

JAMAICA
MACRO SOCIO-ECONOMIC AND ENVIRONMENTAL ASSESSMENT
OF THE DAMAGE AND LOSS CAUSED BY
TROPICAL DEPRESSION NO. 16/TROPICAL STORM NICOLE



Prepared by the Planning Institute of Jamaica

November 2010

PREFACE

This report is prepared to document the impact of Tropical Depression 16/Tropical Storm Nicole on the affected population; estimate costs of damage and losses and identify geographically affected areas.

The assessment was prepared by the Planning Institute of Jamaica in close collaboration with the Office of Disaster Preparedness and Emergency Management (ODPEM) and other member agencies of the Disaster Impact Assessment Core Team¹. Data and information on the damage and losses were provided by various ministries and agencies of the Government of Jamaica as well as several non-government institutions and private sector entities. These include, among others:

- Meteorological Services, Jamaica
- Ministry of Labour and Social Security
- Ministry of Health
- Ministry of Education
- National Works Agency
- Ministry of Water and Housing
- Ministry of National Security
- Ministry of Agriculture and Fisheries
- Rural Agricultural Development Authority
- National Water Commission
- Jamaica Public Service Company
- Forestry Department
- Water Resources Authority
- National Environment and Planning Agency
- Mines and Geology Division
-

The assessment was made following the Economic Commission for Latin America and the Caribbean (ECLAC) Damage and Loss Assessment (DaLA) methodology for estimating the socio-economic and environmental effects of disasters. The ECLAC methodology is based on a stock-flow analysis of the difference before and after an event. Through a sectoral approach, it provides guidelines for the aggregation of value (damage and losses), to be used in the evaluation following an event. It is a basic accounting approach based on the national account framework and impact multipliers in the economy. The information supplied in the report is preliminary and subject to revision. The cut-off point for data used in the report was October 7, 2010.

- ¹ The Disaster Impact Assessment Core Team consists of representatives from the PIOJ, Office of Disaster Preparedness and Emergency Management, Meteorological Service, Jamaica, Ministry of Labour and Social Security, Ministry of Health, Ministry of Education, National Works Agency, Ministry of Agriculture and Fisheries, National Water Commission, Jamaica Public Service Company and the National Environment and Planning Agency

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Executive Summary

Description of the Event

The event produced bands of showers and thunderstorms over most of the island but more so to the east, southern and western sections of the island. The event resulted in approximately 139.54 inches (3,544.4 mm) of rainfall over a 6-day period (September 26-October 1, 2010). Similar rainfall events were experienced in 1979 and in 1986. ODPEM has determined that in light of the volume and intensity of rainfall and the level of damage wrought, the event is to be classified as an extreme event. ODPEM has also indicated that it is now becoming increasingly evident that the return period for what may be deemed a 100-year event is being experienced within periods of 15-20 year cycles. The situation may have been exacerbated by an extended period of rainfall impacting the island in the days leading up to the event.

Summary Cost

The preliminary estimate of the damage and losses incurred by the Jamaican economy due to Tropical Storm Nicole and associated rains was \$20.58 billion (US \$239.6 million²), disaggregated as \$19.51 billion in damage and \$1.01 billion in losses³. With regard to total damage, publicly owned properties accounted for \$19.32 billion or 93.9 per cent, while privately owned properties accounted for the remaining \$1.25 million. The cost of the impact was equivalent to 1.9 per cent of current (2009) GDP, somewhat similar to the 2.1 per cent of GDP occasioned by the impact of Tropical Storm Gustav in 2008, which cost approximately US\$214 million. Damage and losses in the infrastructure sector represented the greatest portion of impact accounting for over 88.1 per cent of the estimated total (See Table 1, Figure 1).

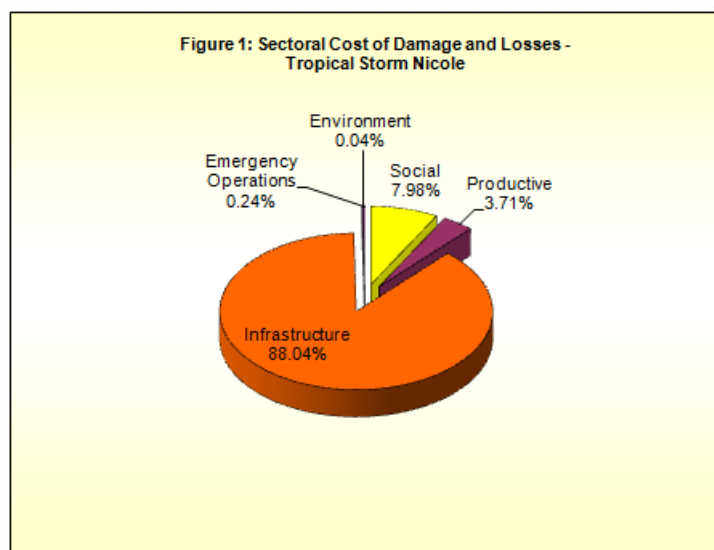
The impact of the rains necessitated a downward revision in the projected GDP growth rate, given the reported damage sustained mainly by agriculture and infrastructure (electricity, water, roads). Thus, GDP is expected to expand by 0.7 per cent instead of the 0.9 per cent projected prior to the event (a detraction of 0.2 percentage points).

² Exchange rate: J \$85.89 = US \$1 (Bank of Jamaica Exchange Rate for September)

³ The estimates delineated for losses may be underestimated as at the time of writing the relevant data were not fully tabulated.

Table 1: Preliminary Costs of Damage and Losses caused by Tropical Storm Nicole

Sector and Sub-sector	Allocated by Classification		Allocated by Sector		Total	% Share
	Damage	Loss	Private	Public		
Total	19,512,169,947	1,066,932,270	1,254,638,710	19,318,863,507	20,579,102,217	
% Share	94.82	5.18	6.10	93.88	100.00	
Social	701,662,557.38	940,000,000.00	274,300,000.00	1,367,362,557.38	1,641,662,557.38	7.98
Housing	274,300,000.00		274,300,000.00		274,300,000.00	1.33
Education and Culture	157,000,000.00	940,000,000.00		1,097,000,000.00	1,097,000,000.00	5.33
Health	270,362,557.38			270,362,557.38	270,362,557.38	1.31
Correctional Facilities				0.00	0.00	0.00
						0.00
Productive	664,856,440.05	98,182,269.95	741,038,710.00	22,000,000.00	763,038,710.00	3.71
Livestock	32,400,000.00		32,400,000.00	0.00	32,400,000.00	0.16
Greenhouse/Protected Cultivation	12,500,000.00		12,500,000.00	0.00	12,500,000.00	0.06
Domestic & Agricultural Crops	531,632,000.00		531,632,000.00	0.00	531,632,000.00	2.58
Fisheries	0.00		0.00		0.00	0.00
Irrigation	0.00		0.00	0.00	0.00	0.00
Mining	0.00		0.00	0.00	0.00	0.00
Manufacturing	0.00		0.00	0.00	0.00	0.00
Relief Assistance (Agriculture)*1		22,000,000.00		22,000,000.00	22,000,000.00	0.11
Tourism	88,324,440.05	76,182,269.95	164,506,710.00		164,506,710.00	0.80
Infrastructure	18,089,050,000.00	28,400,000.00	229,300,000.00	17,888,150,000.00	18,117,450,000.00	88.04
Electricity	92,400,000.00		92,400,000.00		92,400,000.00	0.45
Water Supply and Sanitation	270,000,000.00			270,000,000.00	270,000,000.00	1.31
Transport/Roads and Bridges*2	17,013,900,000.00	27,900,000.00		17,041,800,000.00	17,041,800,000.00	82.81
Farm Roads	574,550,000.00			574,550,000.00	574,550,000.00	2.79
Ports	1,300,000.00	500,000.00		1,800,000.00	1,800,000.00	0.01
Telecommunications	136,900,000.00		136,900,000.00		136,900,000.00	0.67
Environment	7,611,992.00	350,000.00	0.00	2,361,992.00	7,961,992.00	0.04
Forestry	5,250,000.00	350,000.00			5,600,000.00	0.03
Waste Management	2,361,992.00			2,361,992.00	2,361,992.00	0.01
Emergency Operations	48,988,957.61	0.00	10,000,000.00	38,988,957.61	48,988,957.61	0.24
Government Relief Assistance				0.00	0.00	0.00
PC-Drain Cleaning/Vector Control	30,000,000.00			30,000,000.00	30,000,000.00	0.15
ODPEM Relief Supplies	8,333,453.07			8,333,453.07	8,333,453.07	0.04
ODPEM Relief Transportation	655,504.54			655,504.54	655,504.54	0.00
Red Cross Activities	10,000,000.00		10,000,000.00		10,000,000.00	0.05



Infrastructure

As in the case with Tropical Storm Gustav, the greatest impact of Tropical Depression No. 16/Tropical Storm Nicole was to the country's physical infrastructure. Based on preliminary assessments, damage was estimated at \$18.09 billion. The associated losses, though not yet fully determined are estimated to be in the region of \$28.4 million

Damage to main roads and bridges was estimated at \$14.0 billion of which \$1.42 billion represented the preliminary cost to reopen blocked roads. A total of 543 main roads were impacted with St. Thomas accounting for \$1.54 billion or 11.0 per cent of the total cost of the damage. Another \$1.90 billion was allocated to river training (Table 23). Cleaning and reconstruction of retaining walls of the Sandy Gully bridge accounted for 32.7 per cent (\$4.6 billion) of the total cost of damage to the road infrastructure.

Preliminary estimates of damage to the NWC system ranged between \$240.0 million - \$270.0 million. Assessment of damage to rural and remote infrastructure as well as commercial losses, increased operating costs (including the trucking of water) and other costs associated with the tropical storm has not yet been ascertained. More than 40.0 per cent of NWC's 460 water supply systems were damaged and/or forced out of operation and a further 30.0 per cent were otherwise impacted. This resulted in water supply service to most customers being impacted in one way or another. However, within 10 days, more than 95.0 per cent of the Commission's productive capacity and more than 85.0 per cent of its systems were restored.

Preliminary estimates indicate that the electricity sub-industry sustained damage of some \$92.4 million. Associated losses were reported as being minimal as it was mainly the smaller users that were out of electricity. The impact to large consumers, for example hotels, was limited.

The impact on the JPSCo's distribution system resulted in power outages to approximately 48.0 per cent of customers (over 288 000) islandwide. While restoration efforts were hampered by blocked roads, landslides, flooding, badly damaged roadways and ongoing rainfall in some areas, electricity was restored to 99.0 per cent of the total customer base within almost a week of the storm.

Transportation

Physical damage to the JUTC's four depot was minimal, estimated at \$200 000, accounted for fully by damage at the Greater Portmore lay-by. The company, however, sustained loss in revenue during the initial one-week period of the event, which amounted to \$25.0 million. Except for a few cancellations and flight delays, activities at the international airports functioned smoothly. The associated losses, if any, are yet to be determined. The Port Authority of Jamaica (PAJ) reported that there were no damages to its property, plant and equipment.

Agriculture

Preliminary figures from the Ministry of Agriculture indicated that total damage and loss to the agriculture sector was estimated at \$576.5 million. Crop damage accounted for \$531.6 million while damage to livestock was put at \$32.4 million and greenhouses at \$12.5 million. Damage to the infrastructure (farm roads) was estimated at \$574.6 million. Some \$22.0 million was also allocated as relief assistance to small farmers and greenhouse growers.

Some 40.0 per cent of banana production was affected, 26 greenhouses were damaged, and crops mainly affected included vegetables, condiments and banana/plantains⁴. Losses were highest in the parish of St. Elizabeth (\$89.7 million) followed by Clarendon (\$86.2 million) and St. Mary (\$81.2 million).

Tourism

An initial damage assessment indicates that the preliminary cost of damage is put at \$76.18 billion and losses at \$88.32 billion. Damage within the tourism sector was greatest in Negril and the South Coast Resort Areas, Montego Bay, and Port Antonio. There were also reports of various attractions island-wide being affected. The most frequently reported type of damage related to buildings, boats and other vessels; extensive beach erosion; and extensive vegetative and landscape damage due to floods and heavy winds.

⁴ http://www.moa.gov.jm/news/ministry_helps_groups_affected_by_tsnicole.php

Education

Total damage to educational institutions is estimated at \$157 million, while losses amounted to \$940 million, for a total of \$1.10 billion. This represents 6.11 per cent of the damage to the social sector. Some 147 schools were damaged by the event with the main damage being leakage and flooding. During the event attendance at schools was largely disrupted between September 28 and October 1, with all schools being declared closed on September 29.

Health

The Ministry of Health reported that 16 persons lost their lives as a result of the event, 14 of whom have been confirmed dead. Among those who perished were six children between 0 (newborn) and 14 years of age. Nine persons died by drowning and 10 by crush injury. In addition, 42 persons (31 males and 11 females) with injuries related to the weather event were treated at hospitals since September 28, 2010. Nine of the injured were admitted to hospital. The health sector sustained damage and losses to the tune of \$270.0 million. Four Health Centres were closed as a result of the weather conditions. Two hundred and seventy-nine of the 302 Health Centres were opened on Friday, October 1, 2010. Of these, 231 offered full services and 48 partial services. All 24 public hospitals and the University Hospital of the West Indies remained operational with one hospital – the Spanish Town Hospital offering emergency services only. Services at the National Public Health Laboratory and the National Blood Transfusion service were closed temporarily due to floods and leaks.

Affected Population

Approximately 18.7 per cent of the total population or 507,831 persons from 130 communities were directly and indirectly affected by the natural disaster. Most of the affected communities were impacted by flooding. The impact of Tropical Storm Nicole and associated rains was felt throughout Jamaica but tremendous damage was sustained in the parishes along the southeast through to southwest corridor and southern sections of northern parishes. The parishes most affected included Hanover, Clarendon, KSA, Westmoreland, St. Catherine and St. Elizabeth which together accounted for 78.5 per cent of communities affected. During the event there were up to 277 persons confirmed as being in shelters in St. Catherine, 228 in KSA and 49 in Westmoreland.

Data on the directly affected population was generally not provided by gender. However, in terms of death and injuries, males fared worse than females. Males accounted for 75% of mortality and 74% of the injured. It is known that males account for the majority of farmers and would account for the majority of the approximately 17,000 domestic crop farmers and 1700 livestock farmers whose property crops and livestock were damaged.

In the education sector, boys and girls at the early childhood, primary and secondary levels can be assumed to have been equally impacted as enrollment rates were relatively equal at these levels, with slightly higher number of boys at the secondary level.

Comparison of the most affected communities with the poverty map indicates that the communities were generally not located in the poorest areas. There was, however, evidence that some communities such as Sandy Gully, are pockets of poverty within wealthier communities.

A total of 2169 houses were assessed after the passage of Tropical Storm Nicole. Of these, 474 (21.8 per cent) were severely damaged while 54 (2.5 per cent) were totally destroyed. Damage amounted to an estimated \$274.3 million of which \$75.6 million was the replacement cost for those totally destroyed units. Westmoreland had the highest number of homes that were totally destroyed, and accounted for a third of the estimated replacement cost. In terms of overall damage, the five most affected parishes in rank order are Westmoreland with 648 houses and 28.4 per cent of the reported cost of damage, KSA with 261 (15.8 per cent), St. Catherine - 209 (14.1 per cent), St. Mary – 27 (9.8 per cent) and St. Elizabeth with 310 (7.9 per cent) as presented in Table 11. Most of the damage to housing units was caused by flooding.

Environment

The entire island was enveloped by the intense showers of Tropical Storm Nicole. The continuous rains resulted in flooding, landslides and over flowing of rivers/gullies across the island resulting in the loss of lives and property and severe damage to the country's infrastructure. Data from the Water Resources Authority (WRA) indicated that some rivers experienced the highest flows on record. The torrential rainfall also resulted in pollution of the environment from runoff and spills from industrial facilities and sewage treatment plants, coastal erosion, sedimentation of coastal water bodies and accumulation of solid waste. There was also damage to vegetation in some areas, evidenced by uprooted trees.

Emergency Operations

Relief operations during and after the event included the airlifting of 300 relief packages to six marooned communities in the parishes of St. Thomas, St. Catherine & KSA by the JDF. The Ministry of Health responded to 16 emergency requests and eight helicopter Casualty Evacuation (CASEVAC) flights were completed, with transportation of nine patients to hospital. The Red Cross also provided relief supplies to 1,456 people in 7 communities. The total cost for emergency activities was estimated at approximately \$48.9 million. This included \$8.3 million and \$10.0 million to cover emergency/humanitarian relief supplies of the ODPEM and the Red Cross respectively. Another \$0.65 million was spent on helicopter fuel for 18.5 hrs of helicopter flights, and fuel for four trips to carry paddle boats to Pedro River and Chigwell.

I. INTRODUCTION

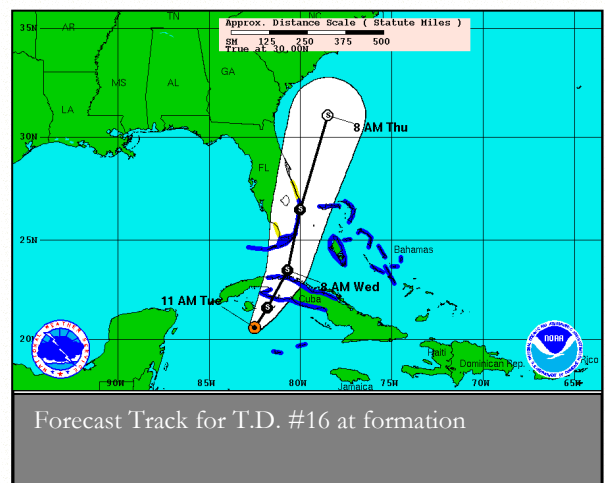
A. Description of Events

The Meteorological Phenomenon

The formation of Tropical Storm Nicole which affected the island from September 28 – October 1, 2010 was the culmination of a series of sequential weather events between September 22 and September 27. These weather events included:

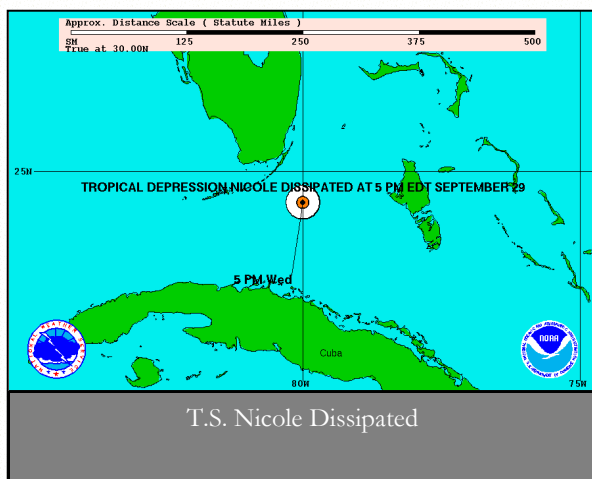
- significant moisture and broad cyclonic flow associated with Tropical Depression Matthew which continued to impact much of the western Caribbean producing strong showers and thunderstorms west of 78°W;
- deep layer moisture across most of the Caribbean west of 67°W. This was associated with monsoonal moisture from northern South America and the large scale cyclonic surface wind field from the remnant low center of Tropical Storm Matthew;
- an upper-level ridge axis that extended eastward to 14°N, 61°W over the remainder of the Caribbean basin. This upper-level pattern provided a diffluent environment aloft and in turn supported the widespread showers and scattered thunderstorms noted on satellite imagery mostly located west of 64°W; and
- a concentrated area of convective activity associated with a broad 1004 millibar low-pressure centre over northern Belize near 18°N, 88°W. Scattered moderate to strong convection was mostly located within 180 nautical miles of the centre and over interior portions of the Yucatan Peninsula. Global model guidance agreed on further organization of this broad area of low pressure over the western Caribbean.

Based on radar reports of continuing showers and thunderstorms over Jamaica on September 26 and into September 27, with the low-pressure area drifting northward in the vicinity of the island, a Flash Flood Warning was issued at 1:00 p.m.



Conditions were, at that time, favourable for gradual development into another tropical cyclone and rainfall was expected to continue over the island for another two days. Throughout the night, radar reports indicated that periods of heavy showers and thunderstorms affected all western, central and southeastern parishes. These were forecast to continue during the day and for the next 2-3 days as Tropical Depression #16 (TD#16) formed west of the island. Marine interests were advised to look out for above-normal wave heights, strong, gusty winds, showers and thunderstorms.

On September 28, Tropical Depression #16 was the main feature across the north-western Caribbean generating numerous showers and scattered thunderstorms over much of the basin north of 12°N between 65°W and 89°W. This widespread area of convection was supported aloft by an anticyclonic circulation centred near 18°N, 75°W that extended an upper-level ridge axis southeast to north-eastern Venezuela near 10°N, 62°W. As TD#16 steered north-northeastward, 10-15 knot east-southeast trade winds were expected to resume over the basin east of 72°W with surface troughing forecast to drift over the western Caribbean between 80°W and 85°W through early Saturday.



With the depression moving towards the north on September 28, rainfall continued across the country and was forecast to peak in intensity within the next 24 hours although continuing through to October 1. Strong winds and heavy rains associated with the depression were expected to occur “a couple hundred miles to the east and southeast of the centre” as it moved

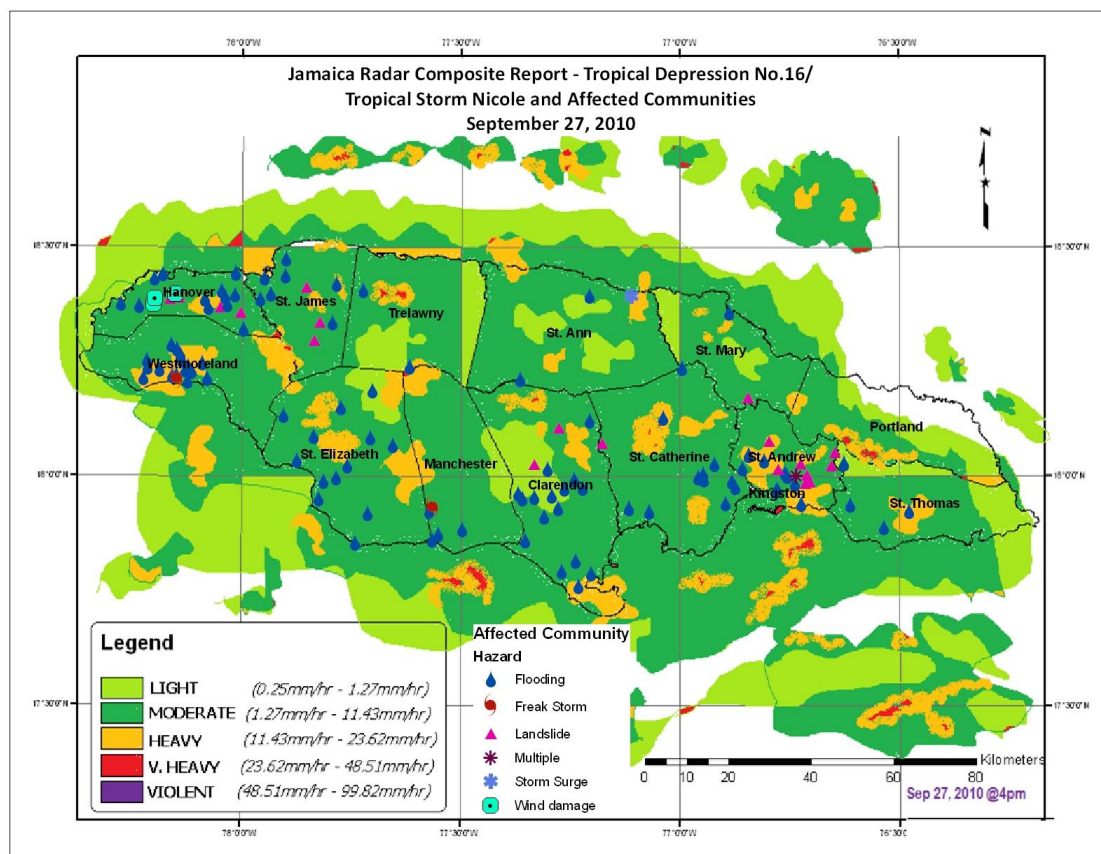
across Cuba. By 5:00 a.m. the next day, September 29, the centre of the tropical cyclone emerged over the Straits of Florida, becoming Tropical Storm Nicole by 2:00 p.m. and dissipating by 5:00 p.m. The broad band of showers and thunderstorms left behind, continued to produce gusty winds and heavy rainfall across Jamaica, forecast to continue for another two days. The Flash Flood Warning was continued.

On September 30, most parishes continued to experience scattered light to moderate and sometimes heavy showers and thunderstorms. These, however, showed gradual reduction on October 1-3; hence the Flash Flood Warning was lifted at 5:00 p.m. on October 3. The broad area of low-pressure had begun to drift northward and away from Jamaica.

Radar Imagery:

Jamaica's Doppler Weather Surveillance Radar was in active operation for most of the severe weather event, although removed from service from 9:00 p.m. on September 28 to 11:00 a.m. on September 30, and again at 9:00 p.m. on September 30 to the end of the period due to power supply issues. Figure 1 and Figure 2 display radar images showing the levels of rainfall impacting the island at the peak of the event on September 27 and 28. Detailed radar images for the extent of the event can be found in Appendix A

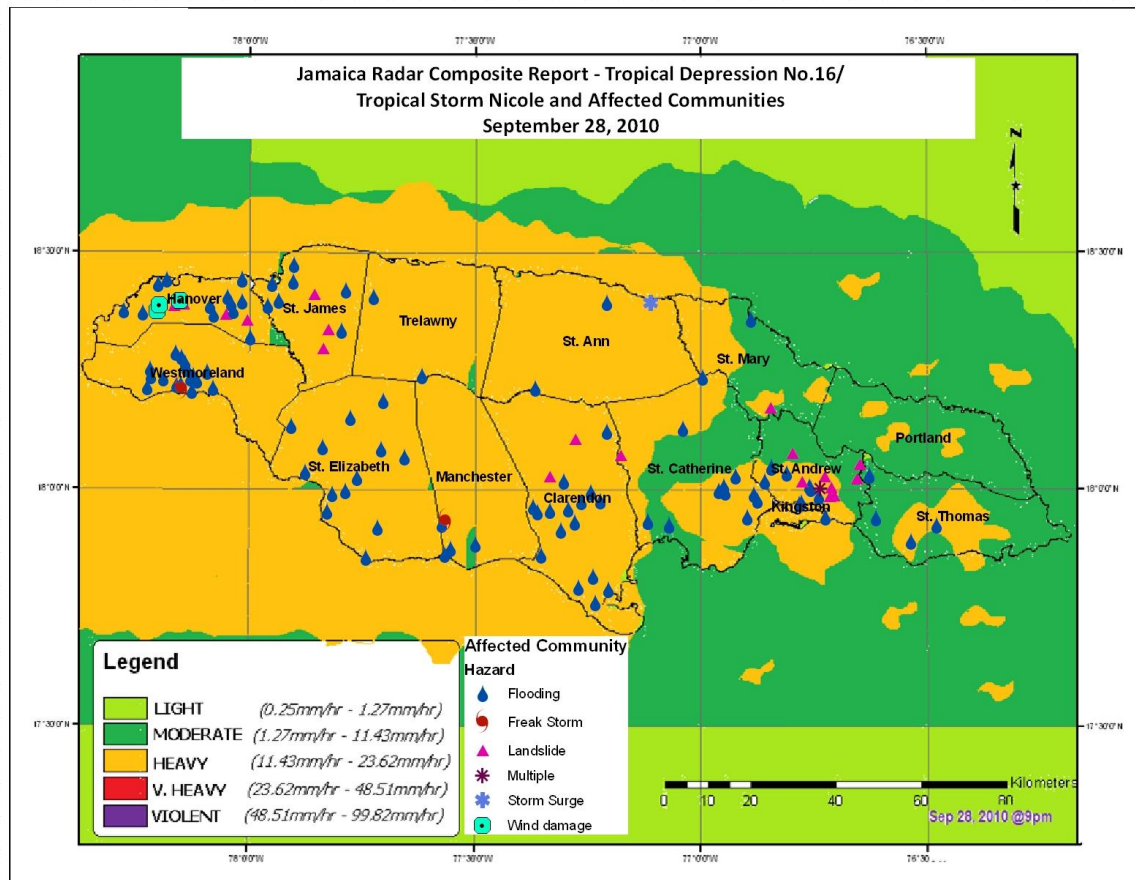
Figure 1: Radar Composite - Rainfall on September 27 and Affected Communities



Source: Meteorological Service, Jamaica, ODPEM

The communities affected by flooding and landslides as displayed in Figures 1 and 2 are consistent with the areas which received heavy rainfall on the days indicated. This covered mainly the western parishes of the island as well as Kingston and St. Andrew and parts of St. Thomas.

