

FLOODING AT NEW RIVER, ST. ELIZABETH

AS A RESULT OF HURRICANE DENNIS AND EMILY

1. INTRODUCTION

Heavy rainfall associated with Hurricane Dennis on July 7, 2005 and Hurricane Emily on July 16, 2005 caused widespread flooding in several parishes across the island.

The impact of Hurricane Dennis was mostly felt throughout the southern and northeastern sections of the island with the parishes of Kingston and St. Andrew, St. Thomas, Portland, St. Mary and St. Catherine being the most severely affected. Damage to the road network and bridges, infrastructure and the agricultural sector was significant with an estimated \$1.1 billion dollars done to roads and infrastructure and \$0.9 billion dollars accounting for destruction of crops and other areas in which the impact of Dennis was felt (Source: The Daily Gleaner, Tuesday July 19, 2005).

Hurricane Emily passed south of Jamaica on Saturday, July 16, 2005. The hurricane's eye was closest to the island at 4 p.m. when it was 140-150 km (90-110 miles) southwest of Luana Point in South Western St. Elizabeth with highest sustained winds of 250 km per hour, making it a strong Category 4 Hurricane. Emily moved towards the west-northwest at 30 km per hour dumping heavy rainfall in south Manchester and St. Elizabeth and caused severe flooding in several communities including New River, New Forest in St. Elizabeth and Moneague in St. Ann. The five lives that were lost at Myresville in St. Elizabeth was attributed to heavy rainfall associated with Hurricane Emily.

2. NEW RIVER FLOODING **July 9-August 2, 2005**

The New River Community also known as Carmel is located approximately 2 kilometers north of Santa Cruz in the Black River Upper Morass, St. Elizabeth. The community has a long history of flooding dated back to 1933.

Between 1933 and 1996 there were 9 reported events averaging one event every 6 years (New River Citizens Association). For the period 2002 to 2005, 7 flooding events have occurred at an average one flooding event every 5 months. (Table 1).

3. HYDROLOGICAL SETTING

The Upper Morass is a low wetland area surrounded by terrain underlain by a karstic white limestone formation. There are numerous major and minor faults in the area and the surface materials are mostly clayey alluvium and peat on limestone.

The Black River Upper Morass is fed by several rivers and by surface runoff from the Don Figuerero, the Nassau and the Santa Cruz Mountains. In addition there are several blue holes within the Upper Morass contributing to substantial groundwater inflow in the area (Figure 1).

4. CAUSES OF FLOODING

The main cause of flooding in New River is that the Community is located in a wetland that naturally drains surface and subsurface flows from Nassau, Don Figuerero and Santa Cruz Mountains and any major rainfall event will result in high volumes of inflows into the Upper Morass which has its only outlet via the Black River. When the Black River maintains a high flood stage for an extended period, the outflow from the Upper Morass is restricted resulting in ponding around the New River Community and resultant inundation of roads and houses.

The impact of flooding has been increased since the flood control and drainage facilities which include large pumping stations installed along a Dyke near the confluence of the Grass River and New River to the Black River were taken out of operation in 1980's.

The Dyke, approximately 5 km long, separates the Black river from the wetlands of the Upper Morass and only allows outflow to the Black River through 16-one meter diameter pipes near the grass river and 4-one meter diameter pipes near the New River confluence. When these outlet points are blocked, the outflow from the Upper Morass is severely hampered leading to ponding of water at New River.

The problem of flooding in the New River area is worsened by the fact that over 40 houses are constructed in the flooding plain and approximately 3 kilometers of roadway is inundated during flooding events.

5. CONCERNS OF NEW RIVER CITIZENS

The New River Citizen Association is concerned about the increasing frequency of flooding events in the community. Two Technical meetings were held in the community in November 2004 and January 2005 and a community meeting with technical representatives from Government agencies and Ministry of Environment officials was held on April 28, 2005. The meeting discussed the problems of flooding and made recommendations for reducing the impact in the community

The following are some concerns of the citizens and recommendation for solving the problem of flooding

1. The Black River and tributaries leading to the Black River should be cleaned and trees and logs removed.
2. All Drains should be rehabilitated.

