	52,174	14,493	66,667
Infrastructure			
Transport	30,667,267	219,462	30,886,729
Telecommunication	92,319		92,319
Energy and electricity		24,224	24,224
Water and sewerage	1,008,282	621,118	1,629,400
Environment			
Miscellaneous			
Emergency expenditure	157,682	14,410	172,092
Foreign assistance			
Total	45,805,692	5,380,930	51,186,622

Source: ECLAC estimates based on official information

Table 26
Summary of damages

Total damages as percentage of GDP	0.7
Total damages as percentage of exports	4
Agricultural damages as percentage of agricultural GDP	3
Infrastructure damage as a percentage of infrastructure GDP	3

Source: ECLAC on the basis of official estimates.

9.1 The year prior to the disaster

9.1.1 General trends

9.1.1.1 *The fiscal performance*

In 2001, Jamaica's fiscal performance was marked by three adverse external shocks (civil disturbances in July, the events of September 11th and flood damage in November) and by the need to accommodate cash payments for interest payments on the Financial Sector Adjustment Company (FINSAC) debt. The slowdown in growth of the United States economy also contributed to dampen fiscal performance. The central government's operations resulted in a deficit for FY 2001/2002 of 3.8 per cent above the budgeted 2.8 per cent. This reversed the trend of the past four years of declining budget deficit and a surplus during FY 2000/2001.

Tax revenues (15 per cent in FY 2000/2001 and 4 per cent FY 2001/2002) reflected in part the measures oriented to closing loopholes and to increase tax rates in selected taxes (including increases in stamp duty, a 50 per cent increase in the drivers' license fees and user fees at Jamaica customs). In the last seven months of the year tax revenues reflected a lower than expected economic growth.

As a result, the General Consumption Tax (GCT) receipts declined (7.3 per cent and 5.5 per cent; and 13 per cent and 2 per cent for the GCT charged on local and imported products for the FYs 2000/2001 and 2001/2002 respectively). The same trend was followed by company tax revenue (3 per cent and -16 per cent for the same periods). For its part the Bauxite/Alumina income tax receipts diminished due to the temporary closure of a refinery. The under-performance of these taxes was partially compensated by increases in international trade taxes (18 per cent of total tax revenue) responding to fiscal policy measures (2 per cent and 9 per cent in 2000/2001 and 2001/2002) and PAYE returns bolstered by higher wage payments and efforts to reduce the incidence of tax evasion.

Total expenditures reflected a higher than expected increase in recurrent expenditures (2.8 per cent and 19 per cent in FY 2000/2001 and 2001/2002) and a containment in capital expenditures (2 per cent and 9 per cent in FY 2000/2001 and 2001/2002) to achieve a sustainable fiscal position. Recurrent expenditures responded to increases in wages and salaries (10 per cent and 21 per cent in FY 2000/2001 and 2001/2002) due to salary agreements, Air Jamaica pension funds and domestic interest rate payments (-2 per cent and 18 per cent in FY 2000/2001 and 2001/2002 respectively) to settle the FINSAC debt. In 2001, the government took over FINSAC's debt and a conversion scheme was put in place to trade debt for stocks in order to avoid a deterioration of commercial banks balance sheets. As a result the debt stock rose from 111 per cent to 142 per cent of GDP. The external debt stock (59 per cent of GDP, 6.1 per cent of interest payments over exports of goods and services and a debt service ratio of 13 per cent on a cash basis) accounted for

40 per cent of total debt.

9.1.1.2 Monetary policy

Jamaica's monetary policy was geared to the maintenance of macroeconomic stability that would allow the reduction in interest rates and that of the required reserve ratio compatible with a money supply management operating target. The main challenge for monetary policy stemmed from the need to maintain this expansionary stance in the face of slowdown in growth while at the same time money supply grew at rates above planned targets and the exchange rate was subject to increasing depreciating pressures. To this end the authorities monitored the growth of money supply by controlling net domestic credit and selective interventions in the foreign exchange market.

Money supply growth (M1 and M2 increased 11 per cent, 19 per cent, 10 per cent and 11 per cent in 2000 and 2001) was determined by the expansion in net international reserves. Its stock increased by US\$871 million (or 89 per cent) between January to December 2001 (US\$1841 million dollars with a 22 per cent deviation from the planned target for the year). This responded to the purchase of official capital flows by the government of Jamaica from commercial and multilateral sources and to the government's domestic issue of United States dollar denominated bonds.

The growth of international reserves was compensated by the contraction in net domestic assets (NDA) (J\$43 billion decline). NDA decreased as a result of declines in net claims to the public sector, net credit to banks and sterilization operations conducted via the reverse repurchase agreements and the reintroduction of certificates of deposit (May 2001).

The preferences of investors to participate in dollar denominated instruments issued by the government and the depreciation expectations following the 11 September events increased the demand for foreign currency leading to a depreciation of the nominal exchange rate between September and October. The authorities decided to counteract the pressures in the foreign exchange market by interventions in the foreign exchange market and by increasing the rate of interest on long-term instruments as well as the maturity period of open-market instruments. This allowed the exchange rate to register a yearly depreciation between December 2000 and 2001 of 4 per cent (from J\$45.53 to J\$47.40).

The monetary conditions allowed the Bank of Jamaica to decrease the short-term interest rates. The Bank's 30-day signal rate, the Reverse Repurchase rate, declined from 16.45 per cent to 14.25 per cent between December 2000 and 2001. The six-month interest rate on Treasury Bills accompanied this movement closing with a yield of 17 per cent at the end of 2001 relative to 20 per cent in the previous year. In addition, the cash reserve ratio was reduced by three percentage points to 10 per cent during 2001 continuing a policy initiated in August 1998 consisting of reduction in commercial bank's statutory reserve.