Figure 2: Radar Composite - Rainfall on September 28 and Affected Communities



Source: Meteorological Service, ODPEM

There were three reported incidents of microburst in Savanna-la-Mar, Westmoreland, Mandeville and St. Elizabeth. Microburst is a kind of severe weather condition, which develops as a column of dropping air. Microburst appears like a tornado and usually has wind speeds of 120.7km (75 miles) per hour.

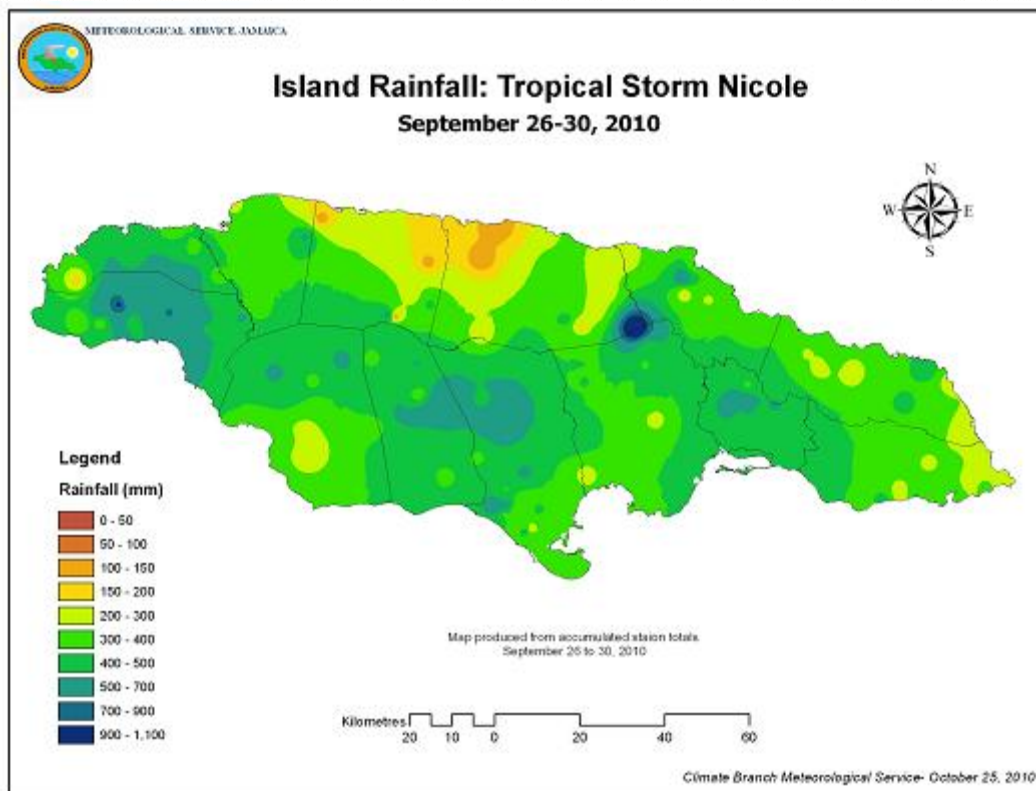
Table 1: Wind Analysis

Parish	Station	Day_26 (knots)	Highest Daily Wind (knots)	Time of Strongest Gust (LST)
St. Thomas	Belvedere	2.2	18.3	0630
	Nutts River	1.7	11.3	0430
Portland	Happy Grove	4.4	21.7	0700
	Fair Prospect	4.1	18.3	0600
	C.A.S.E	3.7	17.4	1430
Kingston	Norman Manley International Airport	8.3	23.3	0558
Parish	Station	Day_27 (knots)	Highest Daily Wind (knots)	Time of Strongest Gust (LST)
St. Thomas	Belvedere	2.2	23.5	1145
	Nutts River	1.4	18.3	1200
Portland	Happy Grove	4.0	20	2400
	Fair Prospect	3.0	17.4	1100
	C.A.S.E	2.6	16.5	1300
Kingston	Norman Manley International Airport	5.4	15.2	0318
Parish	Station	Day_28 (knots)	Highest Daily Wind (knots)	Time of Strongest Gust (LST)
St. Thomas	Belvedere	3.0	20.9	0930
	Nutts River	1.9	23.5	2300
Portland	Happy Grove	4.9	24.3	1130
	Fair Prospect	3.4	20.9	1030
	C.A.S.E	1.2	6.1	0730
Kingston	Norman Manley International Airport	7.6	25.9	2316
Parish	Station	Day_29 (knots)	Highest Daily Wind (knots)	Time of Strongest Gust (LST)
St. Thomas	Belvedere	8.8	36.5	0700
	Nutts River	4.6	31.3	0530
Portland	Happy Grove	7.9	32.2	1000
	Fair Prospect	5.9	29.6	1430
	C.A.S.E	3.8	20.9	1700
Kingston	Norman Manley International Airport	14.1	36.5	1002
Parish	Station	Day_30 (knots)	Highest Daily Wind (knots)	Time of Strongest Gust (LST)
St. Thomas	Belvedere	1.2	13.9	1215
	Nutts River	0.4	8.7	1630
Portland	Happy Grove	4.8	19.1	1630
	Fair Prospect	2.3	19.1	1000
	C.A.S.E	2.5	13.9	0700
Kingston	Norman Manley International Airport	3.5	10.3	1659

Rainfall Analysis

The monthly average rainfall for the island for September was 272 per cent above the normal (30-year mean from 1971-2000). As a whole, rainfall for the island exceeded the 30-year mean figure for the month. The parish rainfall analysis figures indicate that every parish recorded above normal rainfall for the month⁵ (Figure 3). St. Ann recorded the highest percentage of mean with 453 per cent or 468mm. See Appendix B for a breakdown of rainfall by parish. The excessive rainfall prior to and during the event contributed to the high incidence of flooding.

Figure 3: Island Rainfall: Tropical Storm Nicole



The Mount Peto station in Hanover recorded the highest rainfall volume of 307.8 mm in a single day and a total volume of 608.7 mm of rainfall over the 5-day period. Figure 3 gives the percentage of the 30-year mean by station. The following stations recorded 250 per cent or higher of the 30-year mean over the four day period:

⁵ Preliminary Monthly Rainfall Summary for September 2010, Meteorological Service, Jamaica

- Clarendon - Grimmith recorded 342 per cent, Monymusk 317 per cent.
- KSA - Mavis Bank 253 per cent, Newcastle 265 per cent, Palisadoes 296 per cent, Seaview 261 per cent and Waterloo 260 per cent .
- Manchester – Manchester Pastures 302 per cent, Marshall Pen- Sutton 281 per cent,
Spur Tree 268 per cent.
- St. Catherine – Bois Content 250 per cent.
- St. Mary – Boscobel 257 per cent, Hampstead 254 per cent.
- Westmoreland – Barham 263 per cent, Masemure 260 per cent and Shrewsbury 272 per cent.

Figure 4: Percentage Mean Island Rainfall: Tropical Storm Nicole

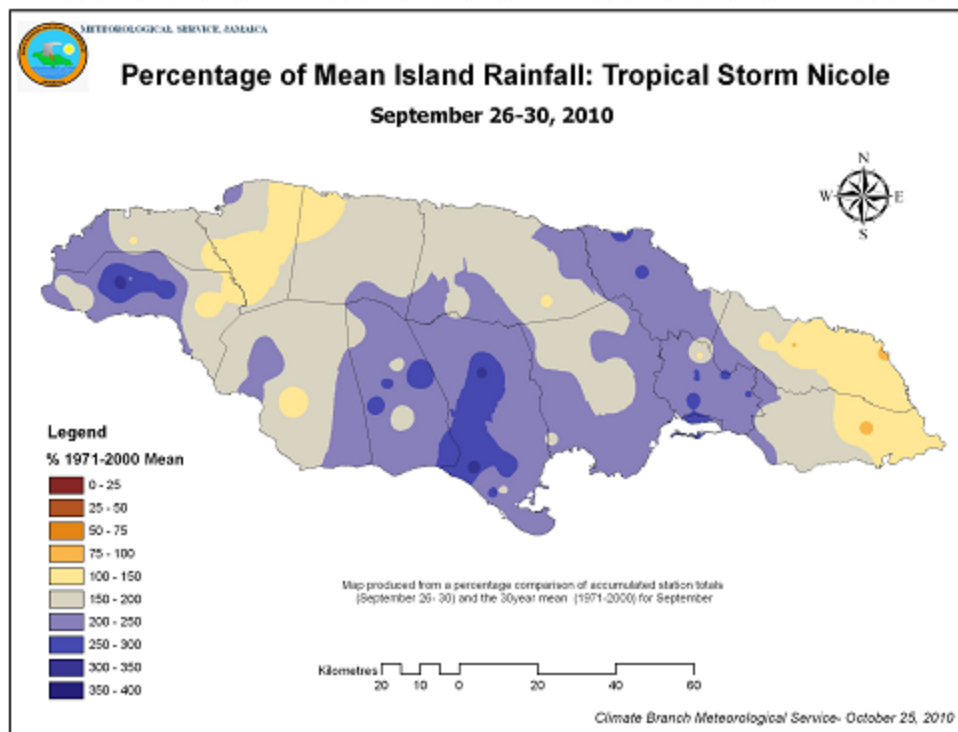


Table 2 shows rainfall amounts collected at select rainfall stations across the island covering the period September 26 – 30, 2010.

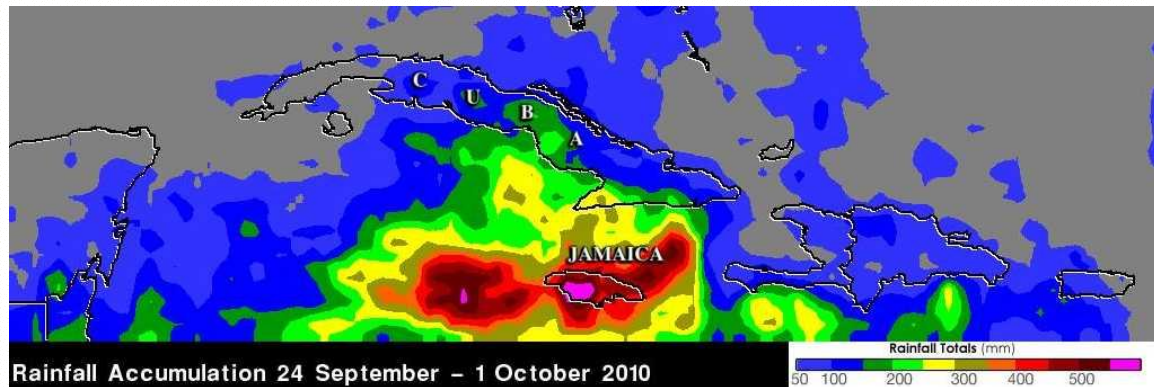
Table 2: Rainfall Volume (mm) in selected stations, September 26-30

Parish	Station	Sep-26	Sep-27	Sep-28	Sep-29	Sep-30	Total
St. Thomas	Belvedere	22.4	21.2	69.6	76.6	25.6	215.4
	Nutts River	43.6	23.2	66.4	134.2	36.2	303.6
Portland	Happy Grove	14.6	2.8	66	126.6	16.4	226.4
	Fair Prospect	8.6	0.6	45.2	192.8	18	265.2
	C.A.S.E	3.4	6.8	0.2	7.8	31.6	49.8
St. Catherine	Worthy Park	14.5	30	132	125	6.5	308
	Swansea	14	36	233	175	7.5	465.5
	Charm Hole	17	22	160	180	8	387
	Tulloch Estates	18.8	13.6	218.2	141.5	8.9	401
Kingston	Palisadoes	30.4	26.2	211.5	150.6	3.5	422.2
Clarendon	*Beckford Kraal	30.5	90	248	241.5	16	626
	Mason River	9.4	40.8	227	180	13.9	471.1
St. James	*Sangster Int'l Airport	2.4	14.3	146.6	114.8	9.8	287.9
	Green Pond	19.8	13.6	155.6	105.6	14	308.6
St. Elizabeth	Appleton	15.6	20.9	177.7	141.3	115.7	471.2
	*Holland	10.9	41.4	238.8	175.3	31.4	497.8
Hanover	Cacoon Castle	0	43.8	164.3	156.5	18.3	382.9
	Shettlewood	6.5	52	114.4	199.6	1.4	373.9
	Sandy Bay (Tryall)	0	89.1	168.2	53	42.2	352.5
	Mount Peto	10.3	73	307.8	189.3	28.3	608.7
Manchester	J. J. Gagnon	9.5	21.8	19.8	141.4	97.1	289.6
	Craighead	40	65	110	158	107	480
	Marshall Pen	37.1	51.2	276.9	271.2	25.6	662
Westmoreland	Negril Point L/H	12.7	102.9	165.1	97.8	100.1	478.6

NOTE: Stations marked with an asterisk (*) are those where the one-day maximum exceeds that station's 30-year mean (1971-2000) rainfall for September.

The National Aeronautics and Space Administration (NASA) reported that the highest rainfall totals associated with the system was over Jamaica where upwards of 550 mm (~22 inches) of rain fell as a result of Tropical Storm Nicole's interaction with the island's terrain⁶ (Figure 5).

Figure 5: Rainfall Accumulation September 24 – October 1, 2010



Source: NASA,

B. Emergency Actions and Expenditure

At the start of the event, all emergency centres were activated. This included the National Emergency Operations Centre, all Parish Emergency Operations Centre and the Tourism Emergency Operations Centre. On September 29, an aerial reconnaissance was conducted by the Prime Minister and other key disaster management personnel. The Jamaica Defense Force (JDF) airlifted 300 relief packages to six marooned communities in the parishes of St. Thomas, St. Catherine and Kingston and St. Andrew (KSA) as well as the medical evacuation of a pregnant mother. Four boats were sent to Chigwell and one to Pedro River. No evacuations were conducted, however, as residents refused to leave their communities.

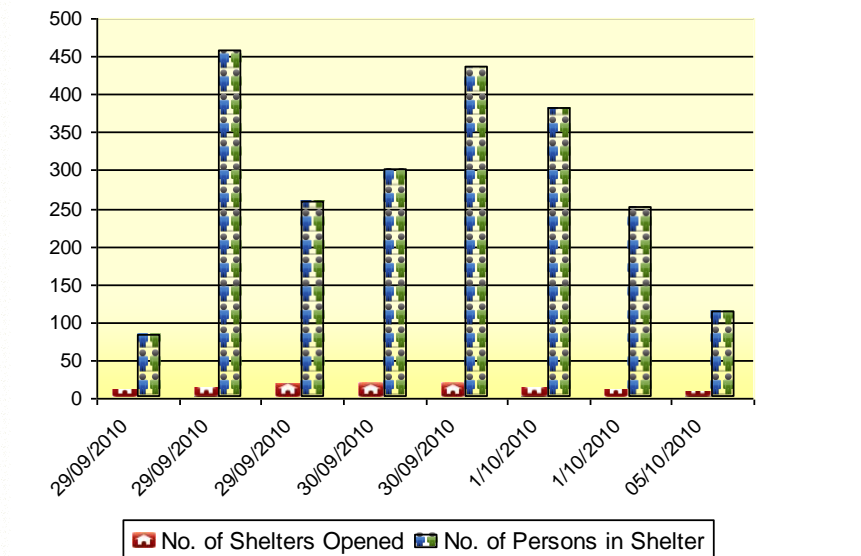
Other critical actions included the evacuation of students from Sandy Park Basic School, and four persons in Westmoreland, Riverside Drive, Havendale, New Haven and Sterling Castle in St. Andrew by the Jamaica Fire Brigade. The Ministry of Health (MOH) responded to 16

⁶ http://www.nasa.gov/mission_pages/hurricanes/archives/2010/h2010_Nicole.html

emergency requests and eight helicopter Casualty Evacuation (CASEVAC) flights were completed, with transportation of nine patients to hospital. The Red Cross provided relief supplies and food packages to 1,456 people in seven communities.

A total of 27 shelters were opened across the island housing 532 persons. At the peak of the event, some 457 persons had sought refuge in 11 shelters in seven parishes. As at October 5, 2010, a total of 114 persons remained in 6 shelters in Kingston, St. James and St. Catherine (See Figure 6).

Figure 6: Status of Shelters Sept 29 – October 5, 2010



The total cost for emergency activities following Tropical Storm Nicole was estimated at approximately \$48.9 million. This included \$ 8.3 million and \$10 million to cover emergency/humanitarian relief supplies of the ODPEM and the Red Cross respectively. Another \$0.65 million was spent on helicopter fuel for 18.5 hrs of helicopter flights, and fuel for four trips to carry paddle boats to Pedro River and Chigwell. The Jamaica Red Cross also stated that some of the funds will be used to support the Ministry of Health's Dengue Emergency Programme and to purchase the chemical, Malathion used to destroy *Aedes aegypti* mosquitoes breeding sites that may be prevalent in some areas.

In the aftermath of the event, the Government allocated \$30 million to be shared by the 14 local authorities to undertake much needed drain cleaning and vector control activities islandwide. Each Council would receive \$1 to \$3 million towards drain cleaning; some received \$200,000 while others received \$500,000 for vector control⁷.

C. Affected Population

The estimated population during the period of the flood rains was 2.7 million. As at October 5, 2010 approximately 18.7 per cent of the total population or some 507,831 persons from 130 communities were directly and indirectly affected by the natural disaster. Most of the affected communities were impacted by flooding (See Table 3 and Table 4).

Table 3: Estimated Affected Population Due To Heavy Rainfall and Flooding from Tropical Storm Nicole (As reported to the ODPEM's NEOC)

	End of Year Population 2006	%	End of Year Population 2007	%	End of Year Population 2008	%	End of Year Population 2009	%	Projected Population At the time of TS Nicole (September 28- October 1, 2010)	Estimated Population Affected during Tropical Storm Nicole
Jamaica	2,669,500	100.0	2,682,100	100.0	2,692,400	100.0	2,698,800	100.0	2,708,813	507,831
Kingston and St. Andrew	660,600	24.7	663,600	24.7	666,200	24.7	667,800	24.7	670,278	94,609
St. Thomas	93,400	3.5	93,900	3.5	94,300	3.5	94,500	3.5	94,851	9,853
Portland	81,500	3.1	81,900	3.1	82,300	3.1	82,400	3.1	82,706	390
St. Mary	113,400	4.3	113,900	4.2	114,300	4.2	114,600	4.2	115,025	9,556
St. Ann	172,000	6.4	172,800	6.4	173,400	6.4	173,800	6.4	174,445	14,892
Trelawny	75,000	2.8	75,300	2.8	75,600	2.8	75,800	2.8	76,081	6,078
St. James	182,800	6.8	183,700	6.9	184,400	6.9	184,900	6.9	185,586	36,489
Hanover	69,300	2.6	69,600	2.6	69,900	2.6	70,100	2.6	70,360	32,057
Westmoreland	143,800	5.4	144,400	5.4	145,000	5.4	145,300	5.4	145,839	36,858
St. Elizabeth	149,800	5.6	150,600	5.6	151,100	5.6	151,500	5.6	152,062	33,879
Manchester	189,300	7.1	190,200	7.1	190,900	7.1	191,400	7.1	192,110	7,770
Clarendon	244,400	9.2	245,600	9.2	246,500	9.2	247,100	9.2	248,017	46,630
St. Catherine	494,200	18.5	496,600	18.5	498,500	18.5	499,600	18.5	501,454	178,769

Source: Economic and Social Survey Jamaica 2009

Note: Population Projection by the Social Policy, Planning and Research Division, PIOJ.

Estimated population affected during Tropical Storm Nicole data based on assessment from the Office of Disaster Preparedness and Emergency Management (ODPEM) and Ministry of Labour and Social Security (MLSS) and using community data from 2001 Poverty Map.

⁷ <http://rjrnewsonline.com/news/local/30m-islandwide-drain-cleaning-vector-control>

Table 4: Hazards Experienced and Affected Communities

Hazard	No. of Communities
Flooding	103
Freak Storm	2
Landslide	19
Storm Surge	1
Wind damage	3
Multiple (Flooding & Landslide)	2
Total	130

Affected persons lost homes and property due to flooding and landslides as well as a freak storms. Some residents lost livelihoods or had their livelihood interrupted. Many of these persons were in the agricultural sector and were banana, vegetable and livestock farmers.

Severely Affected Source: ODPEM NEOC

The impact of Tropical Storm Nicole and associated rains was felt throughout Jamaica but tremendous damage was sustained in the parishes along the southeast through to southwest corridor and southern sections of northern parishes. The level of flooding or damage sustained in the impacted areas appears to have been directly related to the geomorphology, location and the nature of development undertaken in these areas. The areas affected were either located on alluvial fans, at the base of mountains (where the denuded hillsides lead to debris flows) or in karst terrain. The communities listed in Table 5 were the worst affected.



Inundated house in Wilton, St. Elizabeth in which a senior citizen was trapped for four days



Major landslide on the Maggoty main road, St. Elizabeth

Table 5: Communities Worst Affected by Tropical Storm Nicole

St. Andrew - Hope River Valley	Westmoreland	St. Elizabeth	St. Ann	Hanover
Kintyre	Savanna-la-mar	New River	Pedro River	Chigwell
Hope Tavern	Llandilo	Luana		
August Town	Little London	Black River		
	Albany	Bamboo Avenue		
	Big Bridge	Treasure Beach		
	McNeil Lands	Burnt Savannah		

Source: Declaration of Disaster Areas -Information Note Prepared for the Office of the Prime Minister

The parishes most affected include Hanover, Clarendon, KSA, Westmoreland, St. Catherine and St. Elizabeth which together accounted for 78.5 per cent of communities affected (Table 6, Figure 7 and 8).

During the event there were up to 277 persons confirmed as being in shelters in St. Catherine, 228 in KSA and 49 in Westmoreland⁸. Despite the high number of reported

⁸ Shelter population is migratory so numbers may fluctuate from day to day

communities affected in Hanover, Clarendon and St. Elizabeth, no shelters were activated in these parishes. The shelters in these parishes were on standby to receive residents who instead opted to stay with relatives and/or friends.

Table 6: Number of Communities Affected by Parish (as reported to the NEOC)

Parish	Number of Communities Affected
Hanover	20
Clarendon	19
KSA	19
Westmoreland	17
St. Catherine	14
St. Elizabeth	13
St. James	10
Manchester	5
St. Thomas	5
St. Ann	4
St. Mary	2
Trelawny	2
TOTAL	130

Source: ODPEM

On October 1, 2010, the ODPEM recommended that the communities of New River, Kintyre, Tavern, Big Bridge, Little London and McNiel's Land, Hope Tavern, August Town, River View, Bedward Gardens, Gold Smith Villa be declared as disaster areas and that measures be instituted to facilitate immediate actions to address the priorities of vector control, water and sanitation, re-housing or relocation of affected communities, livelihood reinstatement infrastructure replacement or flood control measures.



The entrance to the Apple Valley Park and Farm (left) and the shops along the Maggotty River (right) were inundated when the river overflowed its banks.

Figure 7: Levels of Damage to Houses Critically Affected by Tropical Storm Nicole - Westmoreland

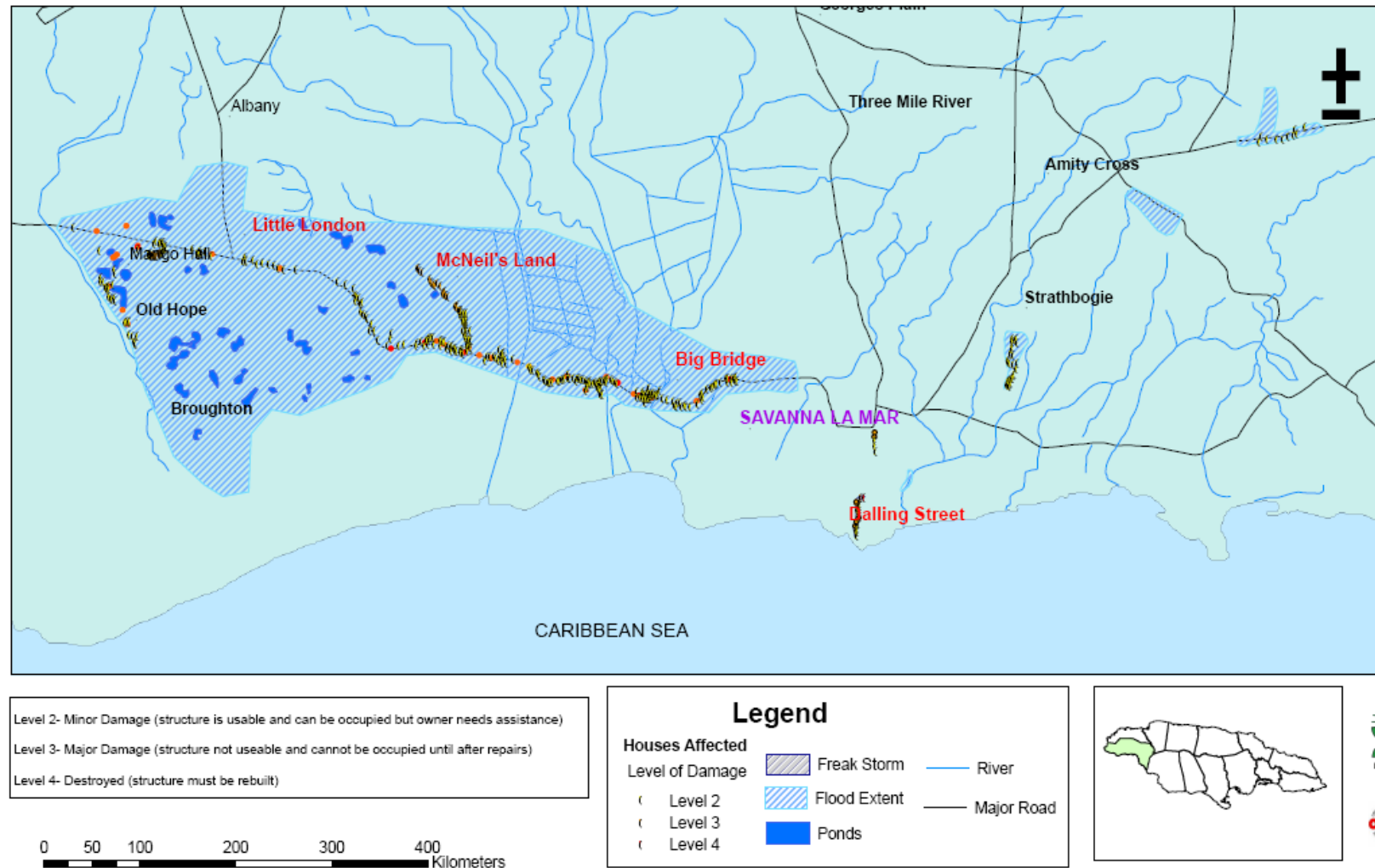
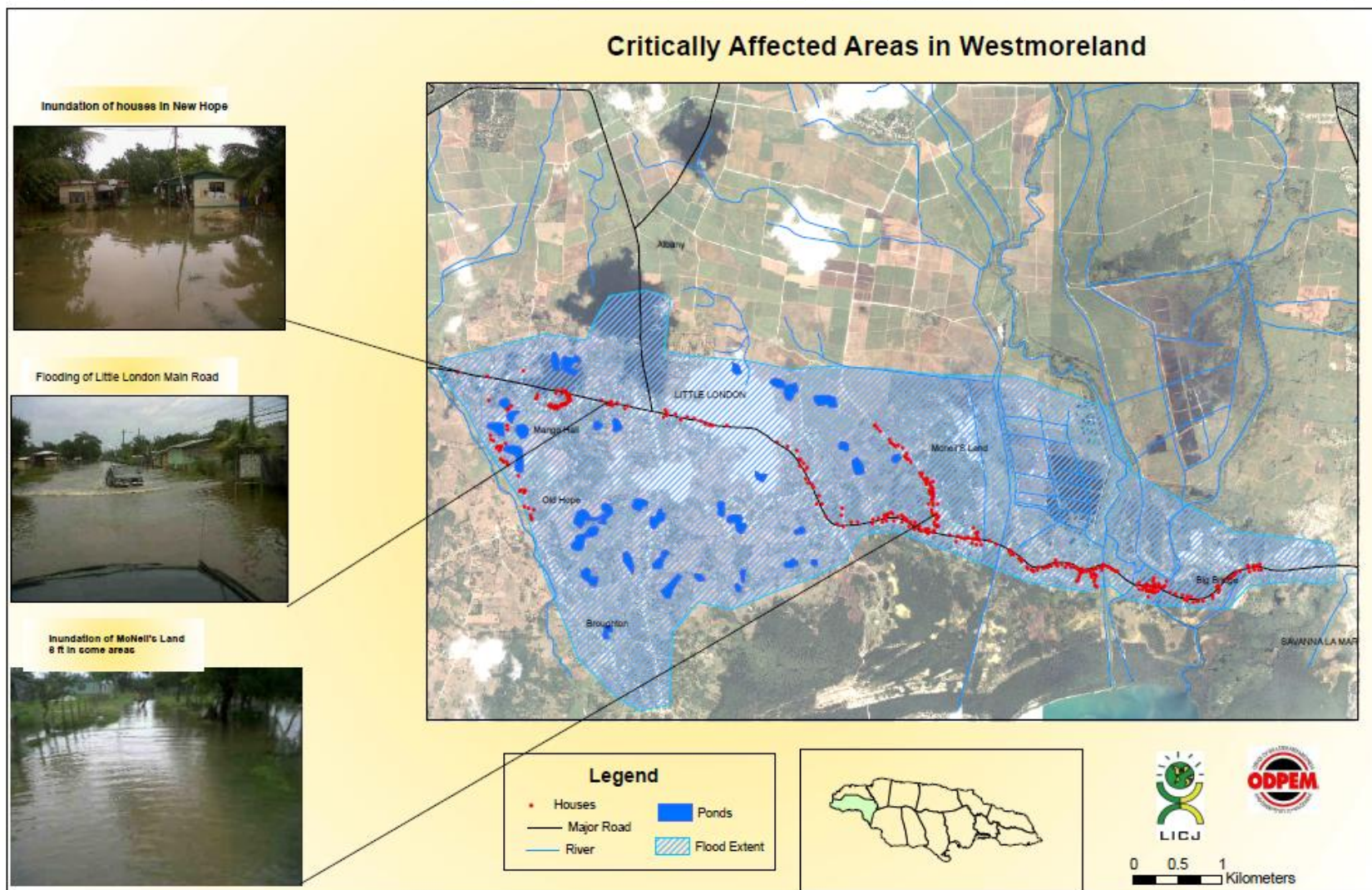


