

**Pampanga River Basin Flood Forecasting & Warning Center
HMD, PAGASA
DOST Region 3 Compound, San Fernando, Pampanga
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PRFFWC Post-Flood Report 2009-01 (Rev. Nov. 30, 2009)

PAMPANGA RIVER BASIN Flood Events

- 1. Tropical Storm “Ondoy”, September 25 to 27, 2009**
 - 2. Typhoon “Pepeng, October 6 to 15, 2009**
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Summary

The months of September and October 2009 had been quite devastating to most parts of the country particularly the Luzon area as several tropical disturbances caused considerable damage to the area. Two of the most destructive tropical cyclones that hit the country during that period were Tropical Storm “Ondoy”, coming on the last week of September, and Typhoon “Pepeng” falling on the first until the second week of October.

“Ondoy” left a trail of destruction over Metro Manila with an unprecedented flooding, including the Southern Tagalog provinces and Bulacan area. “Pepeng” on the other hand, inundated almost one whole province, Pangasinan, including adjacent provinces and the exceptional almost simultaneous reservoir releases of all major dams in Luzon situated in 3 river basins.

“Pepeng’s” passed over northern Luzon can be seen in 2 parts. The first pass was not that all disastrous. However, its second pass over northern Luzon proved to be very devastating as unprecedented destruction to properties, with hundreds of lives loss, was accounted for that event.

Tropical Storm “Ondoy” (Ketsana) was the 5th weather disturbance to affect the basin of Pampanga River for the year 2009, following Tropical disturbances “Emong”, “Isang”, “Kiko”, and the Southwest Monsoon of September 2009. Typhoon “Pepeng” (Parma) was the 6th in that order.

The effect of “Ondoy” on the Pampanga River basin was concentrated more on the southern portions of the basin particularly the areas of Angat watershed and the Guagua river sub-basin area. “Pepeng” effects on the basin came at the upstream part of the basin. This situation is quite ideal for flood forecasting such that flood flows came from the upstream portions of the basin and traversed through the basin downwards towards the flood-prone delta area of the basin.

“Pepeng’s” flood event over the basin also came in on two episodes, from October 2 to 5 and October 8 to 16. The first episode caused just above alert level river flows, while the on the second, relatively much higher river levels above alert stages were attained.

The following report presents the hydrological situation of the Pampanga River basin and partly on the casualties and damages incurred during the passage of tropical disturbances “Ondoy” and “Pepeng”. It also focuses more on “Pepeng’s” second episode effects over the Pampanga River basin.

1.0 Hydrological Area Background – Pampanga River Basin (PRB)

The Pampanga River basin is the 4th largest basin in the country and covers an approximate aggregate area of 10,434 km² (which includes the allied basin of Guagua River)¹. The basin extends from the southern slopes of the Caraballo Mountains, the western slopes of the Sierra Madre range on basin's eastern side and the major portions of the Central Plain of Luzon. It encompasses several provinces in particular the provinces of Nueva Ecija, part of Bulacan, portion of Tarlac and Aurora, and almost the whole of Pampanga. The total length of the main Pampanga River is roughly about 260 kilometers.

The basin is drained through the Pampanga River and via the Labangan Channel into the Manila Bay. The principal tributaries are the Peñaranda, the Coronel-Santor Rivers coming from the eastern side of the basin and the Rio Chico River from the northwest side. The Angat River joins the Pampanga River at Calumpit, Bulacan via the Bagbag River. The Labangan channel, on the other hand, acts as a cut-off channel for the Angat River into Manila Bay. Somewhere between the middle and lower portion of the basin stands Mount Arayat, about 1,026 meters in elevation. Adjacent to Mount Arayat on its eastern side and on the left bank of the Pampanga River is the Candaba swamp, covering an area of more than 200 km² and absorbing most of the surface runoffs coming from the eastern sections of the basin (western slopes of the Sierra Madre mountain range) and the overflowing of the Pampanga River via the Cabiao floodway. This area is submerged during the rainy season but is relatively dry during summer. At the lower sections of the basin, where the Pampanga delta lies, the Pampanga River system divide into several branches, crisscrossed with fishponds to form a network of sluggish, tidal flats and canals, which eventually find their way to Manila Bay. The main river has a relatively low-gradient channel particularly at the middle to its lower sections.