Commercial banks followed suit as the average lending and deposit rates decreased from 32.9 per cent and 10.5 per cent to 26.8 per cent and 9.1 per cent, respectively, increasing commercial bank credit (11 per cent and 21 per cent in 2000 and 2001). A third of loans is devoted to consumption purposes and the rest to productive sectors (50 per cent for the services sector, 6 per cent to manufacturing, 5 per cent to construction, and 3 per cent to agriculture).

9.2 The performance of the main variables

The agricultural sector's performance (-10.9 per cent and 5.2 per cent in 2000 and 2001) was marked by a notable improvement in the first nine months of the year (7.3 per cent) due to an increase in harvested hectares and favorable weather conditions followed by a drop in activity (-2 per cent) following the floods, which occurred in the last quarter, damaging the stock of lands and trees.

Mining and quarrying (-1.7 per cent and 3.8 per cent in 2000 and 2001) reflected the increase in the production of bauxite (-1.7 per cent and 3.7 per cent in 2000 and 2001) resulting from the re-opening of the Gramercy refinery plant in the United States in the last quarter of 2001. The expansion of bauxite output compensated the decline in aluminum (-1.6 per cent) caused by the closure of a plant undergoing restructuring.

Manufacturing growth (0.9 per cent and 0.6 per cent in 2000 and 2001) depended on increases in food processing, alcoholic beverages, non-metallic minerals and metal producing industries (4.1 per cent and 3.3 per cent; 4.0 per cent and 8.9 per cent; -3.1 per cent and 2.9 per cent; and 0.9 per cent and 2.3 per cent in 2000 and 2001 respectively). Domestic demand and efforts drove the performance in these sub-sectors at rationalizing production. The textile and weathering apparel and the leather and footwear industries saw declines in their output (-4.3 per cent and -34.9; -5.2 per cent and -20.3 per cent in 2000 and 2001 respectively) due to a lack of competitiveness due to high operating costs despite the on-going Government Assistance Programme and the introduction of the Caribbean Basin Trade Partners Act (CBTPA) in the last quarter of 2000.

The performance of the tourism sector deteriorated (5.5 per cent and -2.2 per cent in 2000 and 2001) as a consequence of the slowdown of the United States economy, the events of September 11th and civil disturbances that affected Kingston in July 2001. Total visitor arrivals, stopover visitors and the number of cruise passengers decreased by -5.1 per cent, -3.5 per cent and -7.4 per cent respectively. As a result foreign exchange earnings from the tourism sector dropped from US\$ 1 332 to 1 235 million (-7.4 per cent).

9.2.1 *Inflation and unemployment*

The rate of inflation increased from 8.7 per cent to 6.1 per cent on a point-to-point basis (December 2001-December 2000) marking a deviation from the declining trend in the rate of growth of prices that the country has experienced since 1991 (see Table 28). The increase in inflation is attributed to the contraction in the supply of agricultural produce following bad weather conditions, increases in administered prices (bus fares and postal rates) and the depreciation of the exchange rate. The declines in the prices of oil and that of import commodity prices (soybeans (-8 per cent), rice (-7 per cent), coconut oil (-25 per cent) and groundnut oil (-5 per cent)) were mitigating factors helping to dampen the rise in prices.

The rate of unemployment declined from 15.5 per cent to 15 per cent consistent with the increase in the rate of growth of the economy. The unemployment rates for males and females were 10 per cent and 21 per cent, respectively. The national minimum wage was increased by 50 per cent (J\$1,200 to 1,800 per week). Industrial security guards also took a wage increase of 40 per cent (J\$2,020 to 2,828 per week).

9.2.2 The external sector

The current account result deteriorated yielding a deficit of US\$650 millions compared with that of US\$288 million for the previous year. The current account disequilibrium was financed by a capital and financial account surplus (\$650 million).

The current account outcome was influenced by the widening of the trade deficit (\$-1353 and \$-1 580 million in 2000 and 2001) and the income account (\$-350 and \$-489 million in 2000 and 2001) and the contraction in the surplus in the services balance (\$594 and \$547 million in 2000 and 2001) and the inflow of transfers (28 per cent and 6 per cent in 2000 and 2001).

Merchandise exports declined (6.7 per cent) due to the underperformance of major traditional exports and non-traditional exports (-11 per cent and -43 per cent). Major traditional exports were negatively affected by lower world economic growth (aluminum and sugar, -42 per cent and -13 per cent), excess supply of sugar on the United States market, and lower realized prices for sugar in the United States market (-9 per cent) and for sugar and bananas in the European market (-7 per cent and -24 per cent). Non-traditional exports suffered from a lack of competitiveness in the garment industry leading partly to the downsizing of production operations and the reduction in the number of producers. Free zone export behavior (-13 per cent between 2000-2001 and 16 per cent of total exports in 2001) was not an exception to this trend.

Import growth experienced a reduction in relation to the previous year (8.3 per cent and 4.2 per cent for 2000 and 2001). This was the result of a lower demand for raw materials (16 per cent and 6 per cent in 2000 and 2001 and 54 per cent of total imports in 2001). This, in turn, responded to a contraction in the import value of crude oil (-21 per cent) following the temporary closure of an oil plant in the last quarter of 2001. For their part imports of consumer goods and capital maintained their growth rates relative to 2000 (1.2 per cent and 1.3 per cent; 9 per cent and 11 per cent respectively).

The reduction in the surplus of the service account is explained by the larger deficit in the transportation sub-account (US\$-247 and \$-260 million in 2000 and 2001) and by the contraction in net earnings from travel (-4.5 per cent). Both were associated with the events of 11 September and the economic slowdown in the United States.

The increase in the income account deficit was due to a rise in interest payments on the Central Government's foreign debt and profit remittances from foreign direct companies. Finally in correspondence with the international economic situation the growth in transfers was lower than in 2000 (27 per cent and 6 per cent in 2000 and 2001).