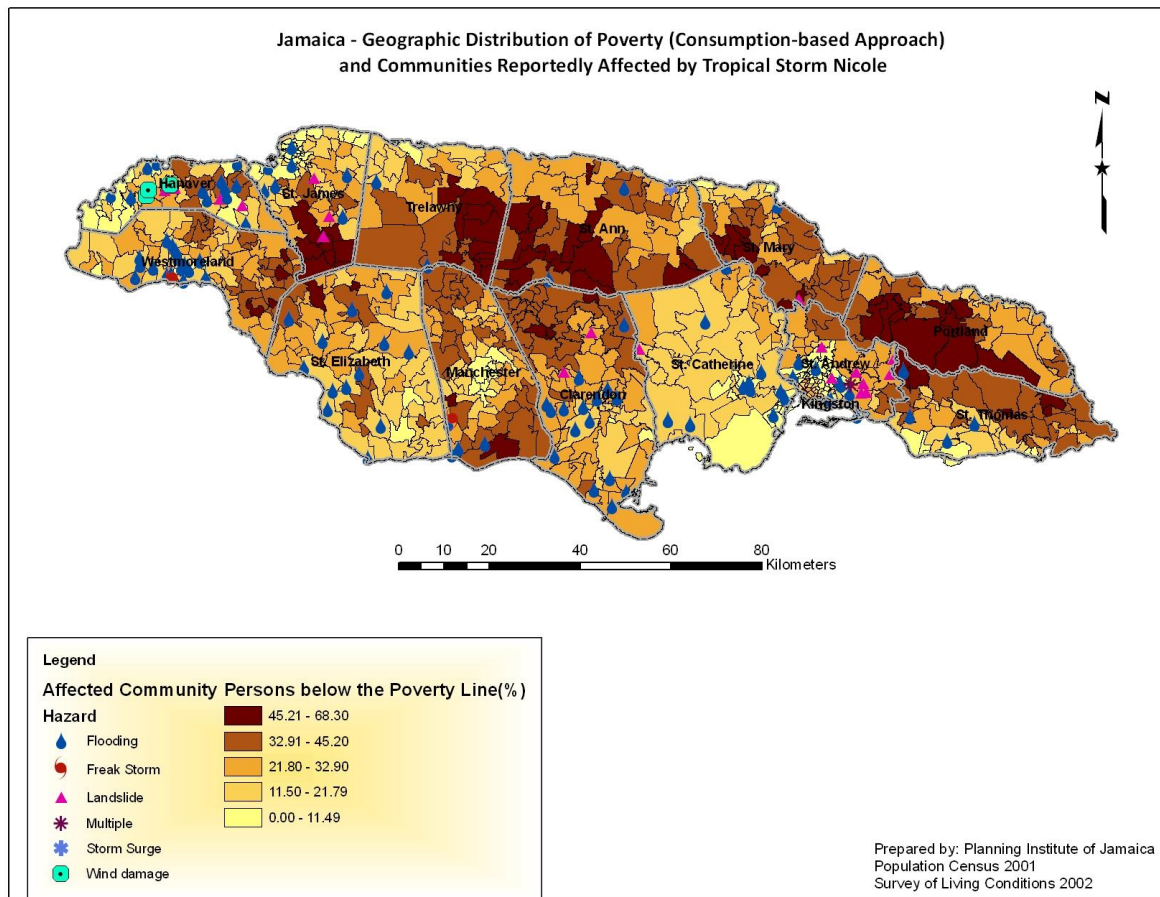
Figure 8: Areas Critically Affected by Tropical Storm Nicole – Westmoreland



Poverty

Generally, there is a direct relationship between the extent of disaster impact and the poverty status of residents, with the poor being more likely to be severely impacted than their wealthier counterparts. The prevalence of poverty for Jamaica in 2007 was 9.9 per cent (JSLC 2007). The majority of persons (71.3 per cent) classified as poor were located in the Rural Areas which account for 48 per cent of the total population. The areas most affected by the event were located in rural areas and this could suggest that those most severely affected were the poor. To examine this assumption, the areas most affected were overlaid on the most recent Poverty Maps. (See Figure 9 which displays the geographic distribution of poverty using the latest poverty maps). The analysis suggests that with the exception of a few communities, the areas most impacted by the storm were not among the poorest. However, the vulnerability of these communities may be due to their location in areas susceptible to landslides and flooding, and in some cases, they represent pockets of poverty in areas indicated as having low percentages of persons below the poverty line.

Figure 9: Communities Affected by TS Nicole and Geographic Distribution of Poverty



Source: PIOJ, ODPEM

D. Impact on Livelihoods and Women and Children

The main impact of the tropical storm on livelihoods was on small farmers, persons in farming communities, greenhouse farmers and persons involved in related economic activities. Some 16,895 food crop farmers and 1,681 livestock farmers were negatively impacted.

E. Casualties

Sixteen persons reportedly lost their lives as a result of the event, 14 of whom have been confirmed dead. Among those who perished were six children between 0 (newborn) and 14 years of age (Table 7). Nine persons died by drowning and 10 by crush injury.

Table 7: Summary of Deaths Related to Tropical Storm Nicole

Parish	Age	Gender	Status
KSA	14	M	Confirmed
KSA	42	M	Confirmed
KSA	34	F	Confirmed
KSA	4	M	Confirmed
KSA	6	F	Confirmed
KSA	61	M	Confirmed
KSA	49	M	Confirmed
KSA	55	M	Confirmed
KSA	29	M	Confirmed
KSA	<u>≈</u> 60	M	Confirmed
KSA	11	F	Missing
St. Catherine	5	F	Confirmed
St. Catherine	81	M	Missing
Clarendon	Newborn	M	Confirmed ⁹
St. Elizabeth	68	M	Confirmed
Westmoreland	68	M	Confirmed

Source: Ministry of Health

Among those who died, were six persons in Sandy Park, St. Andrew, whose two-bedroom house collapsed into the Sandy Gully, and three men who were crushed to death when a retaining wall collapsed on the shed in which they were sleeping in Norbrook Heights. A five-year old girl also lost her life when a tree fell on the house where she was sleeping in Christian Pen, St. Catherine. In addition, 42 persons (31 males and 11 females) with injuries

⁹ The death of the newborn was indirectly related to the disaster.

related to the weather event were treated at hospitals since September 28, 2010. Nine of the injured were admitted to hospital. Three persons sustained injuries when their vehicle overturned on the Toll Road near Hill Run, St Catherine while five persons were injured during the microburst episode in Savanna-la-Mar, Westmoreland. As at October 3, 2010, two persons were still reported missing – an 11 year old from Sandy Park, Kingston and St. Andrew and an 81 year old from Riversdale, St. Catherine. Males suffered the brunt of injury and death accounting for 75 per cent of the deceased and 74 per cent of the injured.

II. SOCIAL SECTORS

The heavy rains which accompanied Tropical Depression # 16 and Tropical Storm Nicole had adverse effects on the lives of the Jamaican population. Damage and losses to the social sectors amounted to \$1.64 billion or 8.0 per cent of the total cost of the impact of the event (Table 8).

Table 8: Summary of Damage and Loss to the Social Sector

Sector	Damage (\$ million)	Loss (\$ million)	TOTAL
Housing	274.3	-	274.3
Education	157	940	1480
Health	270.4	-	270.36
TOTAL	701.7	940	1641.7

The following outlines the cost of damage across various social sectors.

A. Housing

As at October 20, a total of 2169 houses were assessed after the passage of Tropical Storm Nicole. Of these, 474 (21.8 per cent) were severely damaged while 54 (2.5 per cent) were totally destroyed. Damage amounted to an estimated \$274.3 million of which \$75.6 million was the replacement cost for those totally destroyed units. Westmoreland had the highest number of homes that were totally destroyed, and account for a third of the estimated replacement cost. In terms of overall damage, the five most affected parishes in rank order are Westmoreland with 648 houses and 28.4 per cent of the reported cost of damage, KSA with 261 (15.8 per cent), St. Catherine - 209 (14.1 per cent), St. Mary – 27 (9.8 per cent) and St. Elizabeth with 310 (7.9 per cent) as presented in Table 9. Most of the damage to housing units was caused by flooding.

At the time of the event, the predominant dwelling type in Jamaica was Separate House, Detached -80.6 per cent (Jamaica Survey of Living Conditions, 2007). This was the most common dwelling type in all areas, accounting for 92.2 and 83.4 per cent respectively, in Rural Areas and Other Towns compared with 63.4 per cent in the KMA. The housing structures are relatively strong with 66.6 per cent of dwellings having outer walls built with Block and Steel. The other main building materials were Wood (22.8 per cent) and Concrete Nog (8.6 per cent). In the Rural Areas, some 59.8 per cent of Jamaican households own their homes with the Rural Areas accounting for the largest proportion of households living in owner occupied dwelling (67.9 per cent), while Other Towns and the KMA accounted for 63.6 and 46.7 per cent respectively.

Table 9: Summary of Damage to the Housing Sector as at October 20, 2010¹⁰

Parish	Totally destroyed	Cost \$ (million)	Severely Damaged	Cost \$ (million)	Minor damage	Cost \$ (million)	Total Impacted	Total Cost
KSA	9	12.6	81	28.4	68	2.4	261	43.4
St. Catherine	6	8.4	75	26.3	115	4.0	209	38.8
Clarendon	3	4.2	26	9.1	30	1.1	144	14.4
Manchester		0	12	4.2	18	0.6	30	4.8
St. Elizabeth	3	4.2	41	14.4	85	3.0	310	21.6
Westmoreland	18	25.2	121	42.5	291	10.2	648	77.9
Hanover	2	2.8	9	3.2	48	1.7	75	7.6
St. James		0	43	15.1	93	3.3	238	18.3
Trelawny	1	1.4	9	3.2	7	0.2	17	4.8
St. Mary	6	8.4	38	13.3	151	5.3	195	27.0
Portland	5	7	1	0.4		0.0	6	7.4
St. Thomas	1	1.4	18	6.3	17	0.6	36	8.3
TOTAL	54	75.6	474	166.4	923	32.3	2169	274.3

Source: MLSS and derived from Master Builders construction rates

¹⁰ Based on the varying quality of housing, calculations were based on the following assumptions:

1. A 12x18 feet starter house (concrete) is \$6 500 per square foot totaling \$1,404,000
2. Repairing minor damage = 2.5% of the cost of the building

Repairing major damage (an entire roof) = 25% of the cost of the building

Approximate cost of constructing home (per sq.ft) based on information received from Master Builders Association

B. Education

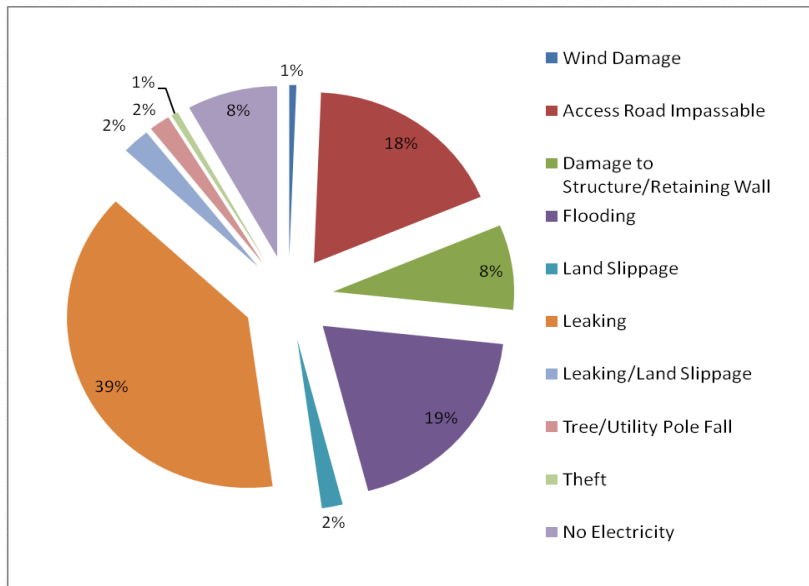
Total damage to educational institutions is estimated at \$157 million, while losses amounted to \$940 million, for a total of \$1.10 billion. This represents 6.11 per cent of the damage to the social sector (Table 10). Some 147 schools were damaged by the event with the main damage being leakage and flooding (Figure 10). Several schools also suffered loss of access to electricity and inaccessibility due to impassable roads. A total of 144 institutions required repair.

Table 10: Damage and Losses to Education by Region

Region	Total (\$ million)	Damage (\$ million)	Loss (\$ million)
1	112	15	97
2	169	13	156
3	106	18	88
4	327	31	296
5	159	25	134
6	224	55	169
TOTAL	1097	157	940

Source: Ministry of Education

Figure 10: Damage to Educational Institutions



Source: Ministry of Education

Primary schools were most affected by the event accounting for 44.2 per cent of the total number of schools impacted (Table 11). A total of 35 high schools and 32 All Age schools were also impacted by the event. The most affected region was Region 6 which covers the parishes of Clarendon and St. Catherine with 55 institutions damaged (Figure 11).

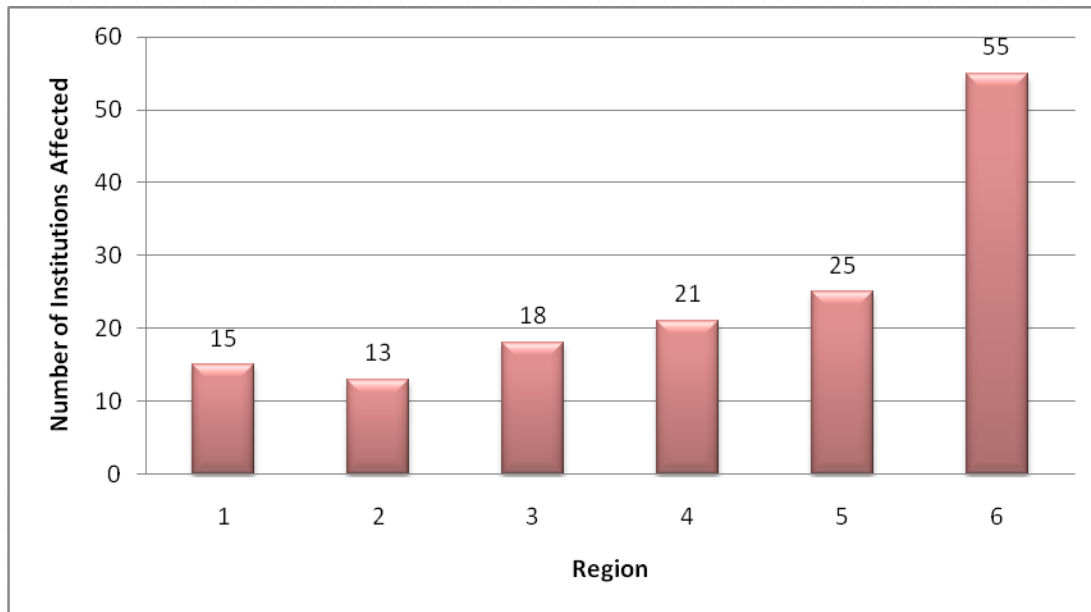
Table 11: Damage to Educational Institutions by Type of Institution

Parish	Infant	Primary	Primary and Junior High	All Age	High/Technical High	Special Education/Other	Total
St. Andrew		9	1		2	1	13
St. Thomas				2	1		3
Portland					2		2
St. Mary		3		1	4		8
St. Ann	1	6		8	1		16
Trelawny		2					2
St. James		4	2	2	1		9
Hanover				1		1	2
Westmoreland		5	4	3			12
Manchester		11		3	1		15
St. Elizabeth		8		2			10
Clarendon	1	7	1	7	9		25
St. Catherine		10	2	3	14	1	30
TOTAL	2	65	10	32	35	3	147

Source: Ministry of Education

*Includes Youth Development Institutions

Figure 11: Institutions Affected by Region



Source: Ministry of Education

During the event attendance at schools was largely disrupted, with all schools being declared closed on September 29. With the official closing of schools and educational institutions approximately 880 000 students and over 25 000 teachers experienced loss of a day's education contact time. These estimates were based on enrollment of the school age population (3 to 24 years) during the 2008/09 academic year¹¹. As at October 5, the Ministry of Education reported that while affected schools had to undertake extensive cleaning activities, most schools had resumed normal schedules. The school year was extended by one day to compensate for the lost classroom time as a result of the event.

¹¹ ESSJ 2009

C. Public Buildings

a) Correctional Facilities

Damage to correctional facilities was minimal with the main complaint from most locations being the leakage of roofs. The perimeter fence of the Horizon Park facility in Spanish Town, St. Catherine was damaged by water from a gully which overflowed its banks. Sections of the compound were also flooded.

b) Heritage Sites

None of the sites under the proprietorship of the Jamaica National Heritage Trust (JNHT) sustained any damage. However, the historic Savanna-la-Mar Baptist Church in Westmoreland, built in 1829, was completely destroyed by a micorburst, which hit the town on September 29.

d) Post Offices

There was no infrastructural damage to Post Offices across the island but some post offices experienced leaking as a result of previous damage. The Maggoty Post Office was flooded as it is in close proximity to the Maggoty River which overflowed its banks. Additionally, Green Hill was cut off from vehicular traffic, as the road leading there was eroded.



Flooded Maggoty Post Office

D. Health

Damage and loss sustained by the health sector was estimated at \$270.36 million. This represented damage and losses which accounted for 44.0 per cent (\$118.9 million) and 56.0 per cent (\$151.4 million) of the total costs, respectively. Direct damage was as a result of partial or total destruction of infrastructure, loss of equipment and furniture and latrine replacement. Hospitals/facilities in all Regions with the exception of the Western Regional Health Authority, in addition to MOH critical facilities, recorded damage. Damage to Health Centres was however, confined to the South East Regional Health Authority (SERHA) and North East Regional Health Authority (NERHA). Damage to equipment was reported only within SERHA. Losses were in the form of disruptions in the distribution of vaccines which was estimated at \$235 026. A total of 200 conventional pit latrines were replaced in five parishes (Table 12, Figure 12).

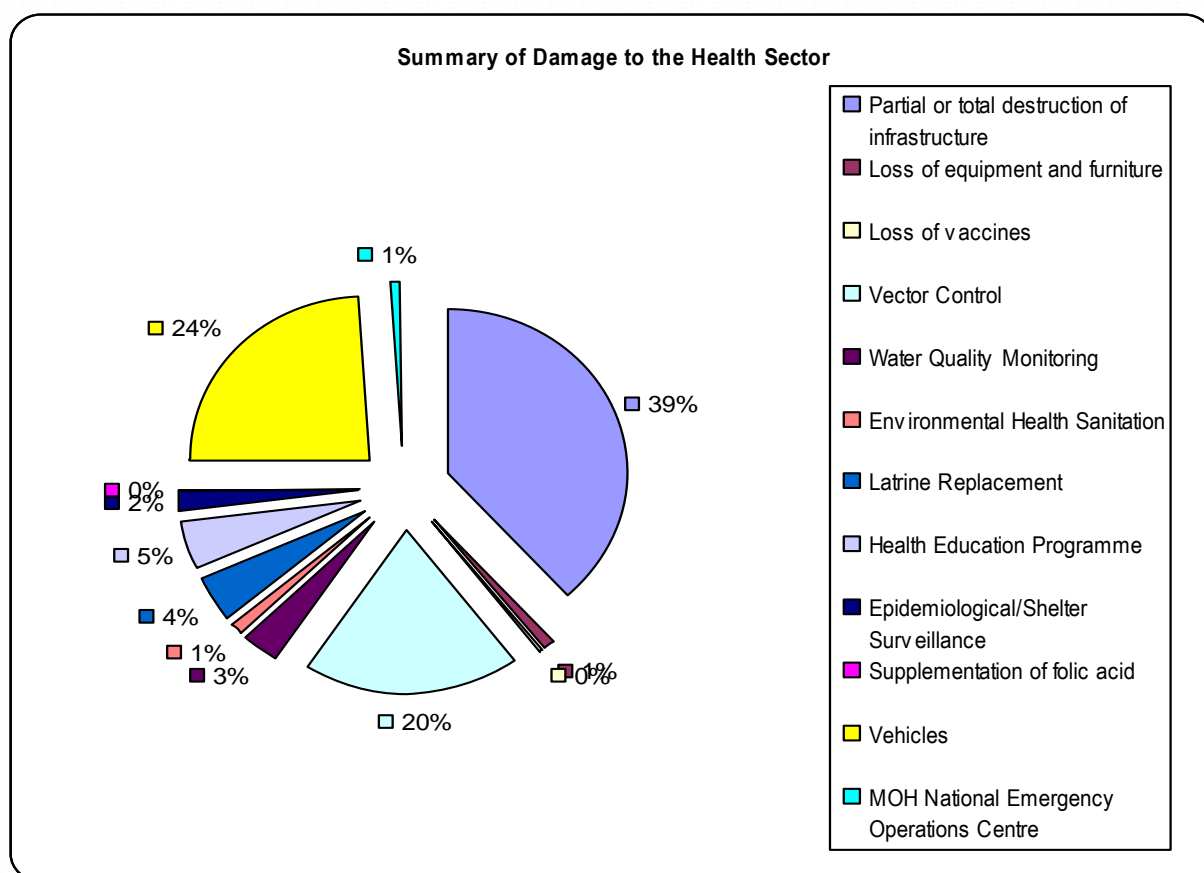
Flooded areas increased the need for vector control activities which amounted to \$42.9 million. Some \$8.7 million was spent on a programme to monitor the quality of water (coliform and bacteria kits) in affected areas

Table 12: Summary of Damage and Loss to the Health Sector

	Total	Damage	Loss
Partial or total destruction of infrastructure	103,688,531.00	103,688,531.00	0.00
Loss of equipment and furniture	3,220,000.00	3,220,000.00	0.00
Loss of vaccines	235,026.38	0.00	235,026.38
Vector Control	52,900,000.00		52,900,000.00
Water Quality Monitoring	8,730,000.00	0.00	8,730,000.00
Environmental Health Sanitation	2,900,000.00	0.00	2,900,000.00
Latrine Replacement	12,000,000.00	12,000,000.00	0.00
Health Education Programme	13,794,000.00	0.00	13,794,000.00
Epidemiological/Shelter Surveillance	4,795,000.00	0.00	4,795,000.00
Supplementation of folic acid	0.00	0.00	0.00
Vehicles	65,000,000.00	0.00	65,000,000.00
MOH National Emergency Operations Centre	3,100,000.00	0.00	3,100,000.00
Total	270,362,557.38	118,908,531.00	151,454,026.38

Source: Emergency, Disaster Management and Special Services Branch, MOH September 9, 2008

Figure 12: Summary of Damage to the Health Sector



Primary, Secondary, and Tertiary Care

Where the status of primary care is concerned, four Health Centres were closed as a result of the weather conditions – Clarksonville and Walkerswood in St. Ann (roof damage with severe leaking) and Kingsville and Copse in Hanover (water damage). An additional nine Health Centres were closed prior to the event. Two hundred and seventy-nine of the 302 Health Centres were open on Friday, October 1, 2010. Of these, 231 offered full services and 48 partial services. No reports were received from ten.

For Secondary and Tertiary Care, all 24 public hospitals and the University Hospital of the West Indies remained operational with one hospital – the Spanish Town hospital offering emergency services only.

Critical Facilities

The National Public Health Laboratory was re-opened on October 2, 2010 and provided all services, following closure on September 29, 2010 due to severe leaking. The National Blood Transfusion Services -The Blood Bank returned to normal operations on October 2, 2010, with donations resuming following closure due to severe leaking. The alternative facility at the National Chest Hospital was used for blood collection from September 29 – 30, 2010. All other blood collection facilities remained open and blood supply was adequate islandwide.

Environmental Health

The risk of disease outbreaks increased as Public Health was compromised in the priority environmental health areas – water quality, food safety, vector control and environmental sanitation. Breeding sites for vectors were created with pooling of water, uncollected garbage and debris, and exposed dead animals. There was also a lack of potable water and electricity in the worst affected communities. Of note, is that the monitoring of the environmental health situation was critical to prevent disease outbreaks, such as for gastroenteritis, malaria and leptospirosis and to control the outbreak of dengue fever which was occurring before this weather event.

Health Priority Areas

During and after the event the Ministry of Health identified four (4) priority areas of focus:

1. Water Quality Monitoring - the MOH conducted monitoring of water supplies, treatment plants and at distribution points. They also collaborated with the National Water Commission, Parish Councils and private suppliers to ensure that their supplies were returned to normal.
2. Food Safety - Continual inspections and food condemnation and seizures were conducted with 64 food establishments being inspected islandwide. A total of 75kg of meat were seized and condemned in Portland.

3. Vector Control - Comprehensive programmes for mosquitoes, flies and rodents were being implemented in all parishes, focusing on the worst affected areas. Source reduction, larvicidal work (oiling and placement of larvicidal agents and fish in pools of water) and fogging were the priorities.
4. Environmental Sanitation - The priority was for the replacement/repair of latrines and the monitoring of waste water plants. Assessments were also done to determine the number that would need to be replaced and repaired. Collaboration with the Solid Waste Management Authorities continued to ensure that attention was given to the accumulation of solid waste islandwide to prevent the breeding of vectors.