3. The pipe beneath the three pumping stations should be removed so that water flow freely and non-return valves installed.
4. Water diverted from the Black River for use by Aquaculture to be returned directly to the river.
5. The Drain leading from Santa Cruz through the Community to the Little River should be completed.
6. The level of the Wanstead to New River road should be lifted.

6.0 WRA FLOOD INVESTIGATION

The Water Resources Authority have been monitoring the New River Flooding since June 2002 and have installed temporary staff gauges in the community to monitor the rate of rise and fall of the flood levels under different conditions. In addition, the WRA have measured outflows and inflows – completed a flood plain mapping for the Upper Morass and attend severe field trips to carry out investigations of the cause of flooding and the impact on the Lower Morass

The WRA observed that flooding occurs when there is heavy rainfall in the Santa Cruz, Nassau and Don Figuerora Mountains and when the Black River between Newton and Lacovia remains high and backs up the outflow from the Upper Morass. It is also observed that the outflow through the pipes at the malfunctioning pumping stations at the Grass and New River along the Dyke does not allow for quick outflow and consequently fast reduction in flood levels at New River when the flood levels are receding.

TABLE 1

NEW RIVER FLOODING HISTORY

Year	Month	Duration (days)	Rainfall Appleton	Black River Peak Flow At Newton	Remarks
1933	-	-	-	-	Flooding reported at Santa Cruz Fire Station 4 feet of water in road
1942	October	-	-	-	
1951					Hurricane Charlie
1973	October 15-17	-	254 mm (3 days)	117 m ³ /s	Black River Overflow into Upper Morass (No Dyke)
1979	June				
1986	June				
1987	April				
1988	September				Hurricane Gilbert
1991	May				
1996	October				
2002	June	29	130 mm		Rainfall occurred May 26, 2002 = 130 mm
2002	October	28	373 mm		Rainfall occurred on Sept 29, 2002. T. Storm Lili
2003	May	31			
2003	October	20	282 mm	86 m ³ /s	
2004	September	70			Hurricane Ivan
2005	July 7	5	282 mm		Hurricane Dennis
2005	July 15	16	91 mm		Hurricane Emily

Table 2 DURATION OF FLOODING EVENTS 2002-2005

Month/Year	Date	Durations	Peak level Above ground level	Mean Daily Rate of Rise/day	Mean Daily Rate of Fall/day
June 2002	27/6 - 26/7	29 days	4.5 feet	0.2 feet	0.16 feet
October 2002	26/10 – 24/11	28 days	4.5 feet	0.20 feet	0.16 feet
May 2003	10/5 - 11/6	31 days	4.0 feet	0.20 feet	0.12 feet
October 2003	16/10 – 5/11	20 days	4 .0 feet	0.22 feet	0.20 feet
September 2004	16/9 - 24/11	70 days	6.0 feet	0.18 feet	0.08 feet
May 2005	9/5 - 20/5	11 days	2.0 feet	0.50 feet	0.40 feet
July 2005	9/7-27/7	16 days	4.0 feet	0.12 feet	0.50 feet

The data collected by the Water Resources Authority show that on average there is extensive flooding in the New River area to a level of 4 feet around some houses and in the roadway leading from Santa Cruz to New River for a distance of approximately 3 kilometers. Thirty-nine houses are directly affected by minor flooding. Over 30 houses in the adjoining community of Harmony Lane near the Santa Cruz bypass was also severely affected by floodwater which drains from the Santa Cruz Mountains and is backed up by ponded water from New River.

Since the June 2002 floods the WRA has installed staff gauges near the funeral parlour on the New River main road and at the first house affected by flooding owned by Mr. Carlos Townsend. The gauges are monitored during the flood events and daily gauge reading have shown that there is an average of 0.20' daily rise and 0.16' daily fall in flood levels when the dyke is not breached.

Based on complaints by the residents and recommendation from the WRA, the National Irrigation Commission, the Agency responsible for drainage of the Upper Morass have opened the Dyke at 2 locations after the October 16, 2003 flooding to allow for increased outflow and consequently a reduction in number of days the community is flooded.