The capital and financial account surplus more than doubled (\$289 and \$650 million in 2000 and 2001) due partly to receipts from Euro bond (\$800 million in total) placements and an emergency loan (\$150 million) from a multilateral agency following the 11 September events. Private investment also surged (\$422 and \$880 million in 2000 and 2001) driven by the divestment proceeds from the sale of the Jamaica Public Services Company and an insurance company, Life of Jamaica.

9.3 The quarter prior to the disaster: (First quarter 2002)

During the first quarter GDP declined -0.2 per cent (See Table 28). The performance resulted from a combination of stagnant growth in the goods producing sectors (0 per cent) and negative growth in the service sectors in the aggregate (-0.3 per cent), which contribute 84 per cent to GDP. Within the goods producing sectors agriculture and mining recorded contractions in their output (-4.5 per cent and 2.2 per cent respectively) while manufacturing and construction increased by 1.3 per cent and 4 per cent respectively. The performance of the services sector was shaped by the sluggish growth in distribution (0.1 per cent), financial services (0.3 per cent) and by the negative outcome of miscellaneous services (-6 per cent) (See Table 28).

Mining and quarrying responded mainly to the reduction in the capacity utilization of alumina processing plants (-5 per cent). Manufacturing performance was determined by increases in petroleum products and beverages and by the constraints to output expansion due to the underperformance of chemicals and apparel industries. For its part, miscellaneous services were determined by tourism which continues, to some extent, to reflect the reduction in leisure and business travel worldwide. Finally, the distribution sector mirrored the general slowdown in economic activity.

The performance of agriculture, which is the most significant sector for purposes of the damage assessment report, reflects the effects of the floods that affected this sector of the economy in November 2001 and to a lesser extent dry weather conditions. Within the agricultural sector, the most affected crops were those destined for the export markets experiencing a decline of -10 per cent while crops for domestic consumption registered a decrease estimated at -5 per cent. The performance of the agricultural-export output was reflected in the reduced production of sugarcane and banana. The volume of sugarcane milled during the period decreased by -15.3 per cent and banana production by -11.6 per cent relative to the first quarter of 2001.

The decline in GDP and imports had a negative impact on production and consumption tax revenues and on international trade tax collections registering declines during January to March of -1 per cent and -1.2 per cent relative to the corresponding quarter of 2001 respectively. This was compensated by higher income and tax profit, tax earnings and in particular by a rise in non-tax revenue (34 per cent). Jointly with efforts on the capital expenditure side of the budget bearing the brunt of expenditure restraint (-27 per cent), the overall fiscal accounts remained in a surplus position albeit at a lower level than expected.

The underperformance of export crops was reflected in an overall decline in exports close to 6 per cent. The potential negative effect on the balance of trade was in part compensated by lower world oil prices and decline in economic activity. This allowed imports to decline reducing the trade deficit significantly from the previous and the corresponding quarters.

The services balance surplus increased relative to the previous quarter as a result of the partial down winding of the effects associated with the events of September 11th. For their part, the income account balance and net current transfers remained at past trend levels.

The overall result was a narrowing of the current account deficit for January-March. The current account deficit was financed in its totality by the surplus obtained in the capital and financial account, itself the reflection of higher foreign direct investment. Foreign direct investment increased by more than 40 per cent during the quarter in question relative to the last quarter of 2001. The

overall balance of payments outcome jointly with the disbursement of loans from multilateral organizations improved the reserve position of the authorities. The balance of payments accounts registered an accumulation of net reserves equivalent in value to an amount above two months imports.

The external performance contributed significantly to the stability in the foreign exchange rate market. The bilateral Jamaica dollar – United States dollar nominal exchange rate moved from 47.40\$ per US 1\$ to \$47.61 per dollar from December to March. This reflected a slight depreciation of 0.4 per cent in consonance with macroeconomic stability objectives.

Monetary policy was geared to the maintenance of price stability and single digit inflation. During the quarter the authorities contracted base money growth by –11.9 per cent to compensate for the reduction in the cash reserve ratio to 9 per cent as part of a programme to enhance the competitiveness of the financial and banking system. In consonance with the money base behaviour the broad money supply declined by –0.3 per cent.

In turn, the stability of the exchange rate and the decline in economic activity which signaled a decline in demand and the possible accumulation of inventories facilitated in conjunction with the containment in the growth of monetary aggregates the decline of the rate of inflation – this, in spite of the increases in labor costs resulting from the increases in the minimum wage to \$1 800 per week in January 2002.

At the component level the decline in the rate of inflation was driven by the downward prices of starchy foods and vegetable and fruits (0.4 per cent and 2.1 per cent in January-March 2002 and October-December 2001). For its part the most important increase was recorded in housing and other expenditure reflecting the change in the minimum wage contributing 0.6 per cent points to the overall inflation rate.

In summary, prior to the May floods the situation of the first quarter was marked by stability in the nominal variables of the economy (exchange rate, money growth, prices, fiscal result) and a deterioration in the performance of the real sector. This slow growth in the real sector is partly attributed to the decline in agriculture. In turn the performance of agriculture reflected the effects of the November floods. However, the decrease in agricultural performance was not totally compensated by productivity improvements in the rest of the sectors of the economy due to structural imbalances and external conditions. The growth in the goods producing sector was nil compared to a 4.4 per cent during the corresponding period of 2001. In a similar vein, the services sector registered a contraction of –0.3 per cent compared to a positive outcome of 1.3 per cent in January-March 2002.