On the other hand, the Guagua River Sub-Basin is an allied system of rivers and creeks to the Pampanga River practically converging down with the latter close at the outlet into the Manila Bay. The basin drains an approximate area of 1,990 km². It is bounded on the north partly by the Agno River Basin and on the south by the Manila Bay, on the east by the Pampanga River Basin, where an earthdike (The Arayat-Apalit Setback levee) protecting the right bank of the Pampanga River separates them, and on the west by the Zambales mountain Range.

The major river systems draining the basin are the Pasig-Potrero, Porac-Gumain, Abacan and the Pasac-Guagua Rivers.

The basin is vulnerable to flooding primarily because of its relatively low elevation and flat terrain, its proximity to Manila Bay where tides impede the flow of rivers and creeks several kilometers upstream, and the narrow and silted waterways brought largely by the eventful Mount Pinatubo eruption (1991). Possible contributory cause is the reported slow sinking of the delta making the area quite vulnerable to flooding.

¹ Area of Pampanga River basin was taken from the NWRB-JICA Progress report on "The study on Integrated Water Resources Management for poverty alleviation and development in the Pampanga River Basin, August 2009"

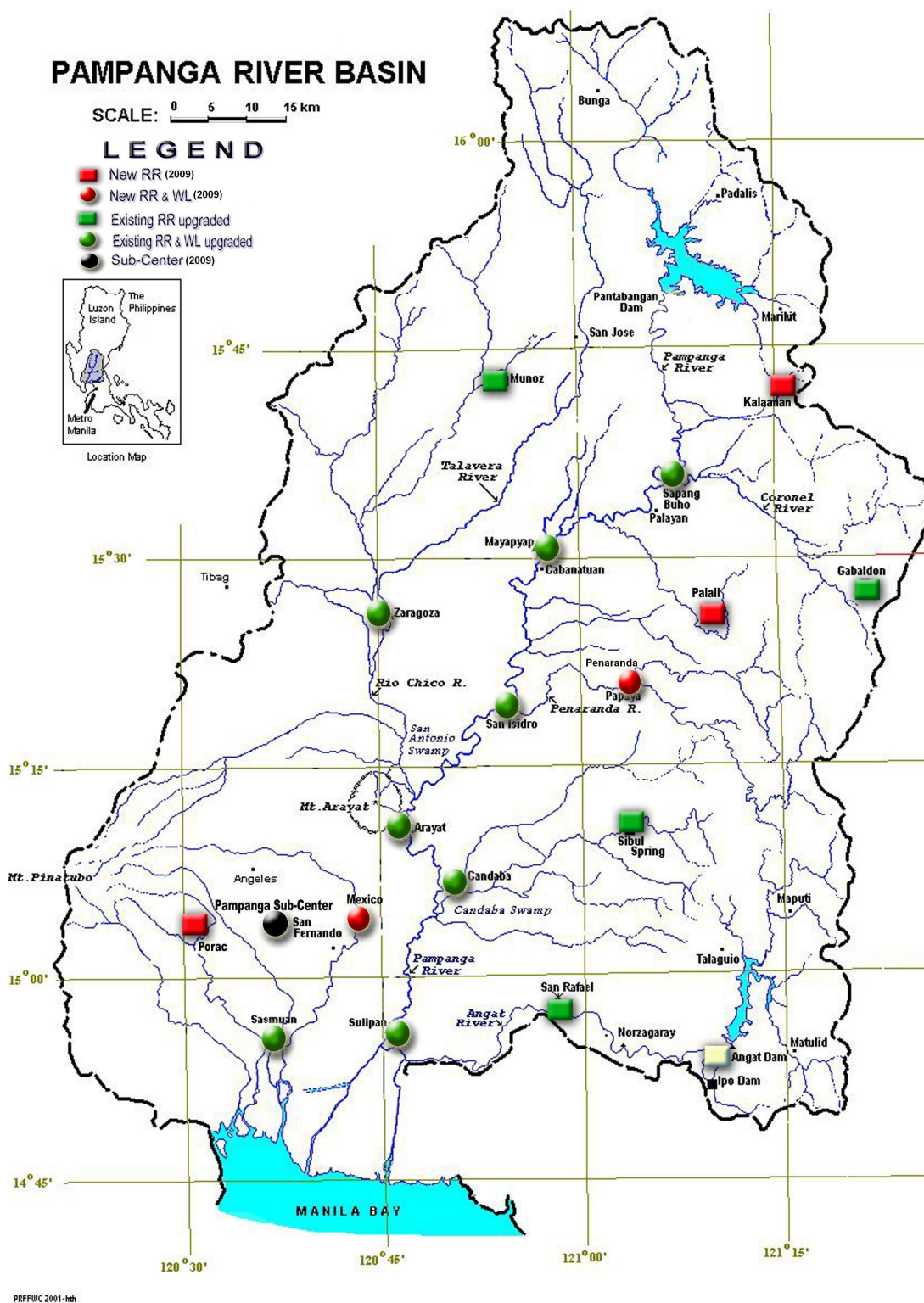


Figure 1.0 The Pampanga River Basin map showing locations of telemetered rainfall and water level stations

2.0 The Pampanga River Basin Flood Forecasting & Warning Center (PRFFWC)

The PRFFWC at present has a total of 17 telemetered rainfall (RR) stations and 9 telemetered water level (WL) stations (Figure 1.0). Within the basin system (Pampanga and Guagua) are 2 synoptic stations, in Clark (Angeles, Pampanga) and Cabanatuan (Nueva Ecija). An agrometeorological station also exists in Munoz (Nueva Ecija). A manually observed tipping bucket rain gage is presently installed and observed in the San Fernando Center.