Children's Homes

All the children at the 61 Children's Homes and Places of Safety remained safe and dry¹². There were no injuries or illnesses and food supplies were adequate. Drinking water was supplied to six facilities -Sophies Place, Gordon Town, St. Andrew; Homestead Place of Safety in Stony Hill, St Andrew; Garland Hall, St. James; New Hope Children's Home, Manchester; Our Lady of Hope, St. Elizabeth; and Strathmore Place of Safety, St. Catherine.

¹² At October 1st City of Refuge Children's Home in Content Gap, St. Andrew was not contacted

III. PRODUCTIVE SECTORS

A. Agriculture

Preliminary figures from the Ministry of Agriculture and Fisheries indicated that total damage and loss to the agriculture sector following a week long intense rainfall from Tropical Storm Nicole was estimated at \$576.5 million for damage to crops and livestock. Crop damage accounted for \$531.6 million while damage to livestock was put at \$32.4 million and greenhouses at \$12.5 million (Table 13, Figure 13). Damage to the infrastructure¹³ (farm roads) was estimated at \$574.6 million. Some \$22 million was also allocated to relief assistance for small farmers and greenhouse growers.

Some 40 per cent of banana production was affected, 26 greenhouses were damaged, and crops mainly affected included vegetables, condiments and banana/plantains¹⁴. Losses were highest in the parish of St. Elizabeth (\$89.7 million) followed by Clarendon (\$86.2 million) and St. Mary (\$81.2 million).

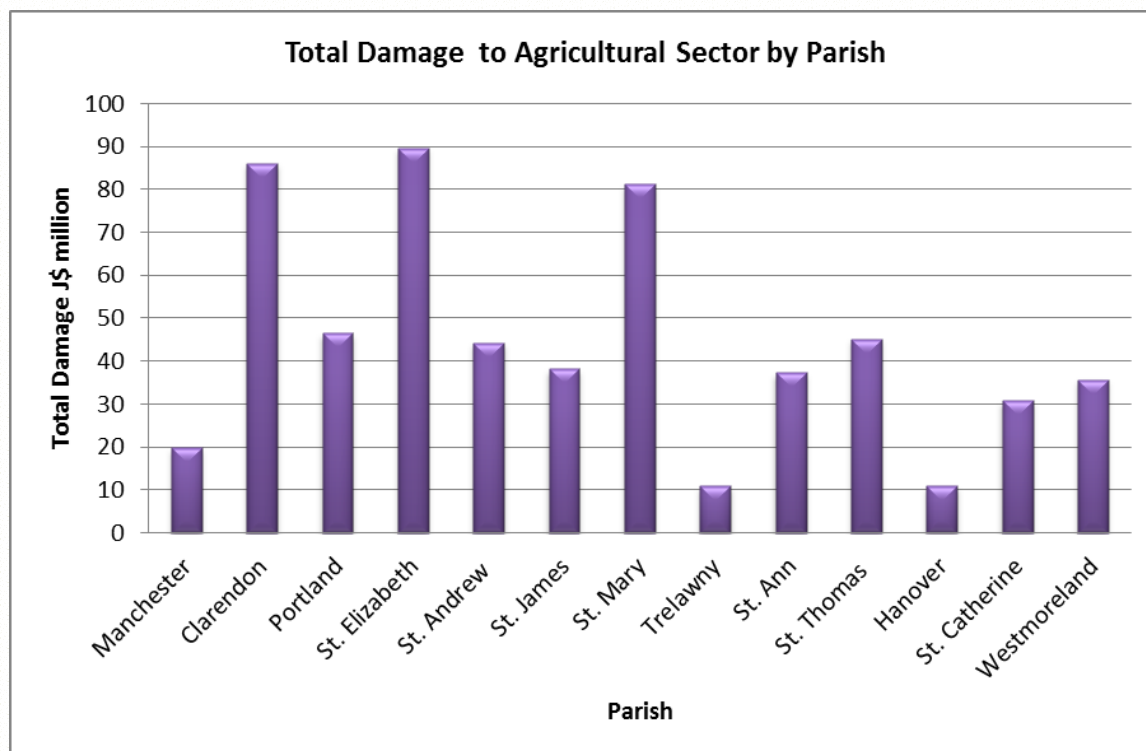
Table 13: Preliminary Estimates of Damage from Tropical Storm Nicole by Parish

Parish	Livestock J\$ million	Crops J\$ million	Greenhouse J\$ million	Total Damage J\$ million
Manchester	1.895	12.865	5	19.76
Clarendon	2.35	83.8	0	86.15
Portland	0.35	46	0.1	46.45
St. Elizabeth	1.3	87.52	0.879	89.699
St. Andrew	3.1	41.22	0	44.32
St. James	1.6	36.321	0.3	38.221
St. Mary	1.64	75	4.6	81.24
Trelawny	0.73	10.2	0.02	10.95
St. Ann	0.35	35.7	1.22	37.27
St. Thomas	1.1	44	0	45.1
Hanover	0.8	9.866	0.18	10.846
St. Catherine	15.75	14.86	0.2	30.81
Westmoreland	1.45	34.28	0	35.73
Total	32.415	531.632	12.499	576.546

¹³. Damage to farm roads was calculated as apart of infrastructure damage

¹⁴ http://www.moa.gov.jm/news/ministry_helps_groups_affected_by_tsnicole.php

Figure 13: Total Damage to Agricultural Sector by Parish



Source: RADA

Domestic Crop and Livestock

Approximately 3 740 hectares of crops were damaged, and approximately 1.8 per cent of the 202 727 hectares of Active Farmlands¹⁵. Some 1 448 hectares (38.7 per cent) was in the parish of St. Elizabeth, the Bread Basket parish, which produces the bulk of fruits and vegetables. It is important to note that during 2009, St. Elizabeth accounted for 32.4 per cent of the total hectares of Domestic Crops reaped (9 724.9 hectares). Approximately 16 895 domestic crop farmers were affected. Table 14 provides an estimate of the area damaged in hectares by parish, major crop categories and value. Farmers in St. Elizabeth, Clarendon and St. Mary were most impacted with damage to crops accounting for 16.46, 15.76, and 14.11

¹⁵ Agriculture Census, 2007

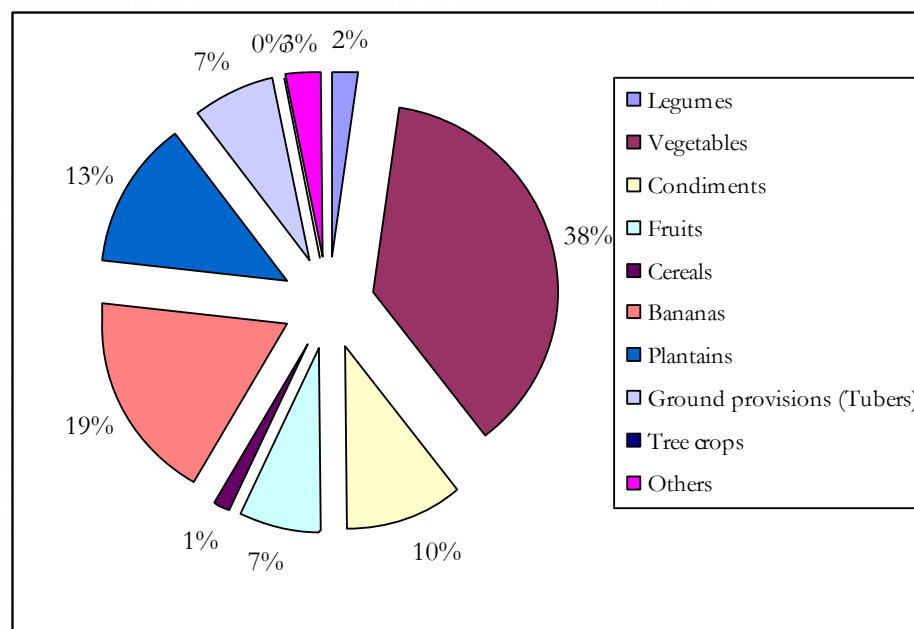
per cent of the total damage respectively. Damage to vegetables and banana crops accounted for almost 50 per cent of the total hectareage of crops affected, and 55 per cent of the total cost of damage to crops (Figure 14).

Table 14: Preliminary Estimates of Damage to Crops by Parish (Tropical Storm Nicole)

	C R O P S												
	Ha										Total		
PARISH	Pulses	Veg.	Cond.	Cereals	Fruits	G / Prov.	Plantain	Banana	Tree Crops	Others	Hectares	Farmers	Value (\$ million)
St. Catherine	6	45	9	0	2	4	15	28	0	12	121	1,680	14.86
St. Andrew	15	60	21	0	1.5	33	20	50	0	8	208.5	2,320	41.22
Portland	2	14	3	1	1	20	54	78	0	1	174	708	46.00
St. Ann	5	140	12	2	0	22	2	3	0	0	186	1,020	35.70
St. Mary	3.5	18	7	1	4	0	139	350	0	5	527.5	1,056	75.00
St. Thomas	6	22	8	3	1	10	25	20	0	0	95	1,380	44.00
Clarendon	13	110	26	0	0	10	5	2	0	0	166	1,010	83.80
St. Elizabeth	196	467	170	42	315	140	54	64	0	0	1,448	2,560	87.52
Manchester	22	154	55	5	12	25	25	30	0	5	333	1,528	12.87
Trelawny	2.5	3	2.5	2	2	12	10	15	0	0	49	710	10.20
Hanover	3	5	4	5	2	10	15	10	1	2	57	516	9.87
St. James	5	22	16	10	22	45	50	80	0	4	254	1,402	36.32
Westmoreland	10	15	12	2	2	8	31	38	0	3	121	1,005	34.28
TOTAL	289	1,075	345.5	73	365	339	445	768	1	40	3,740	16,895	531.63

Source: RADA

Figure 14: Preliminary Costs of Damage to Crops by Type of Crop



Source: RADA

Table 15: Preliminary Costs of Damage to Crops by Type of Crop

Crop	Cost (\$million)
Legumes	12.05
Vegetables	197.37
Condiments	54.30
Fruits	38.90
Cereals	7.65
Bananas	97.72
Plantains	69.18
Ground provisions (Tubers)	37.54
Tree crops	0.43
Others	16.50
TOTAL	531.63

Source: RADA

Damage to livestock was estimated at \$32.4 million. The most significant loss was recorded for the parish of St. Catherine (\$15.79 million) followed by St. Andrew (\$3.1million). Some 165 000 birds were lost overall. St. Catherine was the worst hit, accounting for 100 000.

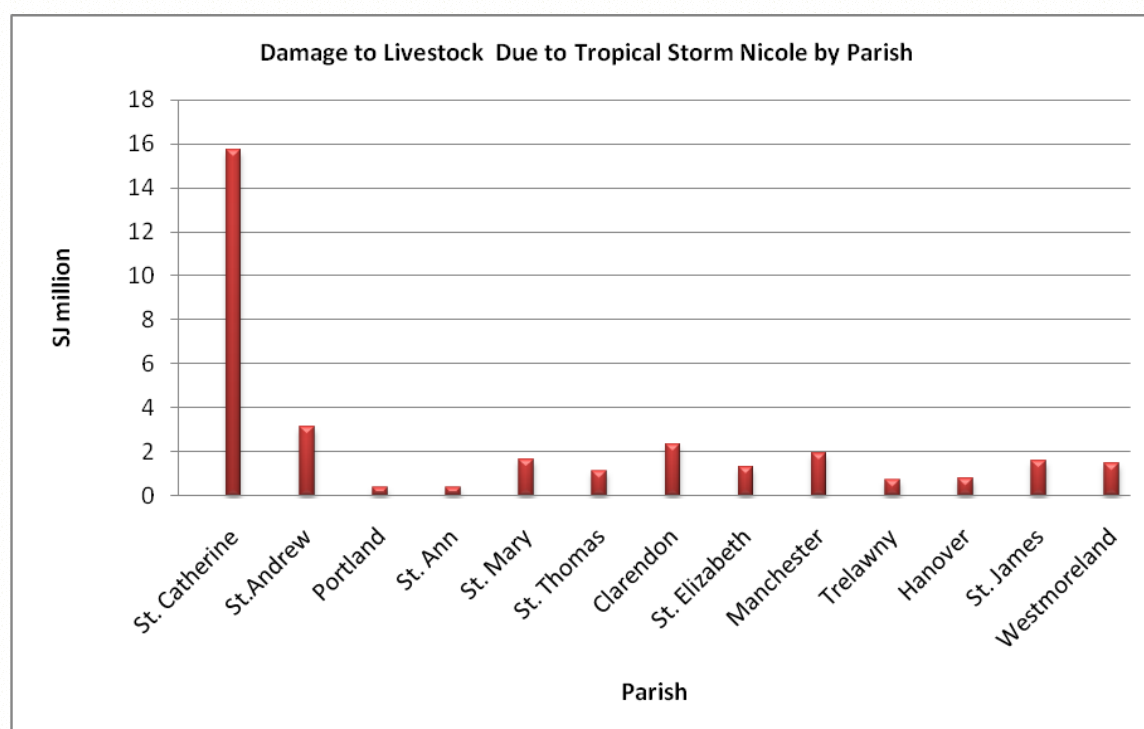
Table 16: Preliminary Estimates of Flood Damage –Livestock (Tropical Storm Nicole)

	L	I	V	E	S	T	O	C	K	
PARISH	CHICKEN	BEE COL.	CATTLE	RABBITS	PIGS	FISH PONDS (ha)	GOATS	FARMERS	VALUE (\$)	
St. Catherine	100,000	10	4	10	150	3.5	140	140	15,750,000	
St. Andrew	3,500	20	5	20	500	0	120	340	3,100,000	
Portland	500		5	18	10		25	75	350,000	
St. Ann	3000	5	0	0	30	0	0	0	350,000	
St. Mary	2000	73	4	18	32		25	75	1,640,000	
St. Thomas	3000	10	0	0	40	0	60	260	1,100,000	
Clarendon	20,000	5	0	0	80	0	0	170	2,350,000	
St. Elizabeth	10,000	30	3	0	50	0	8	13	1,300,000	
Manchester	5,000	20	5	0	250	0	150	233	1,895,000	
Trelawny	4,000	5	0	0	50	0	30	130	730,000	
Hanover	3000	15	8	10	5	0	10	45	800,000	
St. James	8000	20	6		20		25	155	1,600,000	
Westmoreland	3000	20	0	0	30	0	45	45	1,450,000	
TOTAL	165,000	233	40	76	1,247	4	638	1,681	32,415,000	

Source: RADA

In monetary terms, St. Catherine livestock farmers were the worst affected, accounting for close to 50 per cent of the total value of livestock lost and the highest average loss \$112 500 per farmer. Numerically, 1 681 livestock farmers were affected, mostly from the parishes of St. Andrew (340), St. Thomas (260) and Manchester (233). The parishes least affected by the prolonged rains were Portland and St. Ann (Table 16, Figure 15).

Figure 15: Cost of Damage to Livestock Due to Tropical Storm Nicole



Source: RADA

Greenhouse Farming

A total of 26 greenhouses primarily made of metal, sustained damage during the event. Greenhouses in the parish of Manchester were most impacted with seven greenhouses damaged at a total cost of \$5 million. St Mary also reported damage to eight wooden structures and crops at a cost of \$4.6 million. Total estimated damage to structure was \$8.3 million while damage to crop amounted to \$3.96 million (Table 17). The damage to greenhouses represented less than 10.0 per cent of the value of the industry. A significant number of growers were either at the end of the crop or the beginning of the crop, and this contributed to the lower level of crop damage.

Table 17: Preliminary Estimates of Damage to Greenhouses

PARISH	Unit	Type of Structure	Estimated Value Damage to Structure (\$)	Estimated Value Damage to Crops (\$)	Total Damage (\$)
Portland	1	metal	100,000.00	0	100,000.00
St. Ann	3	wood	1,020,000.00	200,000.00	1,220,000.00
St. Mary	8	wood	3,600,000.00	1,000,000.00	4,600,000.00
St. Elizabeth	3	metal	670,000.00	209,000.00	879,000.00
Manchester	7	wood, metal	2,500,000.00	2,500,000.00	5,000,000.00
Trelawny	1	metal	10,000.00	10,000.00	20,000.00
Hanover	1	metal	100,000.00	40,000.00	180,000.00
St. James	2	metal	300,000.00	0	300,000.00
TOTAL ESTIMATED LOSS	26		8,300,000.00	3,959,000.00	12,299,000.00

Source: RADA

Farm Roads

A total of 739.6 km of farm roads were damaged by the heavy rains. St. Andrew and Portland experienced the greatest impact as 141 and 11.8 kms of roads were damaged at a cost of \$100.8 million and \$91.8 million, respectively (Table 18). One hundred kilometers (100km) of farm road was also damaged in the parish of St. Catherine.

Table 18: Preliminary Estimates of Damage to Farm Roads

PARISH	Damage (km)	# of Roads	Cost of Damage (\$million)
St. Catherine	100	25	37.000
St. Andrew	141	31	100.80
Portland	111.8	31	91.80
St. Ann	62.4	17	62.35
St. Mary	30	12	25.00
St. Thomas	62	38	36.30
Clarendon	27	20	27.00
St. Elizabeth	40	15	38.00
Manchester	61.4	18	57.50
Trelawny	33	17	28.80
Hanover	28	11	28.00
St. James	23.5	9	23.50
Westmoreland	19.5	5	18.50
TOTAL	739.6	249	574.55

Source: RADA

It should be noted that, while Portland was among the least affected parishes, some areas in the parish received high volumes and intense rainfall on September 29. This, along with the terrain, would have contributed significantly to the level of damage reported to roads.

In response to the level of damage in the sector, the Ministry of Agriculture and Fisheries identified several measures intended to fast-track the recovery process. These include the following:

- A grant of \$4 million dollars to be provided to the Greenhouse Growers Association to help with the purchasing of plastic for roofing that was damaged.
- Collaboration between the Ministry of Agriculture and Fisheries and the Food and Agriculture Organization (FAO) to allocate some \$12 million towards engaging a number of nursery operators to plant seedlings, which will be grown in a protected environment. It is estimated that some 50,000 vegetable and condiments seedlings will be distributed and fertilizer will be sold at concessionary rate to farmers to start replanting.
- An additional subsidy being provided to the Rural Agricultural Development Authority (RADA) tractor programme to allow farmers to get production back up and running in the quickest possible times¹⁶.
- Small chicken farmers who provide some 40 percent of the market with chicken being given support with chicks and feed in the sum of \$3 million to \$4 million.
- The Veterinary Division dispatching animal technicians to provide prophylactic medication and vitamins to avert foot rot disease to small ruminants, which include goats and sheep. The cost of the medication is estimated at \$2 million.

¹⁶http://www.jis.gov.jm/MinAgriFish/html/20101007T100000-0500_25567_JIS_MINISTRY_TO_PROVIDE_FINANCIAL_AND_TECHNICAL_SUPPORT_FOR_FARMERS.asp

B. Tourism Sector

General Overview

Over the last three years, Jamaica's tourism industry operated in a very challenging environment owing to the impact of the global economic recession. Since 2007, total visitor arrivals have been trending downwards, influenced by consecutive yearly declines in cruise passenger arrivals (Table 20). Stopover arrivals on the other hand has continued its upward growth trend, and in 2009, grew by 3.6 percent compared with 2008 (Table 19).

Historically, the USA represents the largest source market from which stopover visitors to the island originate. For 2009, 64.1 percent of the stopover visitors to the island originated from the USA; 15.9 per cent from Canada; and 15.1 percent from Europe. The winter tourist season, one of the most active periods in the Jamaican tourist industry, runs from December 15 through to April 15. The resort areas and attractions in the island are mainly concentrated along the costal regions of the island, particularly in the areas of Montego Bay, Ocho Rios, Negril.

Fortunately, Tropical Storm Nicole occurred during the off-season and as such damage to the sector was not as bad as it could have been. Similarly, loss of income was somewhat mitigated because, the country had approximately 50.0 per cent less tourists than would have been the case in the high season (Table 20). A review of data from the Ministry of Tourism, indicates that September 29 – October 2 (the period the following the tropical storm), there was an overall increase in total passenger arrivals of 118 compared with the similar period for 2009. There were also 12 more flights recorded over the four day period in 2010. Therefore it may be concluded that the Tropical Storm Nicole had no significant impact on visitor arrivals to Jamaica.

Table 19: Tourism Performance Indicators 2005-2009

INDICATORS	2005	2006	2007	2008	2009	% Change	
						2008	2009
						2007	2008
Foreign Nationals	1 386 996	1 578 207	1 573 267	1 623 675	1 683 846	3.2	3.7
Non-resident Jamaicans	91 667	100 698	127 518	143 596	147 251	12.6	2.5
Total Stopovers	1 478 663	1 678 905	1 700 785	1 767 271	1 831 097	3.9	3.6
Cruise Passengers	1 135 843	1 336 994	1 179 504	1 092 263 r	922 349	-7.4	-15.5
TOTAL VISITOR ARRIVALS	2 614 506	3 015 358	2 880 289	2 859 534 r	2 753 446	-0.7	-3.7
Average Length of Stay (Nights)	9.8	9.8	9.6	9.3	9.2	-3.1	-1.1
Total Foreign Exchange Earnings US\$M	1 545.1	1 870.6	1 910.0	1 975.5	1 939.7	3.4	-1.8
Stopover Foreign Exchange Earnings US\$M	1 448.9	1 753.0	1 795.9	1 871.5	1 859.1	4.2	-0.7
Cruise Foreign Exchange Earnings US\$M	96.1	117.6	114.1	104.0	80.6	-8.9	-22.5

p provisional

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Source: Compiled from data supplied by the Jamaica Tourist Board

Table 20: Cruise Ship Passenger Arrivals 2007-2010

Cruise Passengers				
	2007	2008	2009	2010
January	143,728	144,671	107,827	87,136
February	123,130	133,403	90,477	78,805
March	144,764	139,347	112,416	111,356
JAN-MAR	411,622	417,421	310,720	277,297.0
GDP				
April	113,524	110,838	103,484	80,116
May	93,151	59,860	68,181	60,304
June	71,545	57,962	68,539	66,517
APR-JUN	278,220	228,660	240,204	206,937.0
GDP				
July	76,231	69 343	56,112	
August	71,689	54 656	51,449	
September	60,682	48,821	45,101	
JUL-SEPT	208,602	172,820	152,662	
GDP				
October	63,438	73,165	57,478	
November	99,353	76,223	68,971	
December	118,269	120,612	92,314	
OCT-DEC	281,060	270,000	218,763	
	1,179,504	1,088,901	922,349	

Source: ESSJ 2009

Damage

Preliminary cost of damage is put at \$76.18 million (Table 21). Damage within the tourism sector was greatest in Negril and the South Coast Resort Areas, Montego Bay, and Port Antonio. There were also reports of various attractions island-wide being affected. The most frequently reported impacts included:

- damage to buildings (roofs, windows, awnings, and furnishings);
- damage to boats and other vessels;
- littering of properties and public areas with sea weed;
- extensive beach erosion;
- flooding;
- car parks completely covered by flood waters; and
- extensive vegetative and landscape damage due to floods and heavy winds.

In Negril, there was extensive physical damage to properties and beaches. It was estimated that approximately 80-90 per cent of properties experienced severe structural damage (roofs, windows, awnings, furnishings, etc.). Several structures received internal damage due leaking roofs while in other cases, damage was done to swimming pools and pumps. Fallen trees, silt build up and debris were a feature on all properties. There was damage to beaches and it was reported that there was significant loss of sand from some beaches including those at Shield Negril, Negril Tree House and Charleta.

The South Coast Resort Area experienced physical damage ranging from moderate to extensive with extensive physical damage to properties due to flooding. Treasure Beach and surrounding areas, such as Little Ochie were among the most badly affected. Major infrastructure damage was reported for hotels and attractions. Various areas suffered loss due to rapid flood waters and landslides. In St. Elizabeth, in particular, most properties experienced severe structural damage with the roof of at least one property being lost. Approximately four properties were forced to cease operations.

The Montego Bay Resort Area experienced moderate impact affected with few damage to properties and other infrastructure. Some properties experienced structural damage while others reported leaking roofs and flooding. Among the problems reported were:

- heavy silt build up on some properties;
- flood damage to landscapes; and
- fallen trees and debris on most properties.

Loss

Preliminary cost of losses is put at \$88.32 million (Table 21). Losses caused by Tropical Storm Nicole to Jamaica's tourism sector includes:

- lower hotel occupancy;
- lower tourism revenues, including food and beverages, local transport and recreation;
- cost incurred by some hotels to find alternative energy supply due to lack of electricity after the weather events;
- loss of business due to the blocking of some road by floods, landslides, fallen trees and other debris; and
- cost incurred to off-set loss of communication services, electricity and water .

Table 21: Summary of Damages and Losses in the Tourism Sector

Summary	J\$
Damage	76 182 270.00
Loss of Hotel & Attractions Income	88 324 440.00
Total Damage & Losses	164 506 710.00

Source: PIOJ estimates based on official GOJ data

IV. INFRASTRUCTURE

The country's infrastructure sustained major damage on account of Tropical Storm Nicole. Damage was estimated at \$18 117.5 million , this included \$574.6 million for damage to farm roads (see Chapter on the Productive Sector). The associated losses was estimated to be in the region of \$28.4 million¹⁷. Details of the damage to the electricity, water supply, telecommunications systems and the transport industries are outlined in Table 4.1.

Table 22: Infrastructure – Damage and Loss

	Damage (\$ million)	Loss (\$ million)	Total (\$ million)
Electricity	92.4	n/a	92.4
Water	270.0	n/a	270.0
Transport *	17 013.9	27.9	17 041.8
Airports	n/a	n/a	n/a
Ports	1.3	.5	1.8
Telecommunication	136.9	n/a	136.9
TOTAL	17,514.5	28.40	17,542.9

n/a – not available

* Figures include damage to NWA Roads & Bridges, Parish Council Roads and damage and losses incurred by the JUTC.

A. Electricity & Water Supplies

Prior to the event, the Electricity & Water industry recorded a 1.8 per cent decline in GDP during the January- June 2010 period compared with the corresponding period of 2009. This was due mainly to declines of 9.8 per cent and 8.7 per cent in water production in the January-March and April-June quarters, respectively. Electricity generation increased by 2.1 per cent and 3.5 per cent in the respective quarters. The fall-off in water production in the

¹⁷ While the JUTC continue to incur losses on some of its routes, a generous cut off period of seven days was used to estimate losses.

period must be viewed against: a) record levels of production in the April-June 2009; as well as b) the severe drought conditions experienced which prevailed since the latter part of 2009 into the first quarter of 2010. The declines in April-June 2010 outweighed the positive performance associated with the rehabilitation works being undertaken under the KMA Water Supply Project as well as other plant upgrades. With regard to the July-December 2010 period, given the high water production levels in the July-September quarter, higher production levels are not anticipated. The effects associated with the passage of Tropical Storm Nicole are expected to exacerbate the situation, and thereby impact the performance in the water sub-industry negatively, resulting in further reduction in production in the July-September quarter. This coupled with the effects of the storm on electricity sub-industry is expected to further erode the projected 2.0 per cent decline in GDP for the industry for the July-December 2010 period.

a) Electricity Sub-industry

The Jamaica Public Service is the sole transmitter and distributor of electricity in Jamaica. It serves a customer base of approximately 600 000 customers; has a peak demand of 642 megawatts; and a generating capacity that exceeds 620 megawatts. This energy demand is supplied from 4 main power stations and 8 hydro-electric plants. The JPS also purchase a total of 217 megawatts of power from 3 independent power providers

Preliminary estimates indicate that the electricity sub-industry sustained damage of some \$92.4 million. While there may have been some associated losses, the company indicated that this would have been minimal as it was mainly the smaller users that were out of electricity. The impact to large consumers, for example hotels, was limited and hence the associated losses would be minimal.