9.4 The expected situation for 2002 without the disaster

Prior to the May floods, GDP growth was estimated at 2.0 per cent on a fiscal year basis (2002/2003) (See Table 28). The GDP estimates were founded on positive perceptions of the performance of some sectors. The mining sector was expected to spur its rate of growth partly from the expected investment by the Jamaica government and Alcoa in their jointly owned JAMLCO alumina refinery to increase production capacity. The possible removal of the bauxite levy also

enhanced favorable prospects for that sector. The construction sector was expected to benefit from housing starts by the National Housing Trust (NHT). This in turn would have a positive effect on the number of mortgages and especially on the sales of construction related supplies. In turn, these would have a positive effect on the manufacturing sector. In addition, it was expected that the performance of the manufacturing sector would be enhanced by measures oriented to control the growth of imports and channeling demand to domestic output. The manufacturing sector would, however, be negatively affected by the structural problems of the apparel industry and the poor performance of chemicals.

The main fetters to growth were identified in the agricultural and services sector. While agriculture was expected to partly rebound due to the materialization of recovery efforts, output was expected to fall due to the drought conditions that affected the economy during the first quarter of the year and which will affect mainly domestic crops production. As a result domestic crop production projections situate a decline between 5 per cent and 10 per cent for domestic crop output. Traditional export crops were also seen as declining due to reduced cane sugar supplies translating in turn into a contraction in the volume of sugarcane milled. Finally, production was not expected to fully recover from the November 2001 floods.

For the fiscal year 2002/2003 the government had expected to reduce its central government budget deficit from -5.9 per cent to -4.4 per cent of GDP. Revenues (including grants) were expected to increase by 14 per cent as a result of improved tax revenue collection. Within tax revenues the largest increase was budgeted to be in tax earnings from income and profits and in particular from PAYE collections. For its part consumption and distribution taxes were budgeted to rise by 6 per cent with respect to the previous fiscal year. The rises in recurrent expenditure (10 per cent) were to reflect the behaviour of wages and salaries partly as a result of the increase in the minimum wage in January 2002. Capital expenditures were to be adjusted accordingly to permit a balance result in the fiscal accounts. This was to be achieved, if necessary, by reducing or postponing projects to absorb the necessary adjustment. The loans that the government received and are expected to receive for the rehabilitation necessary to compensate for the damage due to the November 2001 floods will translate into an increase in the external debt. This may aggravate the deficit of the central government measured on a cash basis, which was estimated at 5.9 per cent of GDP for the fiscal year 2001/2002. Interest accounted for 45 per cent of current expenditure and will increase to 48 per cent. Interests on the external debt are budgeted to increase by 58 per cent.

The balance of payments projections indicated an improvement in the current account balance as a result of declining imports and improved export performance. This would reduce the current account deficit from 8.5 per cent to 8 per cent of GDP. Within the current account the joint result of the service, income and transfers net account was an increase in the surplus from 880 to 893 million dollars. This aggregation includes also interest payments for \$343 million marking an increase from \$240 million in the previous fiscal year. Finally, the capital and financial account was projected to yield a surplus financing the current account deficit as a result of the expected significant increase in foreign direct investment. As a result the stock of net international reserves was expected to reach 1 600 million dollars by the end of the fiscal year 2002/2003 representing 4.5 months of imports.

The rate of inflation was projected at 6.5 per cent at the end of the period and 5.5 per cent on average. This reflected the stable conditions on the foreign exchange market and a monetary policy oriented to achieve stable single digit inflation rates. Base money growth is estimated between

a range of 8 per cent to 10 per cent. This estimate took into account the pressures on prices as a result of the increase in local petroleum processing in April and a probable rise in the electricity rates, which will be reflected in the Housing component of GDP. Additional pressures were identified in a possible increase in the price of food as a result of the contraction in agricultural production.

Table 27
Jamaica selected economic indicators

	Yearly data				Quarterly data
	1999	2000	2001	2002 f	First Quarter 2002
Real domestic product					
Nominal GDP at factor costs (J\$ million)	274,333.3	307,039.3	334,698.8	361,474.7	n.a
Real GDP (constant 1986 prices)	19555.1	19,707.4	19930.5	20381.1	.....
Real GDP growth	-0.4	0.7	1.7	2.0	-0.2
Real GDP growth by selected economic sector					
Agriculture, forestry and fishing	1.3	-10.9	5.2	2.6	-4.5
Mining and quarrying	-1.2	-1.7	3.8	5.0	-2.2
Manufacturing	-0.7	0.9	0.6	2.0	1.3
Electricity and water	4.8	3.3	1.1	4.5	3.1
Construction and installation	-1.5	0.2	2.0	2.0	4.0
Distributive trade	-0.5	1.3	0.2	0.3	0.1
Transport, storage and communication	8.6	8.0	6.3	3.5	1.3
Producers of government services	0.2	-0.2	0.7	0.8	0.7
Miscellaneous services	2.2	4.8	-1.8	2.0	-6.0
Prices					
GDP deflator	8.4	11.2	7.1	5-6	.....
Consumer price index (average)	6.0	8.2	7.0	5-6	.....
Consumer price index (December to December)	6.8	6.1	8.7	5-6	0.6
Labor statistics					
Unemployment rate	15.7	15.5	15.0	.....	....
Employment (000')	943.9	933.5	939.4	.....	.....
External sector					
Merchandise exports (f.o.b) (million US\$)	1,499.4	1,555.0	1,451.6	1470	.....
Merchandise imports (c.i.f) (Million US\$)	3,142.9	3,380.7	3,532.8	2980	.....
Gross visitor expenditure	1279.5	1332.6	1234.5	.....	1213.4
Trade balance (as percentage of GDP)	-23.6	-25.8	-28.7		.....
Current account balance (as percentage of GDP)	-3.1	-4.1	-9.0	-8.0	.....
External debt (as a percentage of GDP)	46.3	50.3	57.1	58	.....
External debt service (as percentage of total exports)	40.3	30.7	40.7	41	.....
Fiscal balance					
Total revenue (as percentage of GDP)	30.5	30.8	28.5	29.7	.....
Total expenditure and net lending (as percentage of GDP)	34.8	31.8	34.3	34.1	.....
Overall fiscal balance (as percentage of GDP)	-8.5	-5.7	-5.9	-4.4	.....
Monetary sector					
Narrow money (M1)	29.5	-2.5	18.9	.....	19
Broad money (M2)	17.3	10.6	9.8	.....	12
Nominal interest rates d/					
Weighted average deposit rate	13.27	12.21	10.13	.....	.....
Weighted average lending rate	24.64	22.12	19.50	.....	.....