Several manually observed tipping bucket rain gauges are also located in the province of Bulacan in connection with the Community-based Flood Mitigation and Management Program (CBFMMP) and the School Hydrological Information Network (SHINE), particularly in San Miguel, Calumpit and Pulilan municipalities for CBFMMP (within the basin). Likewise, there is also a standard non-recording rain gauge installed in the Municipality of Guagua, Pampanga. However, in consideration of the irregularity of observations from these stations, the data were totally not considered in the isohyetal analyses of this report.

Table 1.0 Stations within the Pampanga River Basin System.

Station	Station Type	Coordinates
Munoz	Telemeterized RR	15°44'17"N, 120°57'38"E
Sapang Buho	Telemeterized RR & WL	15°35'39" N, 121°07'09"E
Calaanan	Telemeterized RR	15°38'53" N, 121°11'09"E
Mayapyap	Telemeterized RR & WL	15°30'52"N, 120°57'20"E
Gabaldon	Telemeterized RR	15°29'55" N, 121°21'20"E
Palali	Telemeterized RR	15°29'55" N, 121°21'20"E
Zaragoza	Telemeterized RR & WL	15°26'36"N, 120°45'03"E
Peñaranda	Telemeterized RR & WL	15°21'14"N, 121°00'20"E
San Isidro	Telemeterized RR & WL	15°18'49"N, 120°54'09"E
Sibul Spring	Telemeterized RR	15°10'05"N, 121°03'33"E
Arayat	Telemeterized RR & WL	15°10'06"N, 120°46'56"E
Candaba	Telemeterized RR & WL	15°06'56"N, 120°51'01"E
San Rafael	Telemeterized RR	14°58'05"N, 120°54'52"E
Sulipan	Telemeterized RR & WL	14°56'21"N, 120°45'39"E
Porac	Telemeterized RR	15°04'48"N, 120°32'43"E
Mexico	Telemeterized RR & WL	15°04'05"N, 120°43'51"E
Sasmuan	Telemeterized RR	14°56'11"N, 120°37'23"E
San Fernando	Flood Forecasting Center	15°04'04"N, 120°39'22"E
Clark	Synoptic	15°10'N, 120°34'E
Cabanatuan	Synoptic	15°44'N, 120°56'E
CLSU, Munoz	Agrometeorological	15°43'N, 120°54'E

Flood Event 1. TROPICAL STORM “ONDOY”