6.1 UPPER BLACK RIVER MORASS – INFLOWS AND OUTFLOWS

The WRA visited the Upper and Lower Morass during the flooding event of May 17, 2005. The purpose of this visit was to

- a. determine the inflows into the Upper Morass from major tributaries and abstraction from the Black River for Aquaculture.
- b. To determine the outflows of the Upper Morass through man made breaches in the dyke
- c. To determine the impacts of sudden release of ponded water from the Upper Morass on the Lower Morass with particular attention to housing.

6.11 OUTFLOWS AT 16 PUMP STATION

The normal outflow through the existing orifices at the 16 pump station has been determined by the WRA based on the HEC HMS Model and is $14 \text{ m}^3/\text{s}$. The National Irrigation Commission (NIC) has cut an opening 12.2 meters wide and 2.1 meters deep at the northern side of the 16 pump station to allow for increased outflow from the Upper Morass to the Black River. A flow of $44.3 \text{ m}^3/\text{s}$ was measured through the opening on May 17, 2005, making the total outflow through the 16 pump station location $58.3 \text{ m}^3/\text{s}$ on May 17, 2005.

The WRA Staff Gauge reader at New River reported that the Flood level at New River had fallen 0.2 meters (0.80 feet) within 24 hours of the opening of the dyke.

6.12 OUTFLOW SOUTH OF 16 PUMP STATION

An opening in the dyke approximately 50 meters south of the 16 pump station with a dimension of 3 meters wide, 0.45 meter deep had a measured outflow of 1.35 m³/s.

A 2 meter culvert 200 meters north of the 4 pump station was estimated to discharge 1.3 m³/s.

There was no visible outflow from the 4 x 1 meter orifice pipes at the 4 pump station due to back water from the Black River but the broken non return valves were repaired and seemed to be working efficiently.

Table 3 below shows the total water balance of the Upper Morass on May 17, 2005 flood event.

TABLE 3

STATION	INFLOW m³/sec	INFLOW m³/sec	REMARKS
Mt. de las Uvas River	4.58	-	Peakflow on May 9 estimate at 7.5 m ³ /s based on gauge height
Braes River	1.58	-	
Foster River	0.71	-	
South Elim River	1.2	-	
North Elim River	1.47	-	
Aqua Culture	7	-	Diversion from Black River to Fish Farms
New River	0	-	Outflow backed up by Black River
16 Pump Outflow		58.3	Total flow from 16 x 1 meter orifices and cut through Dyke 12.2 x 2.1 m
South of 16 pumping opening		1.35	3 meter wide x 2.1 meter deep.
Culvert South of 16 pump		1.3	2 meter culvert
TOTAL	16.54	60.95	inflow do not include surface water runoff or discharge from spring and blue holes in upper morass.
Net Outflow		44.41	

The net inflow volumes of 16.54 m³/sec may have been underestimated due to the inability to measure discharge from surface runoff, inflow from unidentified springs in the upper Morass and groundwater contribution. The outflow may have been overestimated due to the blockage of the outflow at the 16 pump station.

6.13 CONSIDERATION OF LEAVING THE DYKE OPEN PERMANENTLY

If the dyke is left open at the 16 pump station for an extended period, inflows from the Don Figuerero and Nassau Mountains via the several rivers that flow through the Upper Morass and the Black River diversion inflow to Aquaculture will discharge freely into the Black River without causing ponding behind the dyke. During high flows into the Upper Morass as long as the head of the Black River is higher than the levels in the Upper Morass. This will cause flooding with higher levels in short term in the Upper Morass and New River community but the time period of inundation would be much shorter than a closed dyke scenario.

6.14 BLACK RIVER AT NEWTON HYDROGRAPH RECORDS

Records from the Water Resources Authority hydrometric station on the Black River at Newton have shown that during the 7 flooding events in the New River area May 2002-July 2005 peak flows of above 28 m³/s. and the flood levels of above 1.98 m (60 feet) at gauging stations were exceeded.