Source: Bank of Jamaica and Planning Institute of Jamaica

9.5 The expected economic performance with the disaster

The disaster will negatively affect the Jamaican economy. It will slow down the expected rate of growth of the economy. It will also cause a temporary increase in prices, which will show in the food and drink category and on the fiscal account position through reduced tax collection and higher government expenditure. Finally, as the effects largely affected the agricultural sector the external position may be affected depending on the net effect of the disaster on import demand and requirements for reconstruction purposes.

9.5.1 Effects on growth performance and sectoral analysis

Preliminary estimates largely based on the impact of the disaster on agriculture indicate that GDP growth will be positive. It experienced close to a half of a percentage point relative to the growth rate of the economy expected prior to the May floods. The floods will negatively affect some sectors while others will compensate part of the overall downward effect on growth (see Table 29 and 30).

Agricultural performance will be significantly affected and the sector is bound to register a negative growth rate hoping for a turnaround in the first and second quarters of 2003. Concurrently export and, to a higher degree, domestic supply will contract with positive on agricultural prices and negative on farmers income. Mining has also been affected by the floods but with a much lower degree of intensity. Given the expected stability of mining output during the year and assuming away interruptions to production mining will increase its rate of growth relative to the prior fiscal year. Manufacturing output will be affected by the reductions of agricultural inputs to that sector. The sector may still register sluggish growth in FY 2002/2003 but mostly due to competitiveness and structural problems.

The effects of the floods will also be felt in the service sectors. Transport and communication is bound to be affected due to road damage. The dynamism of the sector will manly come from the communications sub-sector. The performance of the distributive trade sector will suffer from the agricultural and manufacturing slowdown. The sector has been growing in the past years sluggishly (-0.3 per cent on average between 1997 and 2001) and will continue to record stagnant growth rates. Finally, the tourism sector will be affected by the reduction in capacity due to the destruction of infrastructure and the damage recorded in the beaches.

9.5.2 The fiscal impact of the floods

The expected decline in GDP will affect tax revenue collection by reducing the tax base and provoke an increase in expenditure for reconstruction and rehabilitation purposes. The decline in tax revenue will be felt in the coming months due to the lags in tax collection. Given the commitment of the authorities to remain within the announced fiscal targets (-4.4 per cent of GDP) any additional spending will be met through loans and reduced capital expenditure to accommodate the increase in expenditure. This will mean an increase in the external debt and less spending either by postponing capital outlays or slowing the initiation or completion of capital expenditure projects. The loans the government may need to receive are in addition to those that should accrue to the government as a result of the November floods. These amount to US\$45 million (20 from the Inter-American Development Bank (IDB); \$25 million from the Caribbean Development Bank (CDB);

\$50,000 from the United States Agency for International Development (USAID) and \$81 000 from the Bank of Japan).

Table 28
Estimates of real GDP prior and after the May floods
Millions of Jamaican Dollars

	2000/2001	2001/2002	Pre-flood estimates 2002/2003	Post-flood estimates 2002/2003
Goods producing sectors	7,749.5	7,848.6	8,099.2	8276.51
Agriculture	1,417.4	1,434.0	1,471.3	1433.02
Mining	1,769.4	1,801.1	1,891.2	1985.73
Manufacturing	3,096.9	3,110.7	3,166.5	3177.56
Construction	1,465.9	1,502.7	1,570.3	1680.2
Services sectors	16,623.7	16,785.3	17,032.3	17173.7
Electricity	1,059.8	1,073.8	1,095.3	1100.72
Transport	3,287.3	3,455.6	3,576.6	3700.1
Distribution	4,018.0	4,031.4	4,043.5	4053.67
Financial	2,895.1	2,912.2	2,932.6	2950
Real estate	1,753.8	1,773.5	1,791.3	1800.38
Producers of government	1,229.6	1,239.6	1,249.5	1250.64
Miscellaneous	2,294.2	2,212.2	2,256.5	2230.1
Household	85.8	86.9	87.1	88.1
Imputed bank service charges	-4,665.8	-4,703.4	-4,750.4	-4650.5
Total factor GDP	19,707.4	19,930.5	20,381.1	20799.7

Source: ECLAC estimates based on official sources and consultation with government officials.

9.5.3. The effects on prices

The effect of the floods will cause a contraction in the supply of agricultural products. This in turn will result in higher agricultural commodity prices, which will feed into the Consumer Price Index. At the component level the increase will show up in food and drink and meals away from home. The increase will be temporary and a once-and-for all increase since, in the absence of further shocks, a passive monetary policy (monetary authorities are set on keeping a low one digit inflation rate) or wage response, there is mechanism to transform this increase into an on-going phenomenon. For the on-going fiscal year the rate of inflation is 0.8 per cent. On a point-to-point basis the rate of inflation in May was 7.2 per cent.