Tropical Storm Nicole resulted in minimal damage to JPSCo's transmission lines, transformer stations and household installations while minor damage were done to its distribution networks and communication systems. The damage was caused by the heavy rains, strong winds and lightning, which resulted in broken power lines, dislocated poles and damaged electrical infrastructure. The associated impact on the company's distribution system resulted in power outages to approximately 48.0 per cent of customers (over 288 000)

islandwide. The number of customers on the grid was increased to 99.0 per cent of the total within almost a week of the storm. However, restoration efforts were hampered by blocked roads, landslides, flooding, badly damaged roadways and ongoing rainfall in some areas. Therefore, while power was restored to most customers, after almost a week (as at October 5, 2010) some households (approximately 500) were still without electricity on the 6th October.

b) Water Supply and Sanitation

The National Water Commission (NWC) operates 460 water supply systems and 68 waste water systems islandwide. The Commission's water supply infrastructure consists mainly of: wells; water treatment plants and intake works; booster/relift stations; springs and harnessing structures; tanks and reservoirs; and a large network of transmission/distribution pipeline. In addition, the NWC operates approximately 100 sewage treatment plants, including oxidation ditch, activated sludge, waste stabilization pond and primary treatment plants.

The system is highly vulnerable to the effects of hurricane, storms, floods and related extreme weather phenomena. This is due to a number of factors, including the location of intakes in riverbeds; some wells and pumping stations located in low lying plains; most systems being heavily dependent on the National Power Grid for operations; much transmission and distribution pipelines being exposed to landslides, pipeline dislocation and breakages; and the exposure of water sources to very muddy inflows (high turbidity) after heavy rainfall. These problems are exacerbated by the fact that most water systems are at least partly situated in very remote areas that are difficult to access due to the hilly topography on which they are located, even under normal conditions.

Preliminary estimates of damage to the NWC system ranged between \$240.0 million - \$270.0 million. Assessment of damage to rural and remote infrastructure as well as commercial losses, increased operating costs (including trucking of water) and other costs associated with the tropical storm has not yet been ascertained.

The persistent flood rains in the aftermath of the system resulted in more than 40.0 per cent of the NWC's water supply systems being damage or forced out of operation, while another 30.0 per cent were otherwise impacted. Approximately, 45.0 per cent of the disruptions were caused by electrical problems, with the main parishes affected being St. Elizabeth, St. James, Clarendon and St Catherine. Approximately 20.0 per cent of the damage involved broken mains. High levels of turbidity featured in approximately 10 per cent of the disruptions. This problem was particularly evident in the parishes of St. Thomas, Clarendon, St. Catherine, and St. James. Other causes of disruption included:

- flooding at some facilities;
- blocked and damage intake structures; and
- electrical and /or mechanical factors.

Some of the major systems that were impacted include: Constant Spring; Hope Filter Plant; Long Mountain; and Seaview in St. Andrew; Tulloch Springs/Rio Cobre, St. Catherine; Greater Mandeville; Porus, Manchester; Great River; Queen of Spain; Pitfour, St James; and Hounslow, St. Elizabeth.



Undermined and Dislocated Constant Spring Raw Water Pipeline

The NWC was able to restore most of its supply system by Sunday, October 3, 2010, despite several unresolved issues. In the restoration effort, special attention was placed on facilities serving hospitals, clinics, schools and other critical public institutions as well as large population centres. Approximately 85.0 per cent of systems were back in operation fulfilling 90.0 per cent of the company's capacity, due mainly to the restoration of most of the systems servicing large townships. However, a number of smaller systems are still being restored, while others are still out because of unresolved challenges. In addition, the NWC reported that in many areas the restored service may be delivered at low pressure, with intermittent disruptions and other challenges as the systems become charged and settle down. It was estimated that 99.0 per cent of the system was back in operation by Monday October 4, 2010.

Several of the NWC's sewerage systems, including the Negril Sewerage plant and the Harbour View Sewerage Project have been impacted due mainly to:

- flooding;
- power supply and generator failure;
- storm water intrusion;
- illegal and inappropriate garbage disposal into NWC system; and
- some damage on collection network.

In addition, assessments are being done on some water and sewerage improvement works currently underway or recently completed, as they have suffered: a) damage to works in progress – including the Jamaica Water Supply Improvement Project (JWSIP) and sewerage improvement works along Barbican Road and Paddington Terrace in the Corporate Area; b) delays due to several lost days; c) setbacks as some activities already done needs to be redone - in the case of the Harbour View Sewerage Project ; and d) setbacks that will potentially result in expanded scope of work and variation of contracts.

B. Transport

The Transport industry sector sustained damage of approximately \$17.01 billion. This include damage to NWA road and bridges (\$13.99 billion) and Parish Council roads (\$3.00 billion). The remaining \$0.4 million relates to damage to the Jamaica Urban Transit

Company (JUTC) infrastructure. A further \$27.9 million in losses was incurred by the JUTC. Of the estimated \$14 billion damage to roads and bridges, \$1.42 billion represents the preliminary cost to reopen blocked roads. Cleaning and reconstruction of retaining walls of the Sandy Gully bridge accounted for 32.7 per cent (J\$4.6 billion) of the total cost of damage to the road infrastructure. A total of 543 main roads were impacted with St. Thomas accounting for \$1,542.2 million or 11 per cent of the total cost of the damage. Another \$1.9 billion was allocated to river training (Table 23).

a) Road transport

The road infrastructure fared the worst from the impact of the tropical storm. The heavy rains resulted in flooding, landslides, breakaway and scouring of primary road routes. The devastation was across all parishes with Westmoreland, St. Elizabeth and Hanover faring the worst. Approximately 543 main roads across all parishes, river training works, drainage structures and gullies were affected by the flood rains (see Table 23, Figure 16). Significant damage was done to the Sandy Gully and river systems as well as the fording at the Dry River Bridge in Harbour View, St. Andrew. In addition, the Mandela Highway was reduced to single lane as the west-bound lane was inundated, the Bog Walk Gorge was also flooded and the Junction Road, St Mary was closed mainly due to landslides. Emergency responses aimed at clearing roads as well as other access-related activities were activated islandwide.

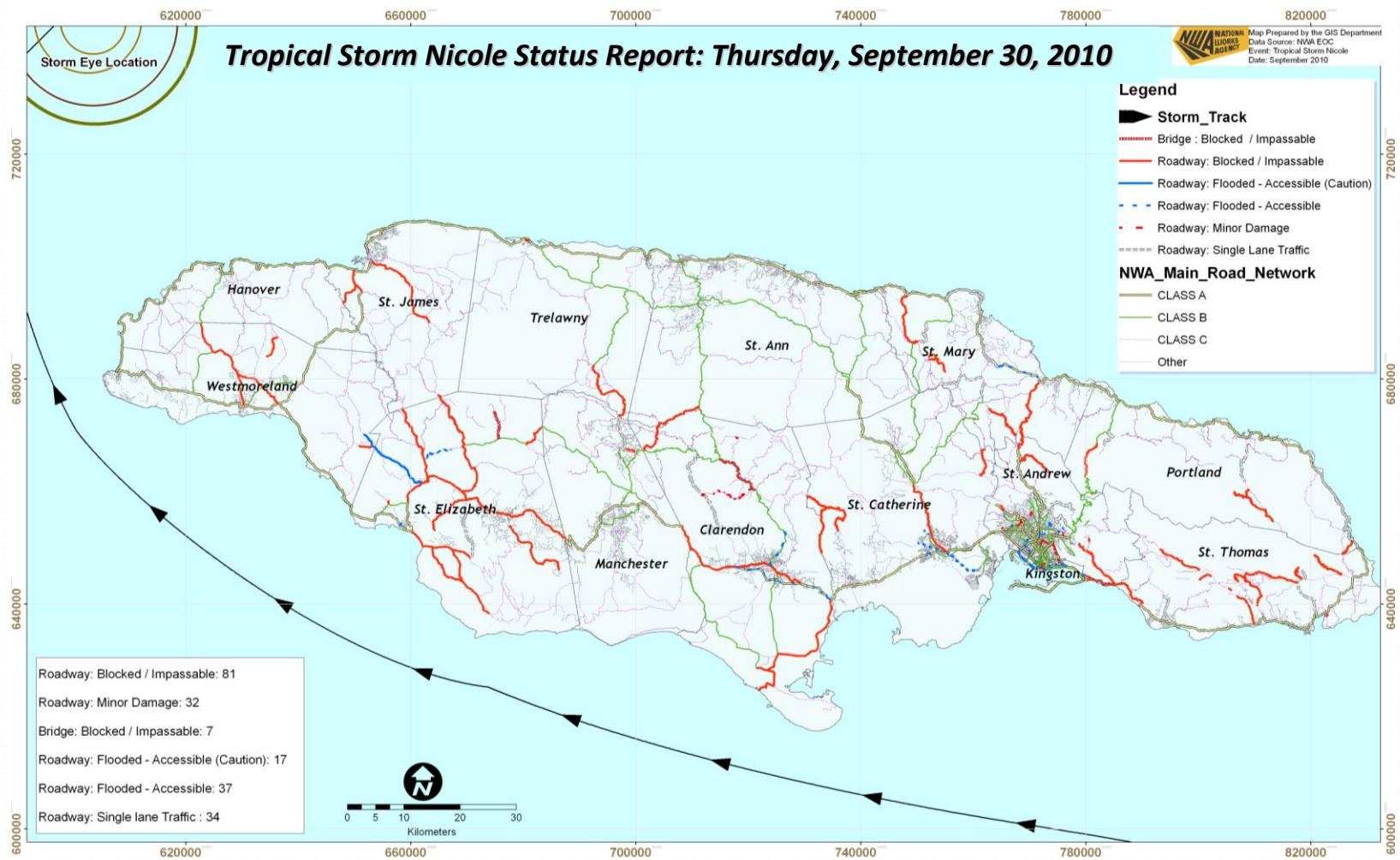
JUTC – Physical damage to the JUTC's four depot was minimal, estimated at \$200 000, accounted for fully by damage at the Greater Portmore lay-by. However, the company sustained loss in revenue. The estimated loss in revenue during the initial one-week period of the event amounted to \$25.0 million. This is calculated based on the average daily revenue for each depot minus the actual revenue made during the one week period. All routes were affected, but the routes most affected were Greater Portmore.

Operation losses were due to road conditions which limited the amount of cycle trips. Some routes, for example, the number 53 – Half-Way-Tree to Above Rocks – were inoperable, while the 54 – the Half-Way-Tree to Border- was about 30.0 per cent operable up to October....

Table 23: Preliminary Cost To Re-Open and Restore Roads Affected As A Result of Tropical Storm Nicole

PARISH	PRELIMINARY COST TO RE-OPEN BLOCKED ROADS (J\$)				PERMANENT RESTORATION OF ROADS (J\$)							TOTAL FLOOD DAMAGE ESTIMATE (J\$)
	Clearing of blocked roads	Temporary repairs to roads	Cleaning of Critical Drains	TOTAL COST TO REOPEN	Restoration of Asphalted roads	Restoration of Unasphalted Roads	Clean Blocked Drains	Repair Kerb and Channel	Relay Culvert	Construct & Reconstruct of RR Walls	Total Cost to Permanently Restore Roads	
St. Andrew	38,604,972	33,390,000	21,550,000	93,544,972	114,200,000	10,000,000	23,993,200	37,000,000	47,734,000	302,000,000	534,927,200	628,472,172
Kingston	12,925,000	38,035,000	57,845,000	108,805,000	105,225,000	-	14,000,000	-	27,600,000	26,100,000	172,925,000	281,730,000
St. Catherine	31,630,000	40,450,000	76,510,000	148,590,000	102,450,000	2,000,000	9,300,000	-	-	393,500,000	507,250,000	655,840,000
St. Thomas	10,260,000	25,850,000	19,300,000	55,410,000	1,256,350,000	24,000,000	6,400,000	-	-	200,000,000	1,486,750,000	1,542,160,000
Portland	8,025,000	31,182,000	13,570,000	52,777,000	750,050,000	133,680,000	1,400,000	8,600,000	3,340,000	12,300,000	909,370,000	962,147,000
St. Mary	22,855,000	33,275,000	19,960,000	76,090,000	236,000,000	-	-	175,400,000	55,000,000	455,000,000	921,400,000	997,490,000
St. Ann	2,365,000	5,100,000	7,115,000	14,580,000	8,000,000	-	-	-	-	1,500,000	9,500,000	24,080,000
Manchester	1,675,000	-	12,710,000	14,385,000	19,200,000	200,000	-	-	800,000	15,800,000	36,000,000	50,385,000
St. Elizabeth	16,910,000	83,650,000	34,450,000	135,010,000	72,450,000	-	-	3,680,000	36,600,000	51,300,000	164,030,000	299,040,000
Clarendon	23,650,000	55,800,000	145,200,000	224,650,000	175,800,000	7,000,000	6,000,000	20,300,000	24,500,000	26,500,000	260,100,000	484,750,000
Trelawny	10,795,000	11,450,000	7,560,000	29,805,000	10,700,000	700,000	2,890,000	320,000	2,100,000	5,550,000	22,260,000	52,065,000
Hanover	10,319,000	2,741,000	9,950,000	23,010,000	4,600,000	-	-	-	-	52,750,000	57,350,000	80,360,000
Westmoreland	2,220,000	8,250,000	8,600,000	19,070,000	-	-	-	-	180,000	8,010,000	8,190,000	27,260,000
St. James	13,100,000	32,450,000	32,051,000	77,601,000	516,000,000	-	-	896,000	7,710,000	57,590,000	582,196,000	659,797,000
River Training				108,000,000						1,891,000,000	1,891,000,000	1,999,000,000
Sandy Gully				175,000,000						4,400,000,000	4,400,000,000	4,575,000,000
Sub Total	205,333,972	401,623,000	466,371,000	1,356,327,972	3,371,025,000	177,580,000	63,983,200	246,196,000	205,564,000	7,898,900,000	11,963,248,200	13,319,576,172
Contingency (5%)				67,816,399							598,162,410	665,978,809
GRAND TOTAL	205,333,972	401,623,000	466,371,000	1,424,144,371	3,371,025,000	177,580,000	63,983,200	246,196,000	205,564,000	7,898,900,000	12,561,410,610	13,985,554,981

Figure 16: Status of Roads after Tropical Storm Nicole – September 30, 2010



As a result trips were shortened and buses ran half empty, resulting in estimated losses of \$120 000 per day and these losses will continue until the roads are repaired. The number 21, 22 and 23 bus routes, which terminate in Spanish Town were also affected due mainly to the flooding of the Spanish Town lay-by. This lay-by was not operating at full capacity, resulting in estimated losses of \$100 000 per day. Combined, losses to the other routes amount to approximately \$150 000 - \$200 000 per day.

b) Airports

Except for a few cancellations and flight delays, activities at the international airports functioned smoothly. The associated losses, if any are yet to be determined.

c) Ports

The Port Authority of Jamaica (PAJ) reported that there was no damage to its property, plant and equipment. However, the system caused an accumulation of debris in the Kingston Harbour from land-based sources. While this did not create any major delays in vessel movements tugs suffered some damage to their propellers, which will have to be repaired, a cost not covered by insurance. The cost for this repair is approximately US\$15 000, while the cost to remove the garbage is \$500 000. There were no other damage or effect on other ports or PAJ's property.

C. Telecommunications

The Telecommunications sub-industry sustained minor physical plant damage on account of TS Nicole. At the time of writing, operational losses were not yet ascertained.

One provider's telephone network was affected resulting in an estimated damage of \$136.9 million. This represented less than one per cent of asset. This was due to downed poles/wires, equipment damage and power outages. Plants which relied solely on JPSCo for power were impacted. Approximately 40.0 per cent of mobile coverage was impacted, with 35.0 per cent being restored within 24 hours. The parish of Portland was inaccessible for some days.

V. ENVIRONMENT

A. General

a) Overview

Given the high reliance of Jamaica's economy on their natural resources, environmental impacts caused by extreme weather events may have disastrous effects on social and economic well-being. The impact of these events is often exacerbated by anthropogenic factors which increase the vulnerability of life and property. Environmental impacts caused by extreme weather events may include damage to critical coastal ecosystems such as coral reefs, wetlands (mangroves) and seagrass beds which act as coastal buffers and are habitat, feeding and nursery areas for fish and other marine organisms. In addition, beaches and coastal infrastructure are also eroded and damaged due to storm surges and flood waters. Equally vulnerable to extreme storm events are forests and other terrestrial vegetation.

b) Pre-Existing Environmental Conditions

Pre-existing environmental conditions can influence the potential impact of natural hazards such as hurricanes on the environment. Such conditions before the passage of Tropical Storm Nicole included the following:

- Extended period of drought from 2009 to April 2010 which resulted in reduced vegetation cover and soil instability. The dry conditions led to a number of forest (bush) fires in mainly parishes such as St. Thomas, Kingston & St. Andrew, St. Catherine, Clarendon, Manchester and St. Elizabeth.
- The existence of formal and informal settlements in coastal and upland areas which are highly vulnerable to erosion, flooding and storm surge. This problem is often made worse by poor housing design in some of these areas;
- Many coastal and inland ecosystems were already being degraded due to marine and land-based pollution, habitat degradation, over-fishing and the effects of previous storm

events (Hurricane Ivan, 2004; Hurricane Dean 2007; Tropical Storm Gustav 2008). The denudation of hillsides and removal of vegetative cover can accelerate erosion due to rapid runoffs which may lead to increased sedimentation and turbidity in coastal areas which threatens marine resources.

- Saturated ground conditions resulting from prolonged rainfall late August to early September prior to the storm.
- Accumulation of solid waste in water channels due to indiscriminate disposal increased the potential for flooding in some areas.

B. Impact of Storm

The entire island was enveloped by the intense showers of Tropical Storm Nicole. The continuous rains resulted in flooding, landslides and over flowing of rivers/gullies across the island resulting in the loss of lives and property and severe damage to the country's infrastructure. In fact, preliminary data from the Water Resources Authority (WRA) indicated that some rivers experienced the highest flows on record. The torrential rainfall also resulted in pollution of the environment from runoff and spills from industrial facilities and sewage treatment plants, coastal erosion, sedimentation of coastal water bodies and accumulation of solid waste. There was also damage to vegetation in some areas, evidenced by uprooted trees.

The analysis of environmental impacts is limited by inadequate data on the characteristics and conditions of the environment prior to the passage of the storm. Therefore, the assessment of environmental damage and losses were, therefore, mainly qualitative. An environmental survey was carried out by a number of agencies which included the National Environment and Planning Agency (NEPA), the National Solid Waste Management Authority (NSWMA), the Forestry Department and the WRA.

a) Ecosystem and Habitat Damage

Coastal and Marine Ecosystems: Increased turbidity and sedimentation was evident in run-off from rivers and gullies. Coastal ecosystems such as coral reefs and seagrass beds are sensitive to sedimentation as impaired coastal and marine water quality could in turn

negatively impact these ecosystems and marine life. Loss of coastal ecosystems such as coral reefs has a negative impact on marine fish catch since these ecosystems provide food and habitat for fish.

Several of the 68 sewerage systems that are operated by the NWC were affected by the floods associated with the storm. In addition some 200 conventional pit latrines were washed out island-wide. Nutrient pollution in runoffs from sewage treatment plants, toilets and farms can affect coral reefs leading to excessive growth of algae which stifles reef growth.

Many gullies overflowed their banks because of the build-up of silt and vegetation (Figure 17).

Figure 17: Gully channel filled with silt and shrub in Clarendon



Source: National Environment and Planning Agency

Large mats of seagrass beds were uprooted by the storm (

Figure 18). Seagrass beds along with mangroves not only act as coastal buffers but they provide coastal stability and habitat and nursery for many fish species and other marine organisms. The loss of seagrass may lead to a reduction in fish catch in the ensuing months within this area and may also lead to further beach erosion. It will also add to the clean up cost of beaches.

Figure 18: Large mats of seagrass uprooted in Negril



Source: Negril Area Environmental Protection Trust

Terrestrial Ecosystems:

Although there was some amount of damage to terrestrial and coastal vegetation, this does not seem to be as significant when compared to other storms that affected the island within the last five years.

b) Coastal Erosion, Flooding and Sedimentation

Several sections of the island suffered coastal erosion, notably, the Negril area (Figure 19). The western sections of the island, it would appear, experienced the greatest erosion as result of the storm.

Figure 19: Eroded section of Long Bay Beach in Negril



Arrow shows approximate extent of beach prior to several erosion events. Part of the building that used to be on beach is now in the sea.

Source: Negril Area Environmental Protection Trust

Although estimates of sediment deposits were not available for this report, significant, sediment deposits were reported at several locations. In fact, many coastal and inland roads as well as beaches were inundated by sediments and other debris which add to clean up costs. The uprooting and deposition of seagrass, as illustrated in Figure 18, may also lead to loss of beach sand as a common practice of citizens and hoteliers is to have the seagrass removed by bulldozer. Sand is therefore removed from the beach with the clean up of the seagrass and debris.

Figure 20: Turbid waters of the Hope River



Turbid waters of
this river means
high sediment
deposits in
coastal waters

The intense and prolonged rainfall caused extensive flooding in many areas (Figure 21).

Figure 21: Main Road Flooded in New Market



Notice
denuded area
on hillside
which can
contribute to
flooding and
sedimentation.

Source: Water Resources Authority

Waste

Significant volumes of waste were deposited in terrestrial as well as coastal aquatic systems, especially solid waste. The deposit of high volumes of solid waste is a recurring problem during storm events due to inadequate waste management in the country. Improper disposal of solid waste does not only cause the blockage of drains which results in flooding, but can threaten the lives of marine organisms and reduce the aesthetic appeal of beaches. It is also possible that a lot of hazardous waste may be deposited in water bodies during flood events which end up in the marine environment. Given the lack of treatment and disposal facilities for hazardous waste, both solid and liquid forms of this type of waste could also harm the marine environment.

The clean up expenditure after Tropical Storm Nicole amounted to \$2.4 million. The Metropolitan Parks and Markets Administrative Region which cover the parishes of Kingston and St. Andrew accounted for 83.2 per cent of the clean up cost (Table 24).

Table 24: Solid Waste Expenditure Associated with Tropical Storm Nicole by Region

REGION	EXPENDITURE
Metropolitan Parks & Markets (MPM)	\$1,965,480.00
North Eastern Parks and Markets (NEPM) Waste Management Ltd.	\$ 236,512.00
Southern Parks and Markets (SPM) Waste Management Ltd.	\$ ¹⁸
Western Parks and Markets (WPM) Waste Management Ltd.	\$ 160,000.00
Total Expenditure	\$2,361,992.00

Source: National Solid Waste Management Authority

c) Indirect Loss

The reduction or loss of the protective effect of coastal ecosystems such as coral reefs, and seagrass can lead to significant erosion of coastline threatening coastal infrastructure and livelihoods. The loss of these ecosystems will also affect marine fish production and disrupt the livelihoods of fishers and other individuals and businesses that directly or indirectly

¹⁸ An estimate of the clean up expenditure for North Eastern parks and markets was not available at the time of writing of this report

benefit from fishing since these areas act as habitat and nursery areas for fish and other marine organisms. Although fish abundance may increase shortly after a storm event, this is short-lived because the coastal and marine ecosystems have been damaged which may eventually lead to migration or death of fish.

Other sectors such as tourism could be impacted from changes in beach morphology, beach erosion and loss of beach due to loss of coral reefs. The high turbidity of coastal waters and debris on beaches affect tourism by reducing aesthetic appeal. Runoff bearing diverse pollutants including sewage not only affects coastal ecosystems but also threatens the health of people living near the coast.

Forestry

The value of total damage and losses to forestry was estimated at \$5.65 million. This resulted mainly from the scouring of road surfaces, landslides, damage to timber stands and retaining structures; and loss of seedlings due to flooding of nurseries.

VI. MACROECONOMIC IMPACT OF TROPICAL STORM NICOLE

C. SUMMARY OF THE DAMAGE AND LOSSES

The total cost of damage and losses associated with Tropical Storm Nicole was estimated at \$20.58 billion (US \$239.6 million¹⁹), disaggregated as \$19.51 billion in damage and \$1.07 billion in losses²⁰. With regard to total damage, publicly owned properties accounted for \$19.32 billion or 93.9 per cent, while privately owned properties accounted for the remaining \$1.26 billion.

The approximately \$20.6 billion in total cost represents 1.9 per cent of 2009 current GDP. This was, however, dwarfed by the 8.0 per cent of GDP that Hurricane Ivan racked up in 2004, but similar to 2.0 per cent of GDP as a result of Tropical Storm Gustav in 2008. Consequently, the shock to the economy associated with Tropical Storm Nicole caused a detraction of 0.1 percentage point from GDP estimates, resulting in a new projected annual GDP change of -0.6 per cent.

As evidenced by the sums provided in Table 25 the country's infrastructure was severely affected, with damage amounting to \$18 089.0 million and losses of \$28.4 million, translating in a total cost of \$18,117.4 million. This represented 88 per cent of the total cost. Costs associated with the impact on the productive sector (\$763.0 million), social sector (\$1 641.6 million), the Environment (\$7.6 million) and expenditure on emergency operations (\$48.9 million) accounted for the remaining 11.9 per cent (see Table 25). Damage to the transport/roads and bridges was the most significant. The roads under the responsibility of the National Works Agency were the worst affected, followed by Parish Council and farm roads. While the devastation was islandwide, the parishes in the western section of the island were the hardest hit.

¹⁹ Exchange rate: J \$85.89 = US \$1 (Bank of Jamaica Exchange Rate for September)

²⁰ The estimates delineated for losses may be underestimated as at the time of writing the relevant data were not fully tabulated.

Damage to the Electricity and Telecommunications sub industries amounted to \$92.4 million and \$136.9 million, respectively. The damage to the electricity industry, due mainly to broken poles and dislocated lines, impacted the electricity distribution system resulting in power outages. However, losses that should emanate from these outages were not established, but are expected to be minimal due to the relatively quick restoration of power, especially to large users.

An approximate cost of \$270.0 million was recorded for damage to Water Supply and Sanitation. This figure mainly reflected damage to the water and sanitation infrastructure in urban areas as assessment of damage to rural and remote infrastructure and associated losses were still outstanding.

With regard to the Productive sector, Domestic Agricultural Crops, Livestock and Greenhouse/Protective cultivation sustained the most damage, amounting to \$576.5 million. A further \$22.0 million in loss was incurred and was related to relief assistance to the agriculture sector. The Tourism industry recorded damage of \$88.3 million and losses of 76.2 million.

Emergency Operations to include Parish Council drainage cleaning, vector control activities and ODPEM Relief supplies and Red Cross activities incurred a cost of \$48.9 million.

Projected Economic Performance in 2010 prior to TS Nicole

General Trends

Economic activity declined by 3.0 per cent in 2009. Despite this, a turnaround was projected for 2010 and the economy was expected to grow by 0.3 per cent. However, the fallout associated with the West Kingston events²¹ in May, was estimated to detract 0.4 percentage point from growth resulting in a revised GDP out-turn of -0.1 per cent. Subsequently, new data revealed a worsening of this position, thus the GDP figure was further revised downwards to -0.5 per cent, reflecting: 1) higher than anticipated

²¹ A cost of approximately \$22.5 billion, representing 2.1 per cent of 2009 current GDP, was incurred.

unemployment levels; and 2) reduced capacity utilization in some industries. Also revised were the fiscal deficit and inflation targets.

Economic Policy

Despite the challenges, Government remains committed to its stated economic policy of channeling the economy towards a path of growth and development. Hence the anticipated growth rate and targets outlined hinge heavily on the gains to be made from the economic policy being pursued by government. Medium-Term Monetary and Fiscal policy were developed within the context of the International Monetary Fund (IMF) Standby Agreement.

a) Fiscal Policy

The fiscal policy to be pursued should result in a projected decline of the fiscal deficit to 6.5 per cent of GDP, down from the 10.9 per cent of GDP recorded in FY 2009/2010. This is slated to be achieved through the fiscal consolidation measures linked to the IMF programme and will involve broad based programmes of adjustment, aimed at tempering the level of debt and associated debt servicing costs, streamlining expenditure and reforming the public sector as well as divestment of non-core public bodies and loss making public enterprises.

b) Monetary Policy and Exchange Rate

Within the context of current economic trends, monetary policy as pursued by the central bank, is guided by the medium-term objective of single digit inflation coupled with a stable exchange rate. During 2010, this policy objective was to be facilitated by, among other things, the:

1. relative stability of international commodity prices, in particular crude oil and grains; and
2. receipt of loans from multilateral institutions following the signing of the Stand-By Agreement with the IMF.