1.0 Meteorological Aspect

TS “ONDOY” (International codename: KETSANA, {0916})²

It developed inside the Philippine Area of Responsibility (PAR) from an active Low Pressure Area (LPA) east of Luzon and gradually moved westward towards Aurora-Quezon Area. Prior from its landfall “ONDOY” intensified into a Tropical Storm (TS) 130 km Northeast of Virac, Catanduanes. It continued moving more to the west and made landfall over the boundary of Aurora and Quezon provinces at approximately 11 AM of Sept. 26 then it crossed Central Luzon for almost 10 hours causing heavy downpour over the Metropolis and some parts of Central and Southern Luzon resulting to flashfloods and landslides over these areas. After crossing Central Luzon, it continued moving farther away as it intensified further over the South China Sea and exited the western border towards Vietnam.

Maximum winds observed: 50 knots (95 kph), Dagupan at 4pm, 26 September.

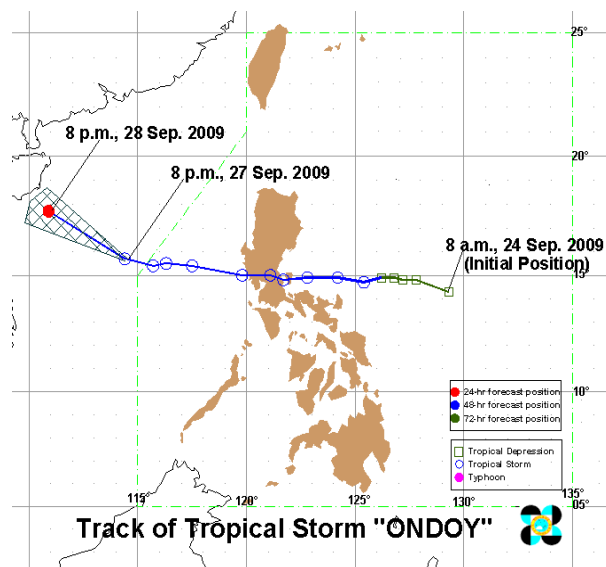
Lowest Mean Sea Level Pressure recorded (hPa): 985.3 at Iba, Zambales, 6pm, on 26 September.

Maximum 24-hr Rainfall (mm): 455 at Science Garden (98430), Quezon City, 26 September.

Public Storm Warning Signals issued:

PSWS # 2 was raised over Camarines Provinces, Burias Island, Catanduanes, Quezon including Polillio Islands, Aurora, Rizal, Bulacan, Nueva Ecija, Quirino, Aurora, Nueva Vizcaya, Pampanga, Tarlac, Zambales, Pangasinan, La Union.

PSWS # 1 was raised over Albay, Laguna, Cavite, Batangas, Isabela, Mt. Province, Ifugao, Ilocos Sur, Mindoro Provinces, including Lubang Island, Marinduque, Bataan, Metro Manila.



² (2009 Tropical Cyclone Summary by Weather Forecasting Section, Weather Division, PAGASA, DOST)