9.5.4. The effects on the balance of payments

The effects on the balance of payments are likely to be felt by a reduction in export due to the damage to agricultural production. The damage will be felt in the reduction in the exports of bananas, sugar and coffee. Import performance will be affected on the hand by the reduction in GDP growth. On the other hand imports are likely to increase due to reconstruction and rehabilitation phases. The net impact of imports is estimated to be a slight increase in its rate of growth. Thus the decline in exports and increase in imports will widen the trade balance. The estimated decline in exports by 5 per cent while the rise imports is estimated at 10 per cent. The deficit on the current account will also widen as a result of the negative trade balance and a probable decline in the surplus of the surplus balance due to the effects of the floods on tourism the

Table 29
Estimations of economic performance pre- and post-May floods
Selected economic indicators

	2000/2001	2001/2002	2002/2003 pre-floods	2002/2003 post-floods
GDP growth	0.8	1.1	2.2	1.9
Consumer price index (end of period)	6.5	7.6	5-6	5-6
Unemployment rate	15.5	15	.....	.....
Central government balance as percentage of GDP	-5.9	-3.8	-4.4	-4.4
Current account deficit Million US\$	-427	-630	-700	-710
Investment as a percentage of GDP	17.8	24	24	27
Public investment as a percentage of GDP	7.2	8.5	11	.....
Private consumption as a percentage of GDP	65.1	64.3	64	.....
Public consumption as a percentage of GDP	26.4	27.1	28	.....
Gross national savings	8.4	8.1	7.6	.....

Source: ECLAC based on IMF and official estimations and on consultations with government officials.

9.5.5 Effects of the floods on monetary policy

The monetary policy geared toward the maintenance of single digit inflation rates will react by curtailing money supply to unforeseen increases in prices that may arise out of a supply shock. The foreign exchange market is likely to remain stable and undesired changes in foreign currency reserves are likely to be met by sterilization operations with the concomitant effects on interest rate behaviour.

9.5.6. The effects of the flood on the expenditure side

The response to the disaster is expected to have some effects on the construction industry. Because of the large volumes of restorative work required, and the rapid nature of the response required, the construction industry of the country will be called upon to respond in a very timely manner. Because these works will require large volumes of stone, gravel, marl, cement and steel, related industries such as quarrying and concrete production will be stimulated.

The restorative work required is also expected to build the capacity of the design sector, which will be called upon to provide expertise in the design of the repair works. Further, supervision of these works will be required. In all, these effects are expected to have a stimulative impact on the overall sector.

9.5.7. The effects of the floods on income and employment

From available data it would appear that many of the persons who have been directly affected by the heavy rains, flooding and landslides, were involved in farming, livestock rearing, craft and related trade or elementary occupations.

In the short term, many may be expected to suffer reduced income due to the loss of livestock and the destruction of crops. There may be some relief in this regard as clean up and rehabilitation operations absorb some of that labour.

IV. GUIDELINES FOR A REHABILITATION AND RECONSTRUCTION PROGRAMME

10.0 Planning, policy and mitigation

10.1 Background

Between 1995 and 1999 Jamaica experienced relatively high numbers of hurricanes, floods, landslides and earthquakes. Table 30 shows the occurrence of floods over the period. Although the island has not had a major hurricane since Gilbert in 1988, it was affected by hurricane Marco in 1996 and hurricanes George and Mitch in 1998. Kingston and St. Andrew experienced landslips each year between 1995 and 1999, while landslips were recorded for 4 of those years in St. Catherine and 3 of those years in St. Thomas and Portland respectively (Statistical Institute of Jamaica, 2001).

Frequent earthquakes of between 2.0 and 3.8 on the modified Mercalli Intensity Scale has been recorded for the period, with the 25 occurring in the Kingston and St. Andrew area, according to Statistical Institute of Jamaica's 2001 Environmental report. Fortunately seismic activity of less than 4.0 on the intensity scale are not considered damaging.

The natural disasters of recent times, particularly hurricanes, floods and landslides (including flooding and landslides associated with hurricane Michelle in 2001) have exposed the vulnerability of

the country and pointed to the weaknesses in planning, land use policies and building practices. The country remains highly vulnerable to flood impacts and although disaster planning and response capacity has evolved appreciably in recent years there is still a need to build resilience to flood and other disasters. This points to the need for changes in land use and building practices. In particular, the recent flood rains, coming so rapidly on the heels of those of November 2001, serve to highlight problems at the planning and design stage. It is most likely that the inadequacies in these systems have contributed to the extensive damages that were suffered.

Table 30
Incidences of Flooding in Parishes of Jamaica, 1995 – 1999

Parish	1995	1996	1997	1998	1999
Kingston & St. Andrew	••		•	•	•
St. Thomas	•••		•		
Portland	••	•	•	•	•
St. Mary	••	•	•		•
St. Ann					
Trelawny	•	•			
St. James		•		•	•
Hanover	•				
Westmoreland	•		•		
St. Elizabeth				•	
Manchester				•	
Clarendon	•		•	•	
St. Catherine	•		•	•	•

(Source: Statistical Institute of Jamaica & NEPA. Jamaica's Environment 2001)

10.1.1. Landuse

The ECLAC damage assessment report on flood and landslide effects of hurricane Michelle cited “heavy rains caused by Hurricane Michelle, in association with steep slopes, highly erodeable soils, and numerous geological faults, ... human activities (and) improper landuse and deforestation...” as the factors leading to extensive flooding and land slippage in Portland.

St. Elizabeth, Manchester, Clarendon and St. Catherine are not as vulnerable to land slippage as Portland. St. Thomas however has similar geological and topographical characteristics and is also a high-risk area. Sections of the southern parishes are considered high risk to flooding. It is generally acknowledged that land use policy and practice do not incorporate current scientific, technical and local knowledge about the relationship between hazard risk and socio-economic vulnerability.

Additionally, despite the advances made in disaster planning and emergency management, not enough work has been done in hazard mapping, so as to inform land use policy and building practices. Expansion of the coverage of hazard mapped areas for floods and risks associated with other events are needed. The Water Resources Authority (WRA) has undertaken flood hazard mapping for sections of the Parish of St. Thomas. Flood plain mapping has been done by WRA for the Rio Cobre River in St. Catherine.

A number of initiatives have been planned or proposed that would improve capacity for land use and watershed management in the country, namely:

- (a) Implementation of a Watershed Policy, under the initiative of NEPA;
 - (b) National Integrated Watershed Management Programme, coordinated by NEPA;
- and
- (c) Flood Control Master Planning, being considered by the Water Resources Division.