TABLE 4

DATE	DURATION OF LEVELS	PEAK GH	REMARKS
May 2002	May 26 – July 1 (37 days)	June 12 – 8.6 feet	Dyke closed – 29 days
October 2003	Sept 30-Oct 31 (31 days)	Oct 4 – 8.5 feet	Dyke closed Flooding – 28 days
May 2003	May 19-June 2 (14 days)	May 28 – 5.98 feet	Dyke closed Flooding 31 days
October 2003	Oct 1-Oct 31 (31 days)	Oct 31 – 7.06 feet	Flood – 20 days Dyke closed
Sept 2004	Sept 11 – Nov 1 (50 days)	Sept 15 – 10.85 feet	Flooding 70 days Dyke closed
May 2005	May 9-20 (11 days)	May 16 – 6 feet	Flooding 11 days Dyke opened
July 2005	July 9 – 27 (18 days)	July 8 – 11.36	Flooding Dyke opened 16 days

A relationship can be developed between the flooding events at New River and the Flood Levels at Newton. A Flood Gauge could be installed at the 16 pump station to

establish a critical flood level at this location and appropriate action taken by the NIC and the residents of the New River Community when this level is reached.

OBSERVATION OF FLOODING IMPACT ON THE LOWER BLACK RIVER MORASS

During the New River flooding event of May 2005 the New River Citizens association requested that the Dyke near the 16 pump station which was opened during the Hurricane Ivan Floods of September 2004, but closed after the flood be once again opened to allow the free flow of ponded water from the community. The Dyke was opened on May 11, 2005 and an addition flow of 44.3 m³/s (1564 cfs) was discharged in the Black River between Newton and Lacovia.

Observation of the impact of this outflow on the Lower Morass was made at the Water Resources Authority Hydrometric Gauging Station on the Black River at Lacovia.

The station hydrograph shows that from a gauge height of 2.92 m (9.64 feet) on May 11, the Black River rose to 3.58 m (11.82 feet) on May 17 and then began to recede. This represents a rise in the Black River at Lacovia of 0.66 m or 2.18) over a period of 6 days after which the river levels started to fall. This rise in river level had no noticeable impact in the lower morass. Please see table below.

BLACK RIVER AT LACOVIA GAUGE HEIGHT MAY 11-MAY 17, 2005

DATE	G.H.	Q CFS	DATE	G.H.	Q	DATE	G.H.	Q
May 11, 2005	9.64	1203	May 18	11.67	1895	May 25	10.60	1494
May 12	10.02	1325	May 19	1.45	1793	May 26	10.50	1465
May 13	10.07	1337	May 20	11.40	1770	May 27	10.27	1398
May 14	10.20	1378	May 21	11.27	1711	May 28	10.02	1325
May 15	10.45	1438	May 22	11.20	1680	May 29	9.75	1268
May 16	10.94	1583	May 23	11.00	1610	May 30	9.52	1219
May 17	11.82	1961	May 24	10.76	1536	May 31	9.27	1169

MEASURED FLOWS O BLACK RIVER DIVERSION CANAL AQUACULTURE

A series of discharge measurements were done on July 5 2005 at the Aquaculture diversion canal from the Black River to verify the total abstraction from the Black River by Aquaculture and the volume of water returned to the Upper Morass via the Grass River.

The results of the measurements show that the maximum inflow to Aquaculture via the canal when all the diversion gates are opened is 6.51 m³/sec or 230 feet³/sec and the outflows from the property is 6.54 m³/sec or 231 feet³/sec. It was observed that whether there is flow from the Aquaculture Property to the Grass River or not, the only significant factor that contributes to flooding in New River when the Dyke is opened is level of the Black River. The Aquaculture flow will only impact negatively on flooding if the Dyke is closed.

CONCLUSION

1. Flooding of the New River Community is likely to be reduced if the present opening in the Dyke remains in place.
2. Surface runoff from the Santa Cruz Mountain contribute significantly to flooding in New River.
3. There is no estimate of flows from Groundwater and spring sources during the flooding.
4. The flooding in the New River Community as long as the elevation of the water surface in the Black River is higher than that in the Upper Morass.
5. The Health Issue is a cause for concern when the New River Community Floods.
6. New River will always be flooded under certain rainfall conditions regardless of interventions taken along the Dyke.

RECOMMENDATIONS

1. The presence of several spring in the Upper Morass needs to be investigated and mapped.
2. The WRA should monitor future flood events.
3. A Power Point presentation on New River with a graphical perspective and history of rainfall events and flooding should be made by the WRA to the New River Citizens Association.
4. The Parish Council should declare an immediate moratorium on building in the area until a “no building” zone is delineated by flood hazard mapping.