Also included in the Government of Jamaica's economic programme is the pursuit of a lower interest rate structure, with the expressed aim of providing affordable financing to both the public and private sectors.

Table 25: Total Cost of Damage & Loss from Tropical Storm Nicole

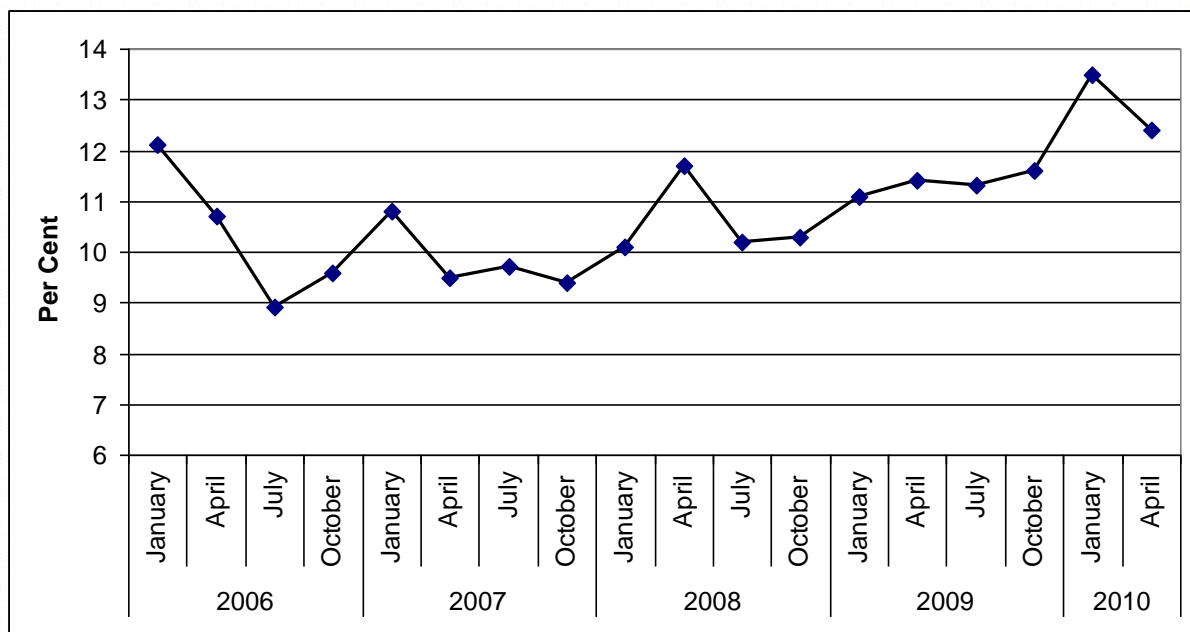
Sector and Sub-sector	Allocated by Classification		Allocated by Sector		Total	% Share
	Damage	Loss	Private	Public		
Total	19,512,169,947	1,066,932,270	1,254,638,710	19,318,863,507	20,579,102,217	
% Share	94.82	5.18	6.10	93.88	100.00	
Social	701,662,557.38	940,000,000.00	274,300,000.00	1,367,362,557.38	1,641,662,557.38	7.98
Housing	274,300,000.00		274,300,000.00		274,300,000.00	1.33
Education and Culture	157,000,000.00	940,000,000.00		1,097,000,000.00	1,097,000,000.00	5.33
Health	270,362,557.38			270,362,557.38	270,362,557.38	1.31
Correctional Facilities				0.00	0.00	0.00
						0.00
Productive	664,856,440.05	98,182,269.95	741,038,710.00	22,000,000.00	763,038,710.00	3.71
Livestock	32,400,000.00		32,400,000.00	0.00	32,400,000.00	0.16
Greenhouse/Protected Cultivation	12,500,000.00		12,500,000.00	0.00	12,500,000.00	0.06
Domestic & Agricultural Crops	531,632,000.00		531,632,000.00	0.00	531,632,000.00	2.58
Fisheries	0.00		0.00		0.00	0.00
Irrigation	0.00		0.00	0.00	0.00	0.00
Mining	0.00		0.00	0.00	0.00	0.00
Manufacturing	0.00		0.00	0.00	0.00	0.00
Relief Assistance (Agriculture)*1		22,000,000.00		22,000,000.00	22,000,000.00	0.11
Tourism	88,324,440.05	76,182,269.95	164,506,710.00		164,506,710.00	0.80
Infrastructure	18,089,050,000.00	28,400,000.00	229,300,000.00	17,888,150,000.00	18,117,450,000.00	88.04
Electricity	92,400,000.00		92,400,000.00		92,400,000.00	0.45
Water Supply and Sanitation	270,000,000.00			270,000,000.00	270,000,000.00	1.31
Transport/Roads and Bridges*2	17,013,900,000.00	27,900,000.00		17,041,800,000.00	17,041,800,000.00	82.81
Farm Roads	574,550,000.00			574,550,000.00	574,550,000.00	2.79
Ports	1,300,000.00	500,000.00		1,800,000.00	1,800,000.00	0.01
Telecommunications	136,900,000.00		136,900,000.00		136,900,000.00	0.67
Environment	7,611,992.00	350,000.00	0.00	2,361,992.00	7,961,992.00	0.04
Forestry	5,250,000.00	350,000.00			5,600,000.00	0.03
Waste Management	2,361,992.00			2,361,992.00	2,361,992.00	0.01
Emergency Operations	48,988,957.61	0.00	10,000,000.00	38,988,957.61	48,988,957.61	0.24
Government Relief Assistance				0.00	0.00	0.00
PC-Drain Cleaning/Vector Control	30,000,000.00			30,000,000.00	30,000,000.00	0.15
ODPEM Relief Supplies	8,333,453.07			8,333,453.07	8,333,453.07	0.04
ODPEM Relief Transportation	655,504.54			655,504.54	655,504.54	0.00
Red Cross Activities	10,000,000.00		10,000,000.00		10,000,000.00	0.05

Evolution of main variables

a) Economic Activity

The improvement in economic activity in 2010 was predicated on a) modest improvement in domestic and global demand, consequent on the gradual recovery from the global economic recession in major markets; b) growth in the Tourism sector, which is set to rebound, albeit at a lag, given the improvement in incomes in some source markets; c) growth in the agricultural sector due to the strengthening in global demand; and d) growth in the Mining & Quarrying industry associated with the reopening of one alumina plant and expansion in crude bauxite production.

Figure 22: Unemployment Rate by Quarters, 2006-2010



b) Prices, Wages and Employment

Inflation was projected to fall within a range of 7.0 per cent to 8.0 per cent for financial year (F/Y) 2010/2011. This reduced rate was predicated on:

- stability in international commodity prices;
- subdued aggregate local demand amidst a reduction in purchasing power; and
- relative stability in the foreign exchange market.

Wages were expected to be contained due to: 1) wage freeze in the public sector; and 2) increase in the level of unemployment. The level of employment has been declining consistently since October

2008. As at April 2010 the net decline in the level of employment was 86 600 persons. This trend is expected to continue given the relative weak domestic demand.

c) The External Sector

Global demand is expected to increase in 2010 as confidence rebounds in both the financial market and the real economy. This projected improvement in global economic conditions should augur well for the Jamaican economy, especially given that its main trading partner, the USA should record increased output. In addition, Jamaica's current account balance is also projected to be impacted by expansions in alumina and crude bauxite imports and increased stopover arrivals.

D. ECONOMIC PERFORMANCE IN THE YEAR OF THE EVENT, BEFORE THE EVENT, JANUARY-JUNE 2010 AND JULY-SEPTEMBER 2010²²

JANUARY-JUNE 2010

1. Fiscal Performance

Central Government operations produced a fiscal deficit of \$7 064.5 million for April – June 2010. The fiscal out-turn was better than anticipated and reflected revenue enhancement measures and expenditure curtailment, which were consistent with the fiscal consolidation requirements of the Stand-By Agreement (SBA). The deficit was the net effect of higher than budgeted inflows of Revenue & Grants at \$78.91 billion and lower than projected expenditure of \$85.97 billion. Increased revenues were due in part to: (i) a greater level of tax compliance as the tax administration intensified tax collection efforts; and (ii) the effect of two tax packages introduced in September and December of 2009. The lower expenditure represented declines in both Recurrent and Capital expenditure.

2. Monetary and Exchange Policy

During January-June 2010, macroeconomic performance was impacted by improvements in both the domestic and international environments. There was an increase in the pace of global economic recovery, which led to an increase in the demand for Jamaican goods and services. Within the

²² Figures for January-June represent actual GDP data from STATIN, while July-September are projections by the PIOJ.

domestic market, business and consumer confidence was boosted by the successful signing of a 27-month Stand-By Agreement between Jamaica and the International Monetary Fund. These developments facilitated:

- the central bank's removal from its list of Open Market Operation (OMO) Instruments, all tenors above 30-days as at January 16, 2010; and
- a reduction in interest rates. The market determined 182-day Treasury Bill yield fell to 9.26 per cent, 7.54 percentage points lower than at the start of the year. Through three moves, the BOJ reduced the rate applicable to its 30-day OMO Instrument, by a combined total of 150 basis points to 9.0 per cent.

3. Economic Activity

For the first half of 2010, real GDP declined by 1.5 per cent relatively to the corresponding period of 2009, compared with the 3.6 per cent contraction recorded in January-June 2009. Economic performance during 2010 was mainly influenced by the protracted effects of the global economic crisis on the domestic economy. Aggregate demand remained weak as the unemployment levels rose and purchasing power of individuals declined. In addition, the economy was also adversely impacted by the effects of: (a) drought conditions which prevailed during the second half of 2009 and the first quarter of 2010; (b) security operations in Kingston and St. Catherine and the associated ramifications during the second quarter of 2010; as well as (c) the JDX programme on financial institutions.

The decline in the economy was reflected in both the Goods Producing and Services Industries which fell by 3.2 per cent and 1.3 per cent, respectively. All Goods Producing Industries declined with the exception of Agriculture, Forestry & Fishing which grew by 1.9 per cent. Within the Services Industry, the Finance & Insurance Services, Wholesale & Retail Trade Repairs and Installation of Machinery and Electricity & Water industries recorded the largest declines of 4.5 per cent, 2.1 per cent and 1.8 per cent, respectively. The Hotel and Restaurants industry, the industry which captures most of tourism's direct contribution to Gross Domestic Product (GDP), grew by 2.9 per cent.

Real value added in the Agriculture industry grew by an estimated 1.9 per cent. Performance in the first two quarters was affected by drought conditions which began in the latter half of 2009.

However, the occurrence of the tropical storm at the end of the third quarter and into the fourth quarter did not have any significant impact on the July- September quarter. The real impact is expected to be felt in the October- December 2010 (Table 26).

Table 26: Year over Year Change of Value Added by Industry at Constant (2003) Prices

	Jan- Jun 2010	Jul- Sept 2010	Oct- Dec 2010	Jan- Dec 2010
GOODS PRODUCING INDUSTRY	-3.2	1.8	1.5	-0.8
Agriculture, Forestry & Fishing	1.9	2.0	-5.0	0.2
Mining & Quarrying	-24.5	31.1	29.5	-1.1
Manufacture	-2.1	-1.4	-0.5	-1.6
of which: Food, Beverages & Tobacco	-2.5	-0.5	-0.5	-1.6
Other Manufacturing	-1.6	-2.5	-0.5	-1.5
Construction	-2.1	-1.0	2.0	-0.8
SERVICES INDUSTRY	-1.3	-0.8	0.2	-0.8
Electricity & Water Supply	-1.8	-4.3	-1.0	-2.3
Transport, Storage & Communication	-1.0	1.2	2.1	0.3
Wholesale & Retail Trade; Repair and Installation of Machinery	-2.1	-2.0	0.0	-1.6
Finance & Insurance Services	-4.5	-4.0	-3.0	-4.0
Real Estate, Renting & Business Activities	-0.6	0.4	0.4	-0.1
Producers of Government Services	-0.2	0.2	0.2	0.0
Hotels and Restaurants	2.9	2.0	3.5	2.8
Other Services	-0.5	0.3	0.5	0.0
Less Financial Intermediation Services Indirectly Measured (FISIM)	-5.8	-5.0	-4.0	-5.1
TOTAL GDP AT BASIC PRICES	-1.5	0.0	0.7	-0.6

The Manufacture industry continued to be negatively impacted by low domestic and international demand for Jamaican Manufactured products. This was exacerbated by the security operations and

State of Emergency in sections of Kingston and St. Catherine during the months of May and June 2010. Consequently, the industry declined by 2.1 per cent in January-June 2010, reflecting the combined effect of a 2.5 per cent decline in Food, Beverages & Tobacco sub industry and 1.6 per cent in the Other Manufacture.

Real value added for the Mining & Quarrying industry declined by 24.5 per cent in January-June 2010 relative to the similar period of 2009, resulting from a downturn in alumina production as crude bauxite production grew.

For January-June 2010, real value added for the Construction industry fell by an estimated 2.1 per cent. This performance occurred against the background of the lingering effects of the negative impact of the global economic crisis on the domestic economy. The downturn recorded for the industry was attributed mainly to the decline in activities in Building Construction due to a reduction in the number of projects. Activities in the industry were further stymied given the completion of major construction work on the North Coast Highway Project at the end of 2009 and work stoppage on Highway 2000 due to geological issues.

Within the Services industry, declines in the Electricity and Water sub industry in January-June stemmed from declines in both electricity generation and water production. Real value added for Transport, Storage & Communication declined by an estimated 1.0 per cent. This performance was influenced mainly by contraction in the Transport & Storage segment due largely to a decline in air transport activities, which was enough to outweigh the estimated expansion in telecommunications activities.

Despite signs of recovery in the global distributive trade, following the negative impact of the contraction in global demand arising from the economic crises, the local trade continued to contract as reflected by the 2.1 per cent decline in real value added in the January-June 2010 relative to January-June 2009. Local distributive activities during the January-June 2010 period were constrained by the downturn in the domestic economy resulting from the lagged effects of the global economic crises.

Real value added for the Finance & Insurance Services industry declined by 4.5 per cent in the period January–June 2010, influenced mainly by: a) lower stock of Loans & Advances compared with the similar period of 2009; and b) the negative impact on net interest income of the JDX which was introduced in February 2010.

The growth of 2.9 per cent in Hotels & Restaurants/Tourism industry was influenced mainly by the increase in stopover arrivals during the first three months of the year, as the May 2010 Western Kingston civil unrest had an adverse impact on the tourist industry. The increased expenditure for damage control to the island should augur well for the industry in terms of setting it on a renewed growth path amidst the negative publicity.

4. The External sector

BOP January – May 2010

For the January - May 2010 period, there was a current account deficit of US\$193.7 million, an improvement of US\$102.3 million compared with the corresponding period of 2009. The contraction in the deficit during the first five months of 2010 stemmed from improvements in all sub-accounts with the exception of the goods sub-account.

During the January-May 2010 period, the deficit on the Goods sub-account was US\$1.24 billion, a deterioration of US\$60.3 million compared with January – May 2009. This increase in the deficit was attributable to a US\$21.3 million decrease in exports and a US\$39.0 million growth in imports. Lower export earnings were influenced mainly by a decline in the value of alumina and sugar exports. The rise in the value of imports was associated with a 32.9 per cent expansion in the mineral fuel imports.

The surplus on the Services sub-account increased to US\$441.1 million during January – May 2010 from US\$407.0 million in the corresponding 2009 period. This improvement stemmed mainly from increased inflows in the travel category, due to a growth in tourist arrivals.

The Income sub-account registered a deficit of US\$185.9 million compared with a deficit of US\$255.6 million in the corresponding period of 2009. This US\$69.7 million improvement was due

mainly to a reduction in outflow of investment income, influenced primarily by a decline in profits remitted by foreign direct investment companies and lower interest payment by the government. A surplus of US\$787.1 million was recorded for the Current Transfers sub-account, an increase of US\$58.9 million. This improvement largely reflected a growth of 10.1 per cent in remittance inflows.

E. PRELIMINARY FORECAST FOR QUARTER OF THE EVENT (JULY-SEPTEMBER 2010)

For the July- September 2010 quarter, a flat real GDP performance is expected, reflecting higher value added of 1.8 per cent in the Goods Producing industry and a decline of 0.8 per cent in the Services industry. Growth in the Goods Producing industry was due to real GDP growth in: a) Agriculture, Forestry & Fishing of 2.0 per cent, brought about by strong growth in domestic crop production; and b) Mining & Quarrying of 31.1 per cent, reflecting the higher crude production at Noranda Aluminium Holding Corporation and the reopening of the WINDALCo Ewarton Plant.

Prior to Tropical Storm Nicole it was projected that the Manufacture industry would decline by 1.0 per cent. Preliminary data for the July-September quarter indicate that performance in the industry was not significantly affected by the storm. The minimal impact of the storm was reflected in Non-Metallic Minerals and Chemical & Other Chemical Products. In the Non-Metallic Minerals sub-industry, there was higher level of cement production for the months of July and August while there was a 45.1 per cent decline in production in September 2010 relative to September 2009.

A decline of 1.0 per cent was projected for the Construction industry, as the industry is being impacted by the limited fiscal space which restrains expenditure on public sector construction projects. This was further exacerbated by the reduction and uncertainty that surrounds private sector investment, evidence by the down scaling of hotel and residential construction.

The projected decline in the Services industry was based on reductions in value added of 2.0 per cent for the Wholesale & Retail Trade; Repair and Installation of Machinery (WRTRIM), 4.0 per cent Finance & Insurance services and 4.3 per cent in the Electricity & Water supplies industry. The lower value added in the Electricity & Water Supplies industry is a result of the effects of the immediate disruptions to these services due to the tropical storm. The Hotels & Restaurants and

Transport, Storage & Communication industries grew by 2.0 per cent and 1.2 per cent, respectively, while all the other services industries are projected to grow by 0.7 per cent. Activities in the Hotels & Restaurants industry is being buoyed by modest recovery in tourism activities as economic conditions in the major source markets improve.

F. PROJECTED PERFORMANCE AFTER THE EVENT, OCTOBER – DECEMBER 2010

1. Impact on GDP

Given the economy's performance in the January-June 2010 and July-September 2010 periods, GDP growth of 0.7 per cent was projected for the October–December 2010 quarter, driven mainly by Mining & Quarrying; Hotels, Restaurants & Clubs; and Transport, Storage & Communication. This projection was made against the background of several risks factors, including:

- sluggishness in economic recovery
- weather-related conditions which accompany the annual hurricane season

Despite this, a downward revision in the GDP growth rate was necessitated, given the reported damage sustained mainly by agriculture and infrastructure (electricity, water, roads). An expansion of 0.7 per cent in GDP is expected, a detraction of 0.2 percentage point from 0.9 per cent forecasted prior to TS Nicole. The expansion in the growth rate in the October-December 2010 quarter, reflected increased value added of 1.5 per cent and 0.2 per cent in the Goods Producing and Services Industries, respectively (Table 25).

While growth projections for sub industries within the Services industry remained unchanged, growth prospects for Agriculture, Forestry and Fishing, Mining & Quarrying sub-industries within the Goods Producing Industry were revised downwards. In the area of Agriculture, decline in the magnitude of 5.0 per cent is projected, overturning the earlier projection of 2.0 per cent growth. The anticipated outturn is consistent with the destruction to domestic crops. These domestic crops are mainly short term, which, if were replanted immediately could come into bearing in the October-December 2010 quarter. However, because of the persistent rains and the threat of other hurricane-related systems the farmers' effort of replanting these crops were hampered. The Ministry of Agriculture has put in place several measures to reduce the impact of the storm and minimize the expected shortages in crop production. These include:

- a \$4.0 million grant to assist the speedy recovery of green house production;
- assistance in agricultural inputs such as land preparation, seeds, fertilizers and chemicals;
- the coordination with the NWA to identify and prioritize the most critical farm roads for clearing, in the first instance, to allow for free movement into and out of crop production areas that have been affected.

The anticipated higher growth forecast for the Construction & Installation industry is predicated on the advancement of work on the affected roads and bridges consistent with reconstruction activities associated with TS Nicole. In addition, the fast tracking of the Jamaica Infrastructure Development Project will impact the industry positively in the short-term. However, expansion in this area in particular, may be tempered by the limited fiscal space, given the conditions that exist under the IMF Programme.

It is anticipated that the two components of the Manufacture industry may be positively impacted by the passage of Tropical Storm Nicole. There is a strong correlation between the activities in the Construction industry and the production of some commodities in the Non-Metallic Minerals and Chemical & Other Chemical Products sub-industries of the Manufacture industry. Against this background, it is expected that reconstruction activities associated with Tropical Storm will generate demand for products such as cement and paint, hence positively impacting the Non-Metallic Minerals and Chemical & Other Chemical Products sub-industries, respectively.

Chemical & Other Chemical Products is also expected to be positively affected by increased demand for Aluminium Sulphate and Sulphuric Acid²³. The increased demand for Aluminium Sulphate is predicated on increased water treatment activities associated with high levels of turbidity caused by the tropical storm.

Domestic inflation is expected to trend upwards, given the impact of the storm on the agriculture industry. Damage to the industry will lead to shortages in the supply of domestically grown vegetables and starchy foods such as cabbage, tomato, and sweet pepper. This situation is expected to be exacerbated by recent increases in international grain prices. This upward movement in prices

²³ Sulphuric Acid is the main ingredient in the production of Aluminium Sulphate.

is however expected to be tempered by the appreciation of the Jamaican dollar, continued constraints in domestic demand, and provisions allowing imports of vegetables in short supply.

2. Fiscal Operations of Central Government

Greater challenges to achieving the target of 6.5 per cent of GDP was due to demands for increased capital expenditure because of infrastructure damage estimated at \$18.90 billion. This will necessitate approval of increased fiscal space by the IMF. This against the background of projected lower GDP and continued increase in unemployment. These will impact negatively on revenue collections and in turn government's ability to provide counterpart funding for some of the necessary infrastructural projects for the remainder of FY 2010/11.

3. Impact on Balance of Payment

The Goods sub-account will be negatively impacted by the effect of TS Nicole on the Agriculture and Mining & Quarrying industries. Domestic agricultural crops which were destroyed are expected to be partially replaced by imports in an effort to prevent a shortage in the market.

4. Upside potential and downside risks to estimates.

With the exception of the Construction & Installation industry, which saw a tempering of the decline forecasted prior to the tropical storm, growth figures for the other industries will either remain unchanged or be impacted negatively in 2010. Consequently, a GDP contraction of 0.6 per cent is anticipated, a detraction of 0.1 percentage point from the forecast pre TS Nicole. There, however, exists both upside and downside risks that may impact these estimates. Included in the upside potentials are:

- Faster than anticipated recovery in the Agriculture, Forestry & Fishing industry; and
- Greater than anticipated growth in Construction & Installation.

Among the downside risks are:

- Additional devastation due to subsequent weather systems; and
- Delayed recovery in the economies on Jamaica's main trading partners.

VII. CONCLUSION AND RECOMMENDATIONS

Since 2001, Jamaica has been impacted by nine disaster events. These disasters have continued to highlight Jamaica's physical vulnerability as well as the man-made factors which have exacerbated the problem. Thus, in the wake of the ever increasing climate change risks, there is a need to take steps to build resilience to natural disasters.

Encroachment of new developments (formal and informal) on flood plains continues to expose large segments of the population to flooding. A considerable amount of the flooding is related to poor drainage. One example of this is the community of Big Pond, St. Catherine which has been subject to repeated flooding. The community is situated in a depression where storm water from all the areas above the district flows to and collects in a pond, resulting in the roads being impassable for several days. In many urban areas, flooding occurs because of residential encroachment along the banks of gullies. The impact of the Tropical Storm Nicole rains showed that in Sandy Park, St. Andrew, for example, some houses were constructed on the banks of the Sandy Gully without observing any setback limits. In other instances such as at Grants Pen, St. Andrew, houses were built with a setback of less than one metre. Even with the existence of drains in some communities, these were inadequate to transport great volumes of water.

Inappropriate land use, another factor affecting the vulnerability of Jamaicans to tropical weather events, led to numerous instances of slope failure. In one case, in Upper St. Andrew, landslide led to failure of a retaining wall and the death of workers who were sleeping in a shed on the property. In some areas, there has been an increase in the number of developments being approved on the hillside with the result that run-off has been reduced due to the reduction of permeable areas and vegetation. In addition, the clearing of hillsides has led to increase in soil erosion and sediment-laden runoff. Other factors affecting flooding include, the inability of existing drains to transport the volume of water; the construction of houses with inadequate floor level heights; and inappropriate land uses leading to blockage of sink holes.

The assessment of the disaster caused by Tropical Storm Nicole has reinforced the need for some of the underlying factors affecting the vulnerability of the country to various hazards to be urgently

addressed. In this regard, the following approaches to advance disaster risk reduction are recommended:

- (i) Enforcement of setback standards for gullies and streams.
- (ii) Demarcation of no build zones, especially in close proximity to gullies in order to preserve life and property.
- (iii) Protection of gully banks by removal of encroaching structures.
- (iv) Implementation of an ongoing drain maintenance programme
- (v) Amendment of the Water Resources Act to make the regulation of Floodwater Control the responsibility of the WRA. This would allow a shift from the present reactive state in dealing with flooding to a more proactive one. The WRA assuming the responsibility for regulation of Floodwater Control would facilitate mapping of flood prone areas, hydrologic run-off assessments/modelling to determine flood boundaries for different return periods, and determination of what structures/development should be allowed within those boundaries.
- (vi) Mapping and delineation of flood prone areas that can be used for non-residential purposes such as agriculture where the impact on life and property would be lessened.
- (vii) Delineation of areas above a certain elevation where residential development can take place, and the implementation of measures to maintain floodwaters at an elevation below the residential development.
- (viii) Mapping of sinkholes in depressions that are flood prone and developing a plan to establish buffer zones around these sinkholes, keep them open and improve drainage capability.
- (ix) Provision of resources to enable the installation of rainfall intensity gauges in the Watershed Management Units to improve the analysis of extreme events and forecasting to mitigate flooding.
- (x) Improving ecosystems management so as to make them more resilient to natural hazards. The social and economic benefits will be through reduced exposure to natural events as ecosystems provide a buffering service.

Proposed Projects

Apart from projects designed to restore and rehabilitate damaged infrastructure and public buildings and facilities, the following projects are proposed to stave off further damage, especially those associated with flooding:

(i) Flood Prevention and Mitigation Planning through improved Sinkhole Management

Sinkholes are a common feature of Jamaica's limestone topography. Over the years, major flooding has occurred in Jamaica around sinkholes which dominate the limestone areas of Jamaica. Inappropriate land use in the areas surrounding sinkholes have often resulted in blockage of sinkholes with the result that they are unable to perform their function of draining water away from the land surface. This has caused flooding in several areas, some of which have led to significant damage and losses. The instances of flooding associated with sinkholes could be reduced with improved management of these physical features. This could be facilitated with better information about sinkholes, which would facilitate the prevention and mitigation programmes. This project proposes to reduce sinkhole flooding by mapping sinkholes, undertaking geologic and hydrologic analyses of sinkholes; and developing a prevention and mitigation management plan for sinkholes. This would include establishing buffer zones to ensure and improve drainage capability including the drilling and use of drainage wells.

(ii) Hydrological Modelling of River Flooding

Riverine flooding is a major contributor to natural disasters in Jamaica. The spread of water over the flood plains of these rivers has a temporal component which is not normally captured in the traditional way of preparing flood hazard maps and as such do not provide the right information to aid development planning. Simulating scenario floods through modelling can help in these cases. This project will execute hydrologic modelling of major rivers (riverine flood flows) to determine flood boundaries. The outputs of the project will provide local authorities with information to guide approval of development within the various boundaries. It will also be of assistance to disaster planners for the development of evacuation plans

(iii) Floodwater Control Master Plan

Floods are Jamaica's most frequently occurring hazards. Over the years, damage and losses due to floods have ran into millions of dollars. These costs of floodings will continue to rise in the foreseeable future unless far-reaching actions are taken to significantly reduce the impact of floods. This project aims to develop a flood control master plan using best management practices. The plan will cover the entire island and will include both structural and non-structural interventions to reduce/prevent flooding. It will also incorporate the physical, hydrologic and ecological functions and processes of rivers.