Mechanisms for effective collaboration between key agencies will be critical to achieving desired changes in practices by bridging the gap between well-intended policies and action on the ground. Critical aims to be achieved in inter-agency cooperation include:

- (a) Expanding the coverage of hazard mapping and utilizing the results to build consensus on strategies to manage risk and reduce vulnerability;
- (b) Creating the bond between disaster planning and land use planning so that disaster mitigation strategies could inform and influence land use policy;
- (c) Broadening the scope of EIA procedures to provide hazard mitigation for new developments; and
- (d) Developing the capacity to manage the multiple land and resource use objectives for watersheds.

The mitigation of flood impacts will require a major and important shift in how land use planning is approached. Soil and water are critical resources whose management is best linked to watersheds or hydrological basins. Since soil and water are key elements that must be managed in floods, it follows that a watershed approach to planning is perhaps the best option for the planned mitigation of flood hazards. This approach is also beneficial to drought hazard mitigation and ecosystem management (including wetlands and riverine forests).

10.2 Building Practices and Standards

While observing flood impacts in St. Elizabeth and Manchester it became apparent that traditional building habits were more sensitive to flood impact mitigation than current practices. Older houses were more likely to have finished ground floor levels > 2 ft above grade than newer buildings where the finished floor level was often < 1 ft above grade (see Photo 00 and 00).

Photo #9:
Older house with adequate floor level elevation, Clarendon



Photo #10:
House with inadequate floor level height, Manchester



This finding is in keeping with observations in other islands of the Caribbean. In flood prone areas in Guyana, Belize and Trinidad, homes were traditionally built on stilts in flood plains. In islands within the more active hurricane belt, older houses are often more hurricane resistant with roof pitch $> 20^\circ$, shutters for doors and windows are more common and roof overhang is often much less than newer buildings.

A critical objective in flood mitigation should be the adoption of traditional building habits by raising floor levels to reduce the frequency of flooding. This would require:

(a) The application of minimum floor level standards for buildings in flood plains and topographically depressed areas – *the regulatory option*;

(b) Encouragement to insurance companies to adopt policies on insurance premiums that acknowledge the relatively higher risks associated with building in flood plains and other vulnerable areas and to provide rebates for policy holders that comply with agreed building standards or practices – *the market option*; and

(c) A creative awareness campaign targeted particularly to low income households without property insurance and to communities in flood plains.

10.3 Housing developments

Despite the existence of EIA procedures and other permits required by NEPA in planning approval, some housing developments remain highly vulnerable to natural hazards, including flooding. Planning and design flaws were contributing factors cited in flood impacts to housing developments in Kennedy Grove, Clarendon and White Water Meadows in St. Catherine. Another factor seems to have been the absence of an enforceable design standard for drains at these projects. Discussions with persons in the Ministry of Water Resources and Housing suggest that standard practice in drainage design appears to be based on a 1 in 25 year return event. Agreement on a standard as the basis for enforced mitigation against future flood damage is critical for new housing.

With the impacts of recent events fresh in people's minds, it would be appropriate and effective for key stakeholders to meet to discuss options leading to the adoption of standards seeking to reduce the vulnerability of housing projects in the country. Participants in the discussions should include NEPA, ODPEM, Ministry of Water Resources and Housing, National Housing Trust, National Housing Development Corporation, agencies involved in Operation Pride and private sector interests in the Joint Venture housing operations.

10.4 Other considerations

Other initiatives should include strategies aimed at reducing vulnerability to essential services and to mitigate against flood impacts associated with road construction.

10.5 Essential services

One of the major aims of a national mitigation strategy should be the reduction of vulnerability of the country's essential services and related facilities, including hospitals, clinics, schools, buildings housing critical records, water, electricity and communications infrastructure and shelters.

Consideration should be given to evaluating the vulnerability of facilities providing the most critical services by a process of prioritization. Vulnerability can be assessed using hazard vulnerability audits (HVA) and the results used as the basis for upgrading such facilities

10.6 Roads

Observations suggest that flood conditions were exacerbated by the construction of main and secondary roads through low-lying terrain. Raising the surface of the roads above design flood levels achieves drainage objectives for the road itself and reduces maintenance costs. However, without adequate through culverts, the road sometimes acts to contain flood waters on its upland side. Where the provisions for release is inadequate, water levels will rise and flood the road itself.

This suggests the need for detailed evaluation of the alignment and design of future roads. New road construction should therefore be subjected to thorough impact evaluation using relevant EIA procedure. Ideally, segments of roads in flood plain areas could be subjected to HVAs.

The various modes of damage that occurred to roads and infrastructure in general have been described in previous sections of this report, however, it is worthwhile to repeat them here. In summary, these are:

(a) Intense rainfall that appeared to have varied from the 1 in 2 to the 1 in 100 year event. It must be borne in mind that most road drainage structures are designed to accommodate the 1 in 10 year event. On secondary and farm roads, this criterion may even be at the 1 in 5 year level. The exception to this is for the main drainage channels in Kingston that were designed to take the 1 in 100-year event;

(b) Improper maintenance of drains, which resulted in blocked drains and subsequent ponding of water;

(c) The development of many housing areas, that have contributed to increased run-off, without perhaps adequate sizing of peripheral drains;

(d) Improper location of houses in areas that are vulnerable to hazards such as the flooding that occurred;

(e) Inappropriate treatment of hillside areas, so that increased soil runoff becomes a problem. This was very noticeable during the May rains; and

(f) Excessive rise in the water table in some locations as a result of the recharging of the aquifer.