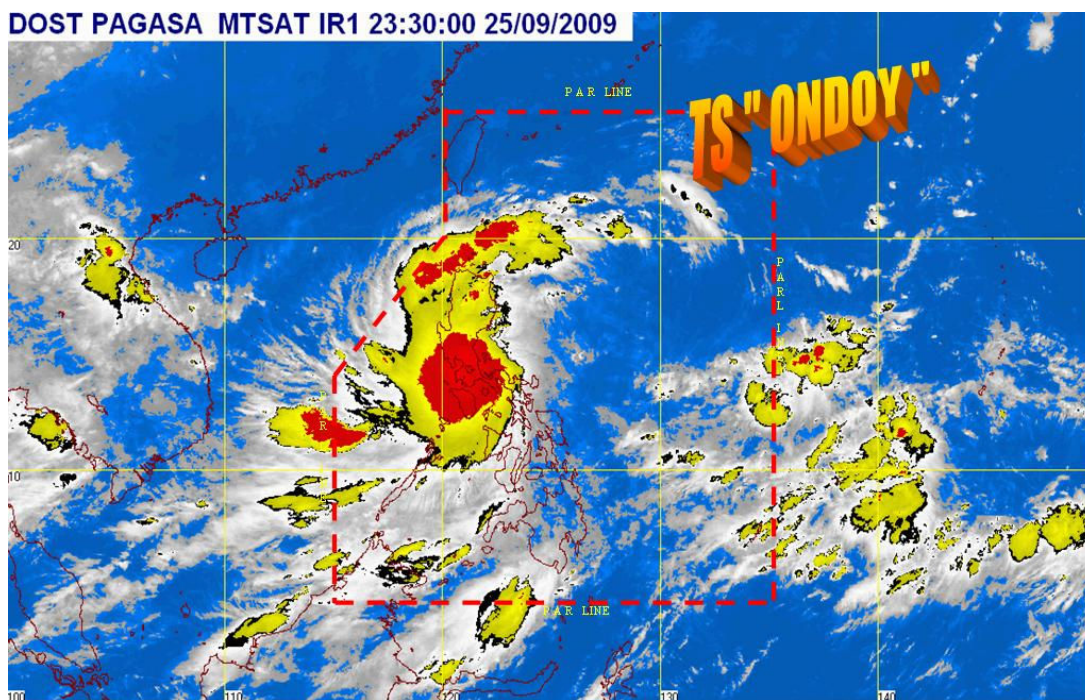


Figure 1-2.0 Satellite image of Tropical Storm “Ondoy” at 7:30am (LST), 26 September 2009

2.0 Basin Hydrological Aspect

2.1 Rainfall

Table 1-2.0 Rainfall Intensity Classification Table (mm)

Category	1 hour	3 hours	6 hours	12 hours	24 hours
Light	< 2.5	< 7.5	< 15	< 30	< 60
Moderate	2.5 – 7.5	7.5 – 22.5	15 – 45	30 - 90	60 – 180
Heavy	> 7.5	> 22.5	> 45	> 90	> 180

Rainfall data from all the telemetering stations and from several synoptic stations during the period September 25 to 27, 2009 were used to produce the 24-hour isohyets for each day during the said period (table 1-2.1)

Table 1-2.1 24-Hour (8 AM - 8 AM) Rainfall Totals in mm during Tropical Storm Ondoy - Pampanga River Basin (September 2009)

Stations	25th	26th	27th	Max 1-hr observed	Time/Date of observation
Muñoz	34.0	9.0	2.0	5.0	3am, 26 Sept
Sapang Buho	55.0	12.0	18.0	11.0	3am, 26 Sept
Calaanan	64.0	24.0	16.0	13.0	3am, 26 Sept
Mayapyap	35.0	7.0	1.0	11.0	3am, 26 Sept
Gabaldon	85.0	94.0	19.0	16.0	3am, 27 Sept
Palali	78.0	16.0	14.0	15.0	11pm, 25 Sept
Zaragoza	34.0	23.0	3.0	10.0	4pm, 26 Sept
Peñaranda	57.0	20.0	1.0	13.0	2am, 26 Sept
San Isidro	41.0	67.0	1.0	37.0	2pm, 26 Sept

Sibul Spring	113.0	61.0	2.0	46.0	2pm, 26 Sept
Arayat	26.0	93.0	6.0	19.0	3pm, 26 Sept
Candaba	61.0	77.0	3.0	28.0	2pm, 26 Sept
San Rafael	87.0	129.0	6.0	33.0	3pm, 26 Sept
Sulipan	33.0	115.0	9.0	36.0	4pm, 26 Sept
Cabanatuan	43.2	14.4	2.6		
Ave.Basin RR	56.41	50.76	6.91		
Accumulated Daily Basin Rainfall	56.41	107.17	114.08		

Guagua River Sub-Basin

Porac	26.0	172.0	38.0	41.0	4pm, 26 Sept
Mexico	34.0	126.0	14.0	25.0	4pm, 26 Sept
Sasmuan	27.0	150.0	22.0	43.0	4pm, 26 Sept
San Fernando	31.5	146.8	15.0	63.5 *	5pm, 26 Sept
Clark	21.5	109.0	25.4		
Ave.Basin RR	28.00	140.76	22.88		
Accumulated Daily Basin Rainfall	28.00	168.76	191.64		