(iv) Mapping of Gullies and Drains in main towns to determine their: condition including levels of erosion; proximity to housing developments and commercial activities and to provide information for retrofitting existing drains etc. and reducing flooding.

Watershed Rehabilitation and Livelihood Diversification

Tropical Storms Gustav and Nicole underlined that there is severe degrading in the upper reaches of the Hope River Watershed and that this has contributed significantly to the level of impact along and downstream the Hope River. The UNDP Tropical Storm Gustav Early Recovery Report identified a number of anthropogenic activities that contributed to the level of devastation and strongly suggested watershed rehabilitation as a means of addressing the problem. The project components could include:

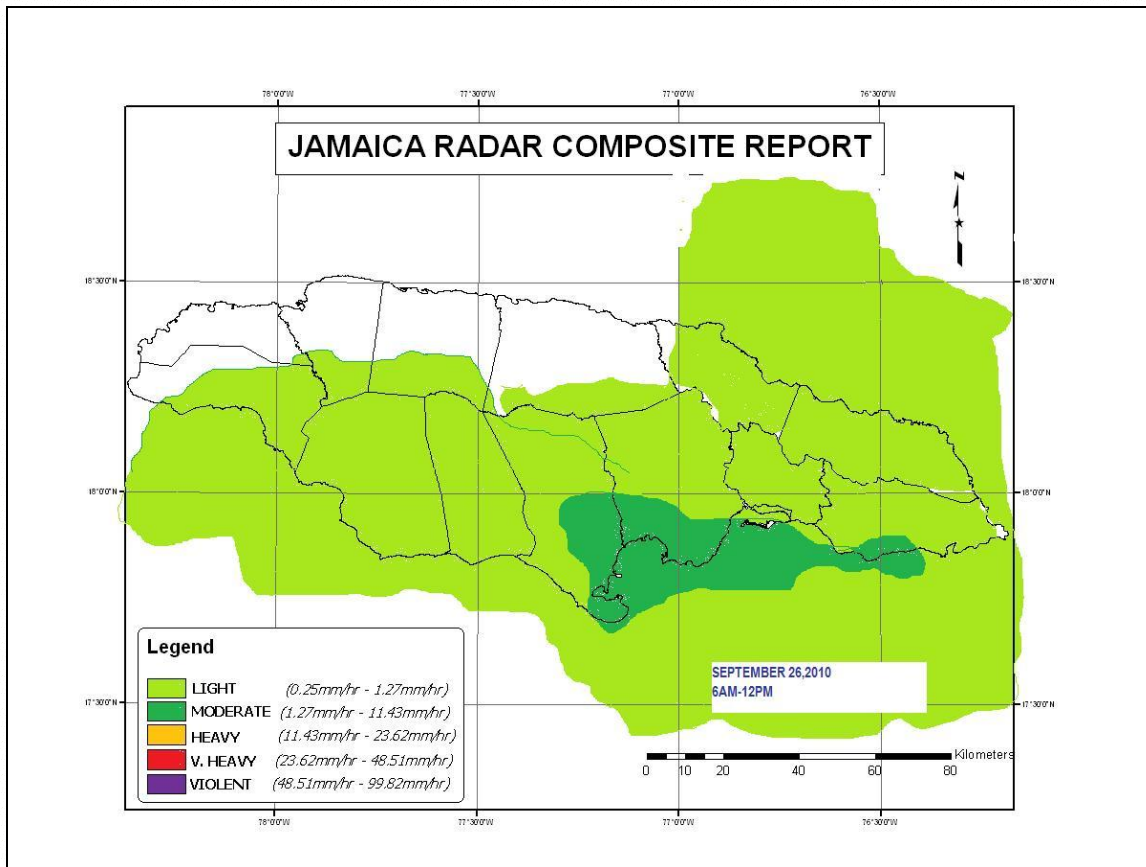
- Replanting of deforested areas
- Slope stabilization (using vetiver and lemon grass)
- Training in construction techniques and employment in the rehabilitation of civil infrastructure (for ongoing rehabilitation and as a means of livelihood diversification)

APPENDIX

APPENDIX A

Radar Summary

26th September 2010 to 1st October 2010



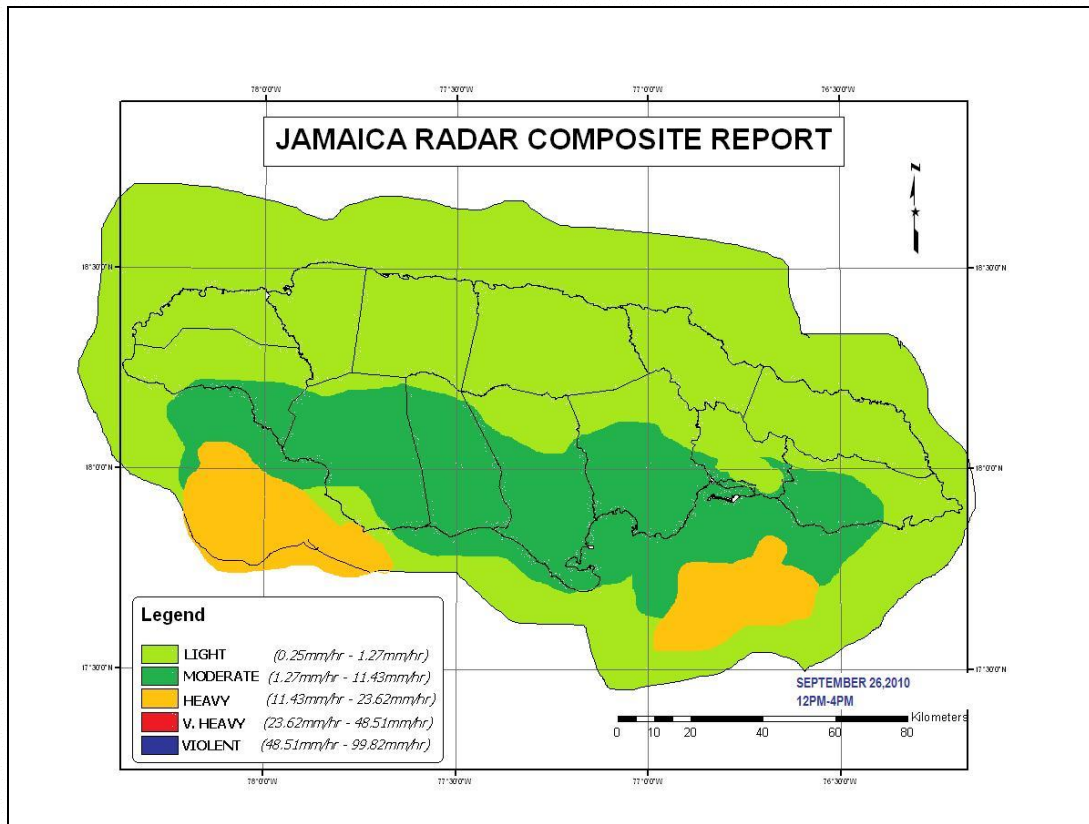
RADAR SUMMARY

DATE : September 26, 2010

PERIOD : 6am – 12noon

DURING THE AM:

Light to moderate showers affected all southern and northeastern parishes and southern sections of northern parishes



RADAR SUMMARY

DATE : September 26, 2010

PERIOD : 12noon-4pm

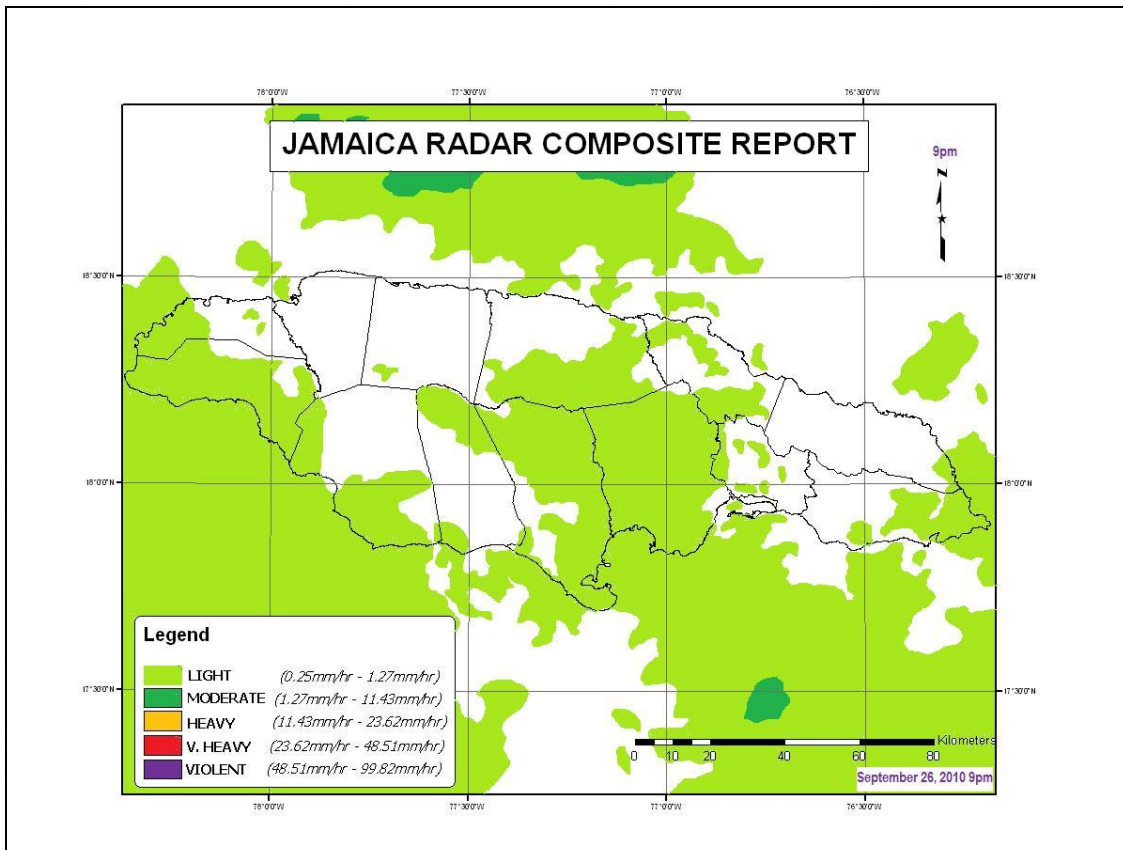
DURING THE PM:

Scattered light to moderate and heavy showers affected sections off all parishes. Heavy showers particularly across the southern parishes and offshore waters.

CURRENTLY:

At 4:00pm light to moderate showers affecting sections of most of St. Catherine, South-West St. Elizabeth interior St. Ann n St. James and interior St. Thomas sections of St. Andrew offshore the north and south coast...

max tops: 30,000ft all along the south coastal waters...



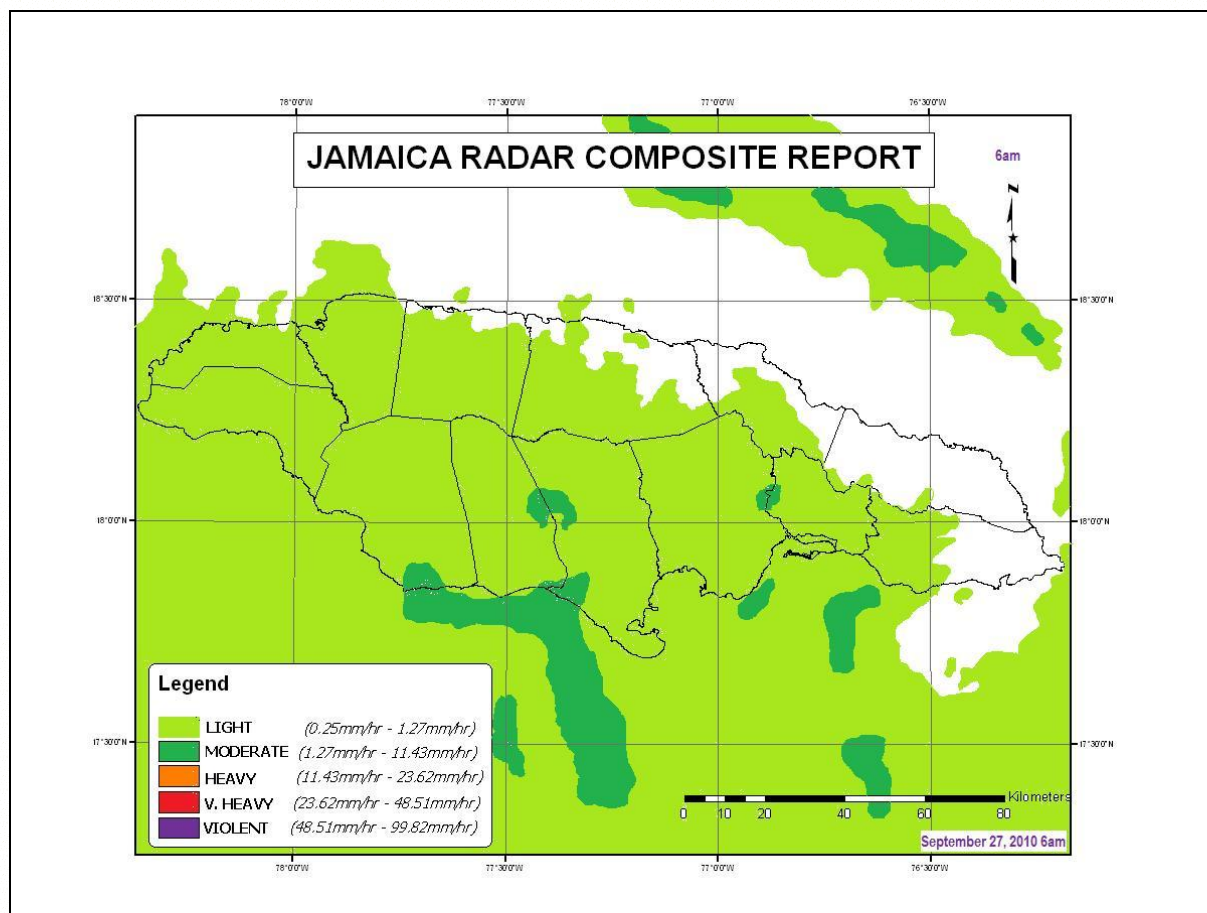
RADAR SUMMARY

DATE : September 26, 2010

PERIOD : 4pm – 9pm

During the period scattered light to moderate showers affected mainly coastal and interior areas of Southern and N-central parishes as well as offshore areas of both N and S coasts.

CURRENTLY: At 2110 scattered light to moderate showers Western half of Hanover and Westmoreland and offshore areas of both N and S coasts.



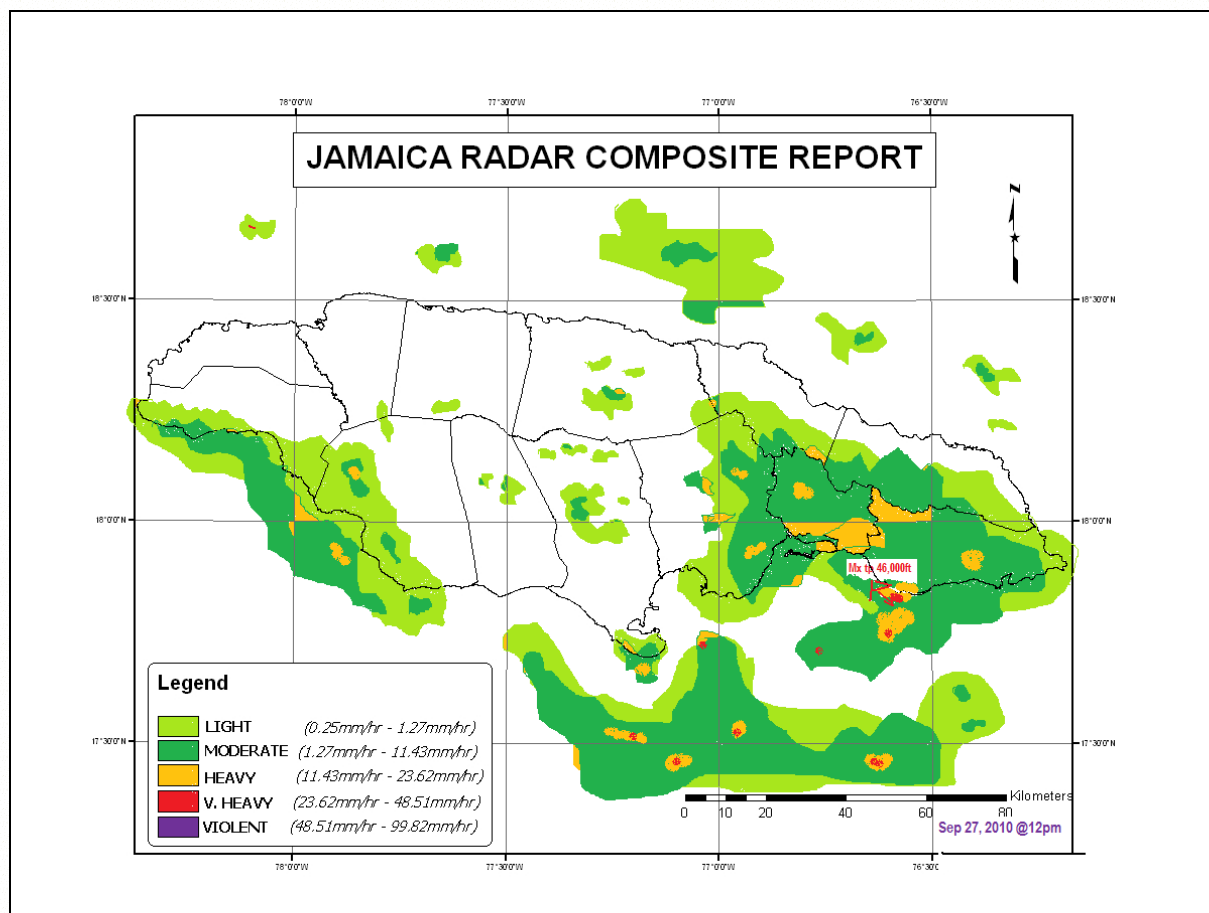
RADAR SUMMARY

DATE : September 27, 2010

PERIOD : 9pm - 6am

Throughout the period an area of light to moderate showers moved NE'wards affecting gradually Western, Central and parts of some Eastern parishes.

CURRENTLY: At 6:10am scattered light to moderate showers most of St. Andrew extending into Southern St. Mary, Eastern St. Catherine and parts of Palisadoes. Light showers Morant Point, St. Thomas and widely scattered offshore the N and S coasts.



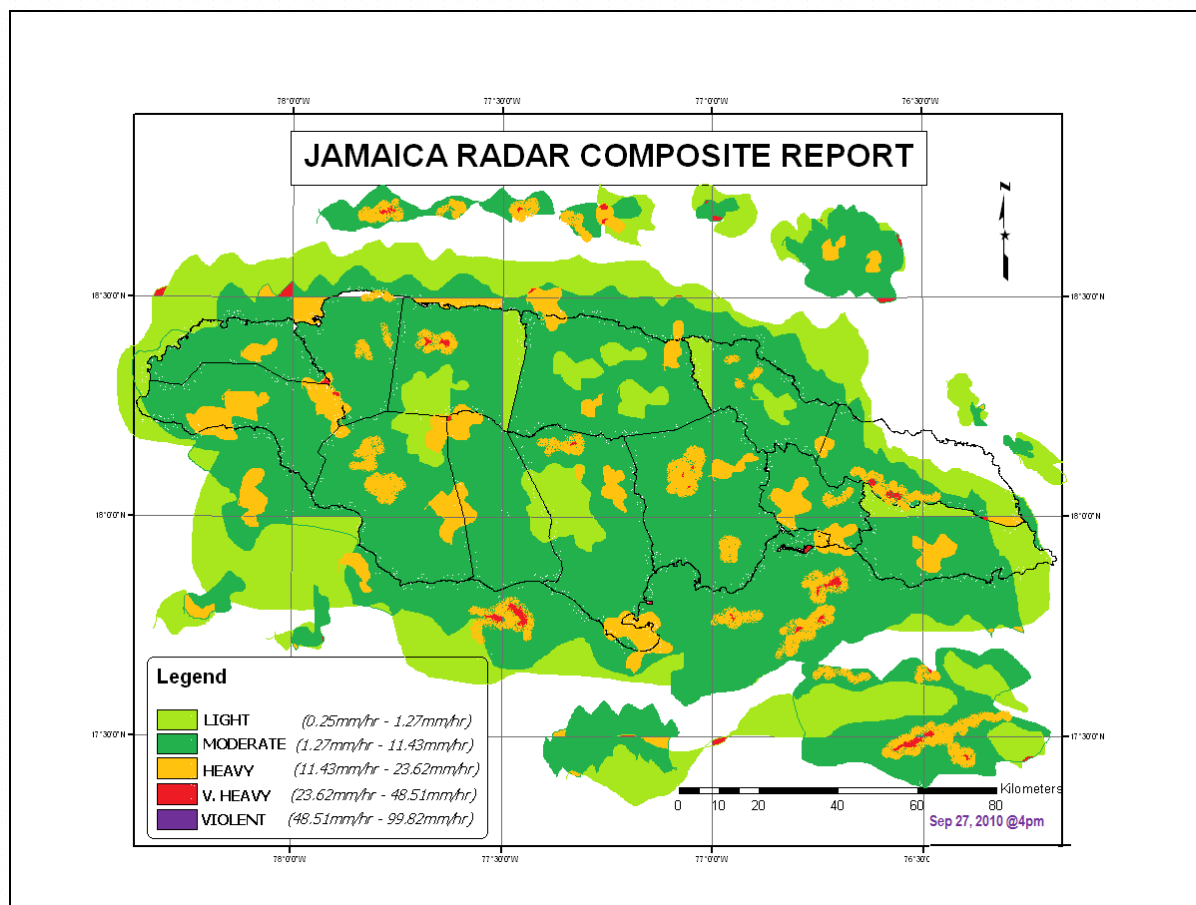
RADAR SUMMARY

DATE : September 27, 2010

PERIOD : 6am – 12pm

DURING THE AM:

Scattered light to moderate and occasional heavy to very heavy showers and thundershowers affected coastal and most areas of Eastern parishes, coastal and interior sections of Southern parishes, interior sections of some Northern parishes and coastal and Southern sections of some Western parishes. Scattered light to moderate and heavy thundershowers offshore North and South coasts.



RADAR SUMMARY

DATE : September 27, 2010

PERIOD : 12pm – 4pm

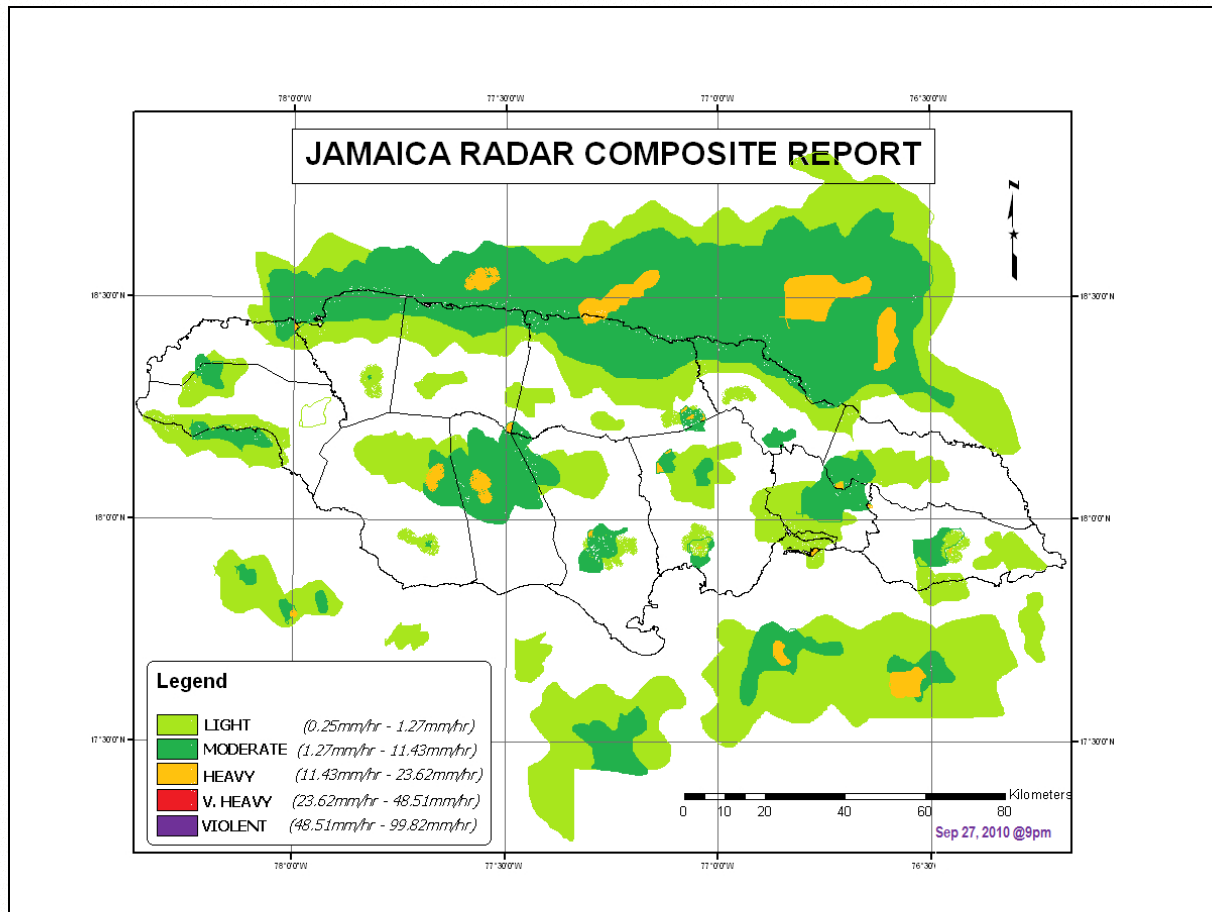
DURING THE PM:

Widely Scattered light to moderate showers were detected over most areas of all parishes with occasional heavy to very heavy showers over some parishes as well. Scattered light to moderate and heavy showers and thundershowers offshore N and S coasts.

CURRENTLY:

At 4:10pm scattered light to mod showers over most areas of most parishes with heavy to most heavy showers offshore N and S coasts.

MAX TOPS: Mx top 46,000ft 49.6km/110° from RDR S/Central St. Thomas.