Mitigation strategies to address these identified problems may be devised in a multi-faceted manner. These should include the following components:

10.6.1. Soil Conservation/ Slope Protection

The practices that need to be adopted in order to promote soil conservation include:

- (a) Minimizing the removal of trees, in particular young trees, on steep slopes (> 40 degrees);
- (b) Halting the use of fire as a means to clear lands for agricultural purposes;
- (c) Promoting the planting/retaining of vegetation, especially on steep slopes;
- (d) Alternating between tree crops and grass along slopes, and in keeping with the natural land contours;
- (e) Constructing, where appropriate, slope and diversion drainage channels made out of earth or wood;
- (f) Planting low growing crops to increase the soil cover under the canopy;
- (g) Mulching crops;
- (h) Limiting the exposure of topsoil on slopes by planting crops or grass;
- (i) Adopting 'no-tilling' farming practices;
- (j) Planting vegetation known to have deep roots;
- (k) Constructing minor engineering structures such as spillways, check dams and waterways;
- (l) Diverting water from existing landslides; and
- (m) Planting fast growing tree species within and adjacent to landslides.

10.6.2. River Bank Protection and Flood Hazard Mapping

Much of the soil that was carried down by the rivers during the floods came from the riverbanks. This was particularly noticeable in St. Thomas during the May floods. Measures to protect the soil along river banks includes:

- (a) Retaining the vegetation on gully and stream banks;
- (b) Ceasing the mining of gravel and sand from the upper reaches of riverbeds;
- (c) Planting fruits and forest trees along gully and river areas when possible;
- (d) Constructing minor river training works to prevent undercutting of developed areas;
- (e) Clearing river and tributary channels of excess debris;
- (f) Stabilizing any material removed from channels with stones or vegetation (if stored near to the channel);
- (g) Promoting and enforcing proper development planning, so that development does not take place on riverbanks. In order to facilitate this objective, a number of investigative steps must be carried out. The WRA has proposed a program to improve the development planning process that includes: flood hazard mapping, which is a necessary and fundamental tool in disaster preparedness; improved data collection and management, through the implementation of additional intensity rain gauges and water level recorders for Portland; adoption of regulation guidelines for flood plain usage; preparation of technical guidelines illustrating appropriate standards and criteria relating to the siting and dimensioning of buildings and hydraulic structures; and
- (h) Planting crops that require and can utilize large amounts of water (e.g. banana and cane) on floodplains.

10.7 Review of hydraulic design criteria

In light of the fact that the historical data shows that flooding events of magnitude could occur on average once every four years, it may be prudent to review the presently adopted design standards and criteria for drainage works. It may now be appropriate to reduce the vulnerability of main roads by increasing the design return period to a 1 in 25 year event or greater. Such a decision would, necessarily, have to be informed by economic considerations. For parochial and minor roads, a 1 in 10 year criterion may be adopted.

11.0 Projects

Project title: to restore and enhance the productive and competitive capacity of the crop farmers in the affected areas.

Sector: Economic

Subsector: Agriculture

Background: The direct and indirect assessment of the agricultural sector showed that the sector experienced a loss of J1 200 M including direct and indirect damages. The damage affected a variety of crops and is estimated to have affected 2 422.7 hectares of arable land.

Project objectives: The main goal is allow the farmers to recover from the damages of the flood and to assist them in improving their efficiency and competitiveness. The project will focus, *inter alia*, on:

- (a) Accessing the right credit facilities;
- (b) Improving the efficiency and competitiveness through the provision of technical assistance;
- (c) Provide an improved institutional framework for cooperation; and
- (d) To raise the awareness to include during the phase of reconstruction vulnerability reduction elements.

Project title: To restore the productive capacity of the farmer for the export market.

Sector: Economic

Subsector: Agriculture

Background: The study showed that part of the damage affected export oriented crops. Export oriented agriculture has an important effect on domestic variables and on the current position of the economy. For these important reasons, among others, the export farmer must a key player in any reconstruction framework.

Project objectives: The main objective is to rehabilitate the capacity of the export farmer an efficient and sustainable manner. The specific objectives of the project are to (a) develop the export capacity through technical assistance and by providing the adequate capital and financial means to accomplish the task; (b) to identify a clear and concise framework and methodology providing a consistent approach for the restoration of productive capacity.

Project title: Export diversification

Sector: Economic

Subsector: Agriculture

Background: the study undertaken to provide an evaluation of the flood rains showed the risks inherent to agricultural activities and the need to diversify production to minimize these risks.

The objectives of the project are: (i) to identify potential sources and possible niches of export diversification; (ii) assess in a timely and comprehensive way their feasibility; (iii) present alternative scenarios for their implementation.

Project title: Replanting crops affected by the floods

Background. The recent floods that affected Jamaica will have an important impact on agriculture, which in turn will slowdown the rate of growth of the economy. Replanting crops at an early stage to recoup part of the losses imposed on an economy by a natural disaster is an essential both of reconstruction and rehabilitation.

The objectives of the project are: i) to identify priority areas for replanting crops; ii) to ascertain the inputs needs for the successful completion of the project; iii) to identify the population that will benefit from the replanting; iv) to define the cost and financial steps involved in a replanting of crop project.

PHOTOGRAPHIC ANNEX



Gulying of main road



Erosion of roadway



Source: Clarendon Site Inspection Report – National Spatial Planning and Research Branch,
Photo #4 – Flooding of housing units in Kennedy Grove



Source: Clarendon Site Inspection Report – National Spatial Planning and Research Branch,
Photo #5 – Location of pump station in depression at Kennedy Grove



Source: Clarendon Site Inspection Report – National Spatial Planning and Research Branch,
Photo #6 – Submerged sewage treatment pump, Kennedy Grove



Source: Clarendon Site Inspection Report – National Spatial Planning and Research Branch,
Photo #7 – Flooding in sections of McGilchrist Pen

**OCHO RIOS (WHITE RIVER REGGAE PARK),
WALL DESTROYED BY FORCE OF WATER**



BANNISTER (5 JUNE 2002), Flooded roadways