RADAR SUMMARY

DATE : September 27, 2010

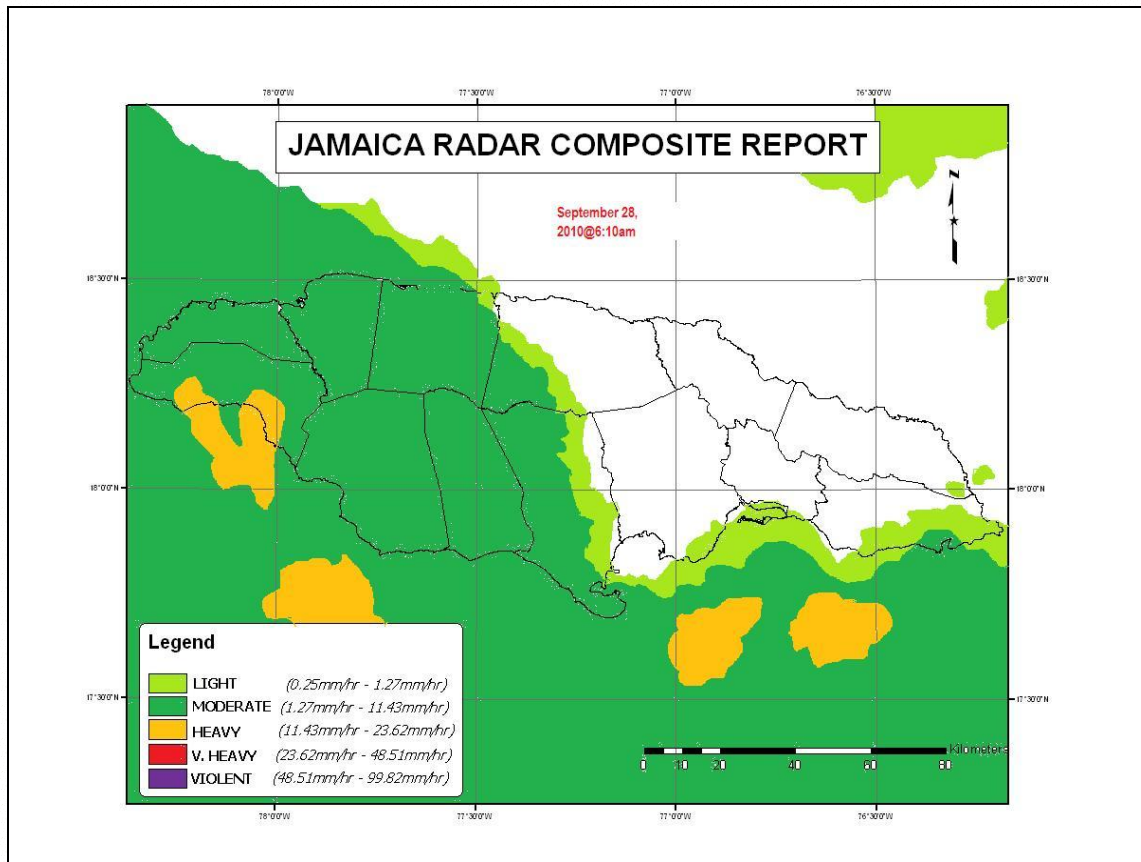
PERIOD : 4:00pm – 9:00pm

During the period:

Widely Scattered light/moderate and occasional heavy showers affected coastal and interior sections of most parishes. Scattered light to moderate and heavy to very heavy showers offshore N and S coasts.

CURRENTLY:

At 9:00pm No sig echoes over the island; Scattered light/moderate showers offshore N and SE coasts.



RADAR SUMMARY

DATE : September 28, 2010

PERIOD : 9pm - 6am

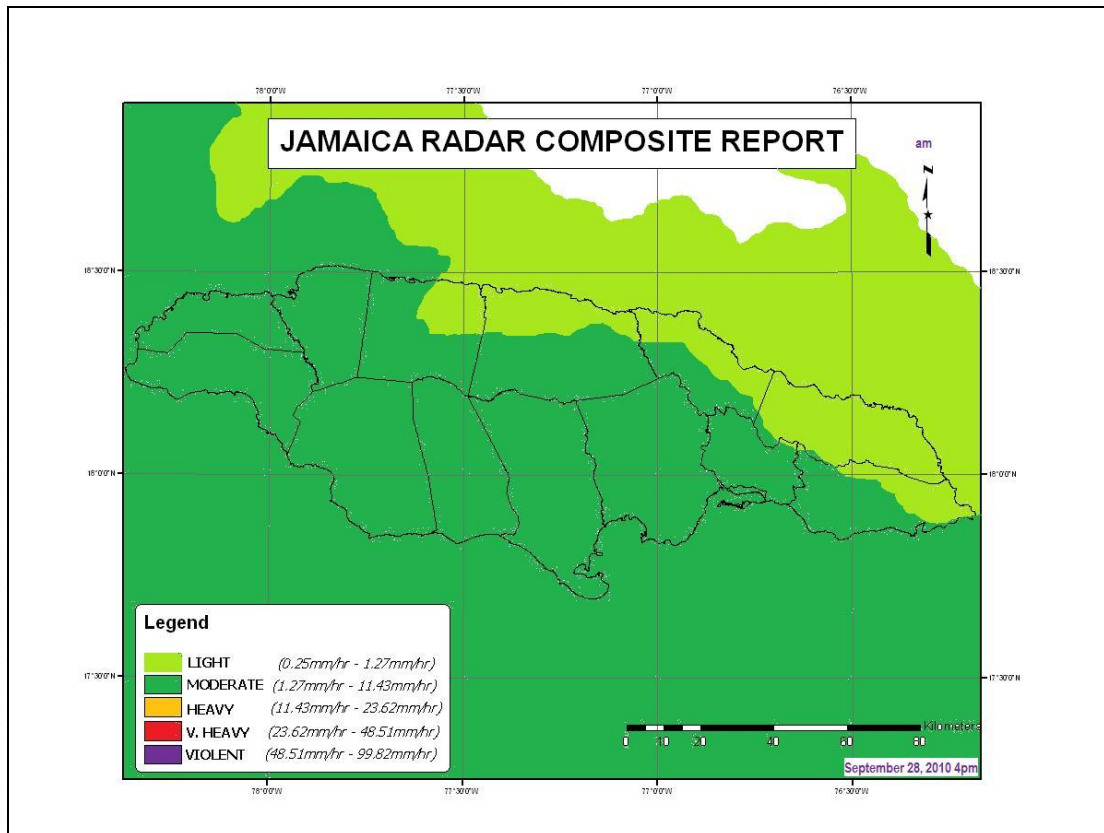
During the period:

Scattered light to moderate and heavy showers and thundershowers affected all areas in the County of Cornwall also all of Manchester, most of Clarendon W and S sections of St. Ann and mainly S sections of other parishes on the S coast.

CURRENTLY:

At 6:10am Scattered light/moderate showers most areas in the County of Cornwall also most of Manchester and Clarendon. Scattered light/moderate and isolated heavy showers and thundershowers off the N and S coast.

Max Tops: Tops over 50,000ft off the S coast.



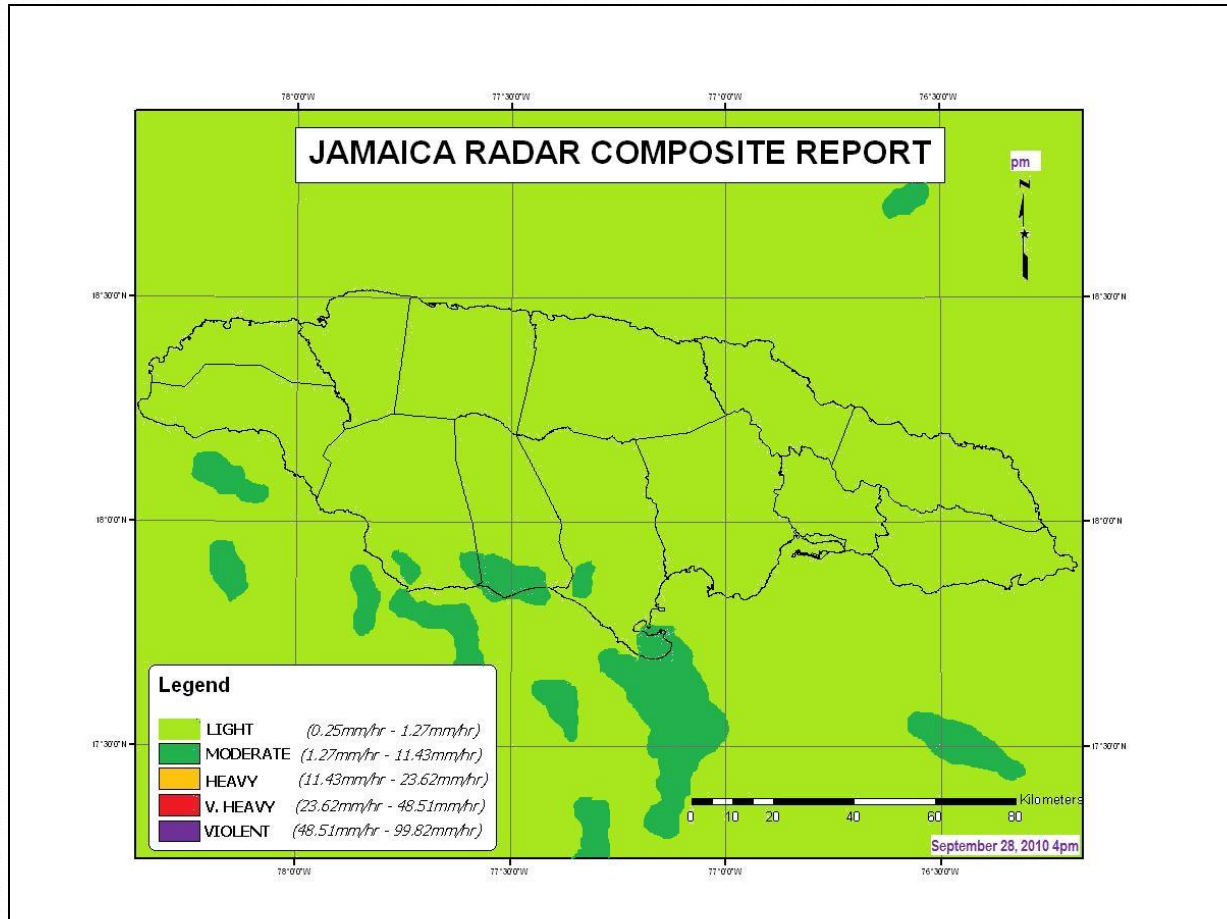
RADAR SUMMARY

DATE : September 28, 2010

PERIOD : 6am – 12pm

DURING AM:

Light to moderate showers affected all parishes and offshore areas NW, W and S of the island.



RADAR SUMMARY

DATE : September 28, 2010

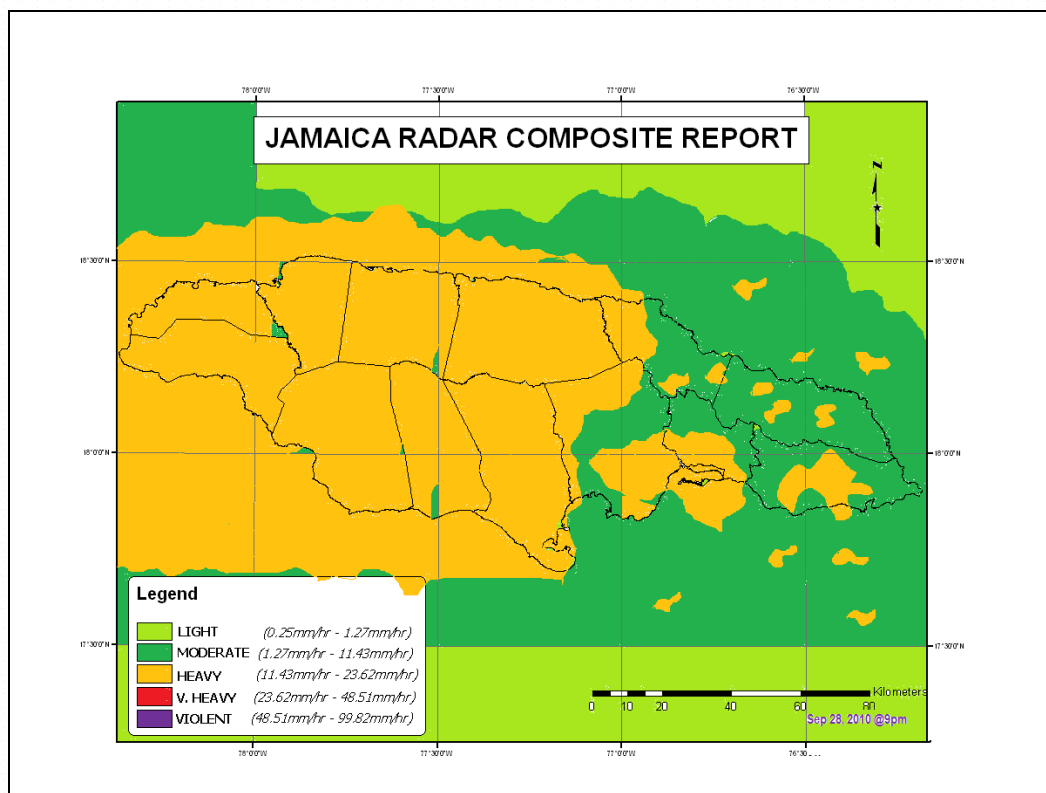
PERIOD : 12pm – 4pm

DURING PM:

Light to moderate showers continued to affect all parishes as well as offshore areas of the island's coasts.

CURRENTLY:

At 4:10pm scattered light to moderate showers most areas of Western and central parishes and Eastern coastal areas of Portland as well as offshore areas of the N and S coasts.



RADAR SUMMARY

DATE : September 28, 2010

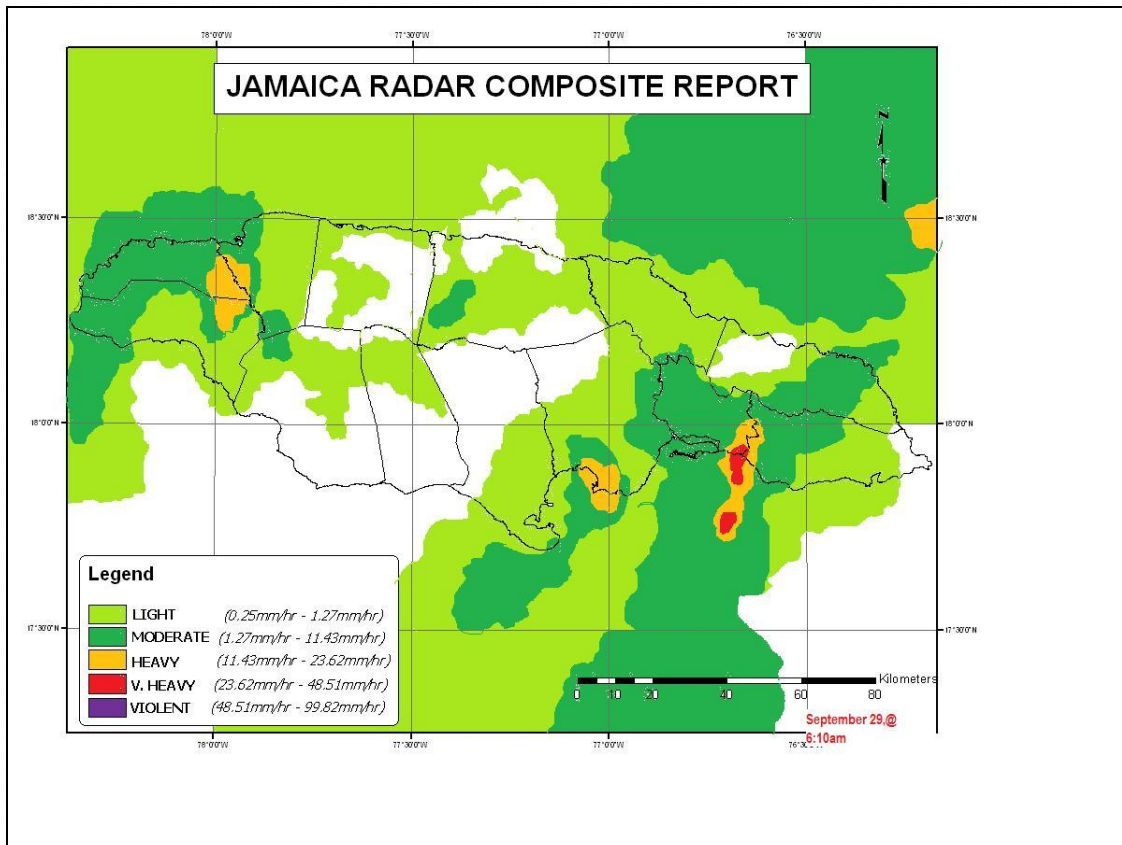
PERIOD : 4:00pm – 9:00pm

During the period:

Broad area of light/moderate and heavy to very heavy showers and thundershowers affected all parishes. Scattered light to moderate and heavy to very heavy showers offshore N and S coasts.

CURRENTLY:

At 9:00pm scattered light/moderate and occasional heavy to very showers over most parishes as well as offshore N and S coasts.



RADAR SUMMARY

DATE : September 29, 2010

PERIOD : 6:00am and 1:00pm– 2:00pm

DURING AM:

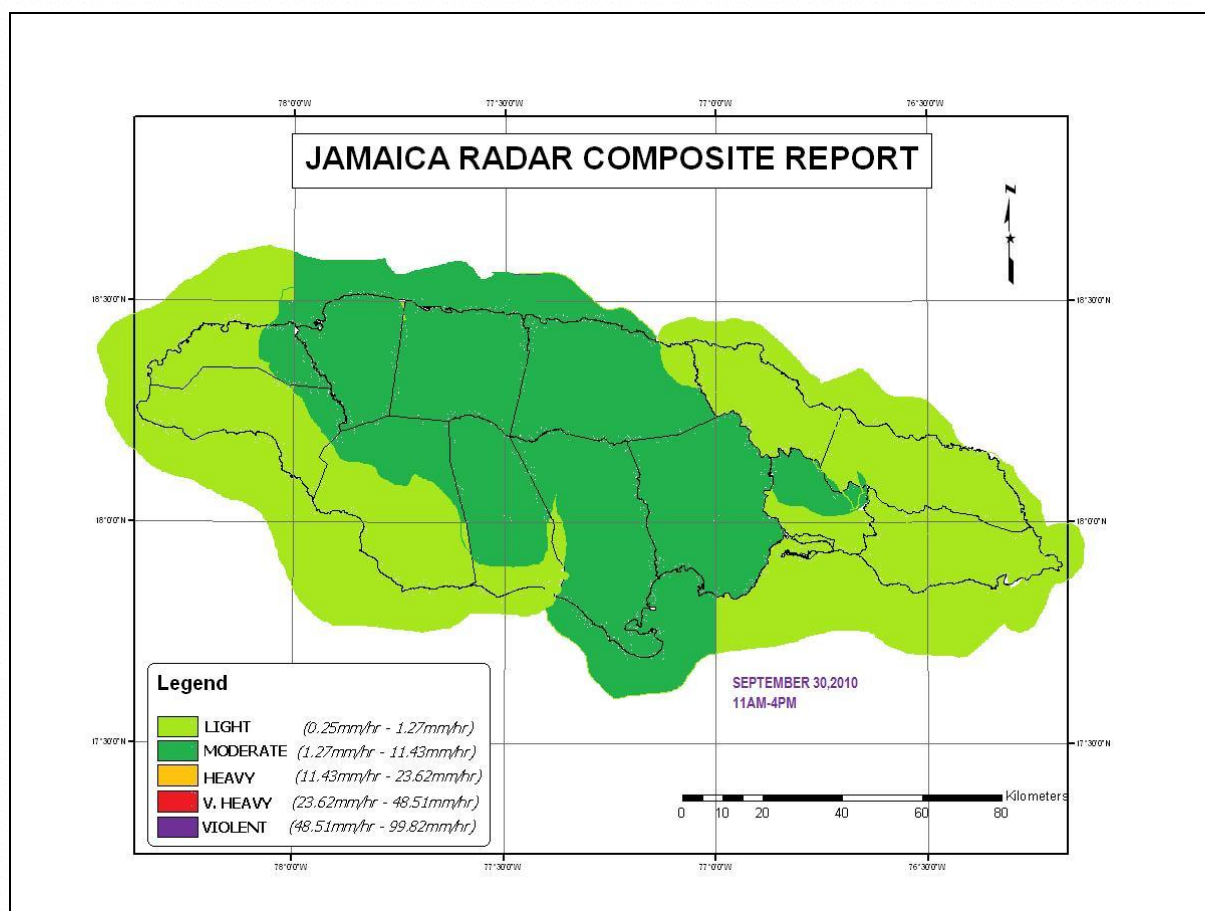
RADAR was unserviceable for most of the period however the 6:10am composite shows scattered light/moderate and some heavy/v/heavy showers and Thunderstorms over part of all parishes.

DURING PM:

RADAR was unserviceable for most of the afternoon. Scattered light/moderate and some heavy showers and Thunderstorms affected parts of all parishes between 1:00pm and 2:00pm.

CURRENTLY: **RADAR unserviceable.**

MAXIMUM TOP: 60,000Ft near Three Roads Westmoreland.



RADAR SUMMARY

DATE : September 30, 2010

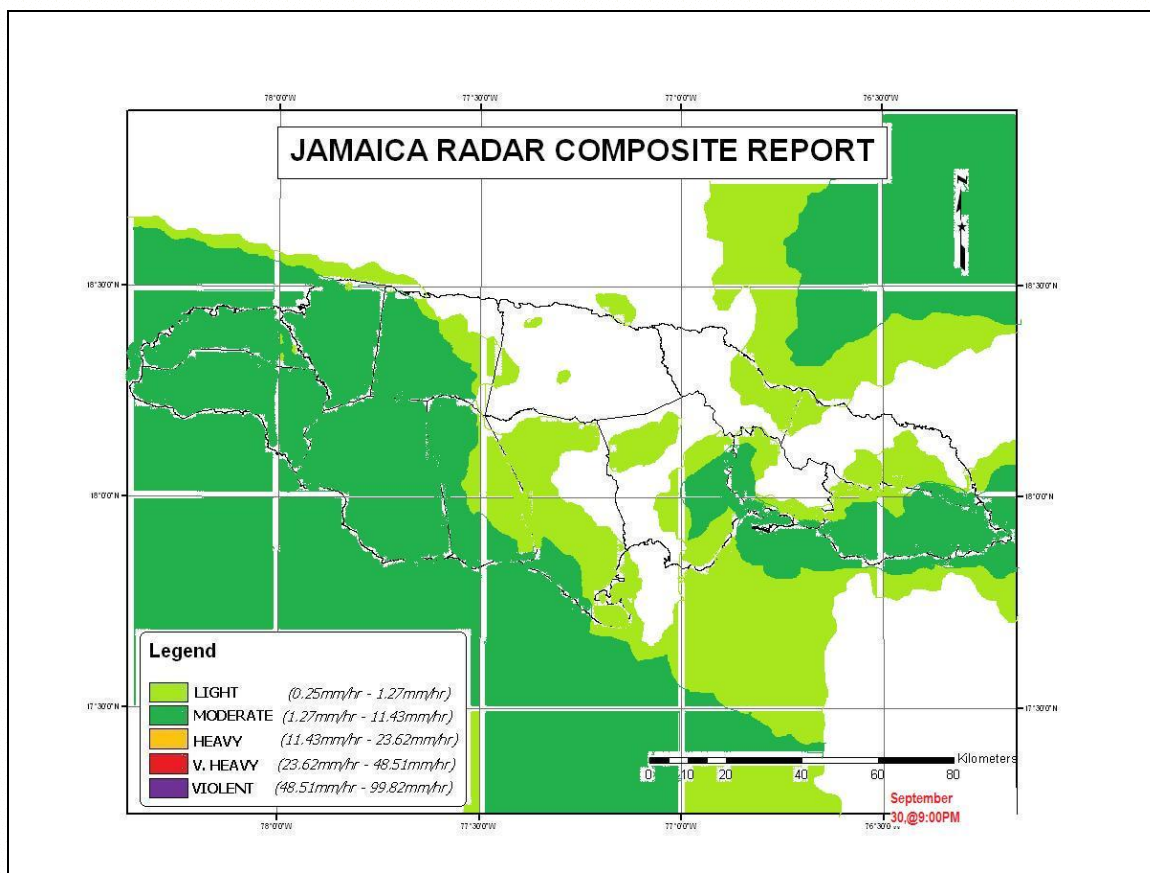
PERIOD : 11am – 4pm

DURING THE AM: Radar serviceable at 11:00am

DURING THE PM: Widely Scattered moderate to heavy showers were detected over most areas of all parishes with occasional heavy to very heavy showers over mostly central parishes. Scattered light to moderate offshore N and S coasts.

CURRENTLY: 4:00pm Scattered light to moderate showers affecting all areas of eastern and central parishes also all of Westmoreland and Hanover

MAX TOPS: 35,000ft over N Clarendon.



RADAR SUMMARY

DATE : September 30, 2010

PERIOD : 4pm – 9pm

During the period scattered light to moderate showers and Thunderstorms affected all areas in the County of Cornwall also most of Manchester, Clarendon, The Corporate Area, St. Catherine and St. Thomas also E Portland and N St. Mary.

CURRENTLY:

At 9:10pm Scattered light/moderate showers S St. James W&S Trelawny parts of E Hanover E Westmoreland all of St. Elizabeth most of Manchester and C&W Clarendon. Scattered light to moderate showers offshore the N & S coast.

APPENDIX B

Parish Rainfall Summary for September 2010							
(Rainfall in mm)							
Parishes	KEY	SEP	SEP	SEP	% OF 30 YR NORMAL		
		2010	2009	30 YR NORMAL (1971-2000)	2010 JUL	2010 AUG	2010 SEP
Hanover	HAN	472	212	292	95	98	162
Westmoreland	WES	742	261	254	87	91	292
Manchester	MAN	764	191	203	149	86	376
St. Elizabeth	STE	538	186	229	109	104	235
Clarendon	CLA	632	50	171	301	38	369
St. Catherine	STC	561	150	172	175	126	326
Trelawny	TRE	435	162	137	192	174	317
St. James	STJ	345	171	222	204	202	155
St. Ann	STA	468	138	103	253	165	453
St. Mary	STM	479	72	141	228	61	339
Portland	POR	415	141	243	199	69	171
St. Thomas	STT	567	120	255	181	98	222
Kgn. & St. And.	KSA	725	231	206	307	157	352
Jamaica	JAM	549	160	202	166	108	272

Table 1: Parish Rainfall Summary for September 2010 (Rainfall in mm)

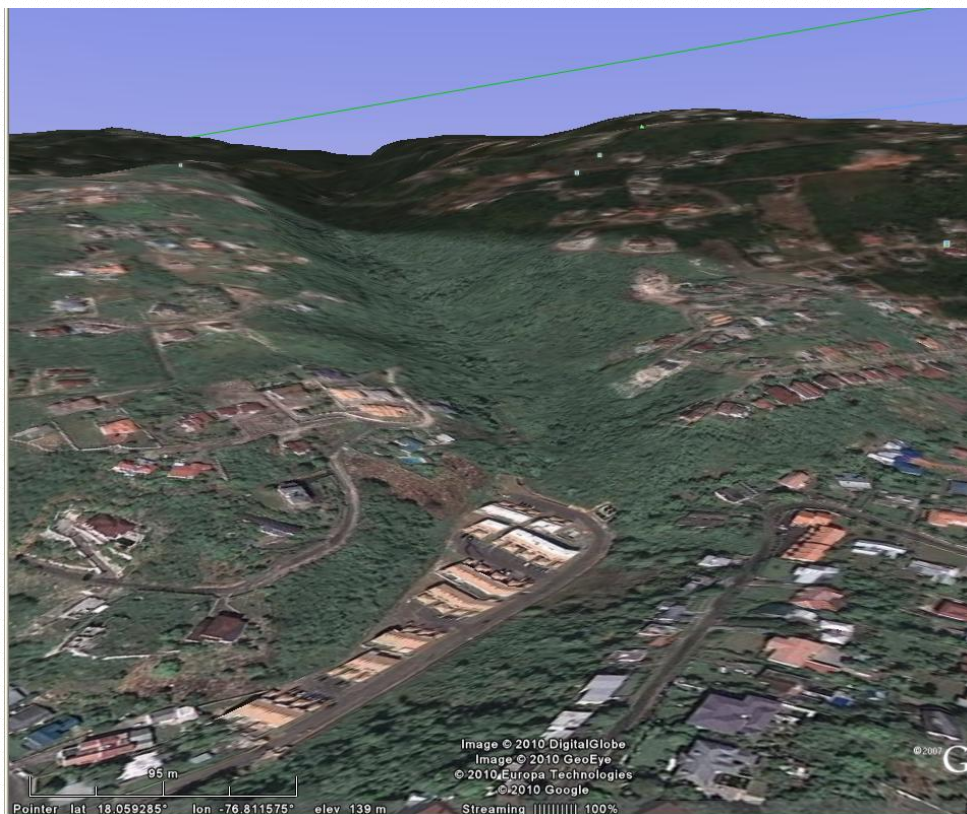
Source: Meteorological Service Jamaica – Climate Branch

APPENDIX 3

Depression in New Market filled with water



Location of development in valley



Flooded Roadway



Houses constructed along the bank of a gully



Blocked drain