* Based on a 2-hr period

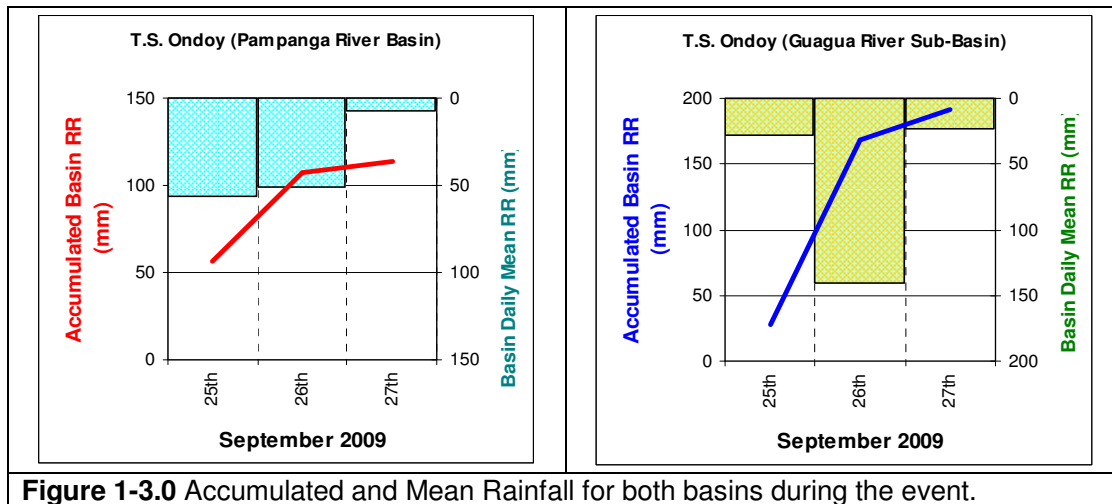


Figure 1-3.0 Accumulated and Mean Rainfall for both basins during the event.

Table 1-2.2 24-Hour (8 AM - 8 AM) Rainfall Totals in mm

Tropical Storm Ondoy (September 2009)

Auxiliary Stations within and around PRB

Stations	25th	26th	27th	Max 1-hr observed	Time/Date of observation
San Miguel	45.5	98.8	0.0	39.4	2pm, 26 Sept
Calumpit	8.6	48.0	37.6		
Pulilan	1.8	103.4	4.6	27.2	4pm, 26 Sept
Sta. Maria	1.8	116.1	0.0		
Parada, Sta. Maria	90.9	267.7	14.0		
Meycauayan	1.3	153.2	1.8	49.5	1pm, 26 Sept
Marilao	18.5	197.6	5.8	74.7	2pm, 26 Sept

SJDM (NHS)	130.5	29.7	0.0		
Kaybanban, SJDM	156.2	332.5	0.0	48.8	2pm, 26 Sept
Other Stations adjacent to Pampanga River Basin					
Baler Synop	33.0	21.5	30.0		
Iba Synop	28.2	103.8	39.8		
Subic Synop	50.4	127.7	55.4		
Dagupan Synop	17.8		5.0		
Baguio Synop	26.0	35.0	13.2		
Casiguran Synop	55.0	32.8	17.4		
Quezon City *	96.5	437.4	6.4	98.6	12nn, 26 Sept

Note : Rainfall values from auxiliary stations are observed at random using tipping bucket rain gauges by LGU personnel

Red colored numbers require validation * Independent rainfall observation station

Basin hyetograph and hydrographs for each station for the event are presented in Figures 1-4.0 & 1-5.0. Temporal patterns indicated in the accumulated basin rainfall curves (Figure 1-3.0) for the event shows that the most intense rainfall period for both Pampanga and Guagua River basins was on the 26th of September. However, maximum basin rainfall for the Pampanga river basin was on the 25th while Guagua river sub-basin was on the 26th. Based on available data, intense rainfall for both basins started late night of the 23rd of August. Maximum rainfall observed for most of the upstream stations was around 3am of the 26th, while for middle to downstream stations was between the period 11am to 4pm of the 26th.

Similarly, observations at several synoptic stations adjacent to the basin and several auxiliary stations (CBFMMP, Bulacan Province) showed maximum rainfall totals on the afternoon of September 26. Daily rainfall patterns during the event are as follows:

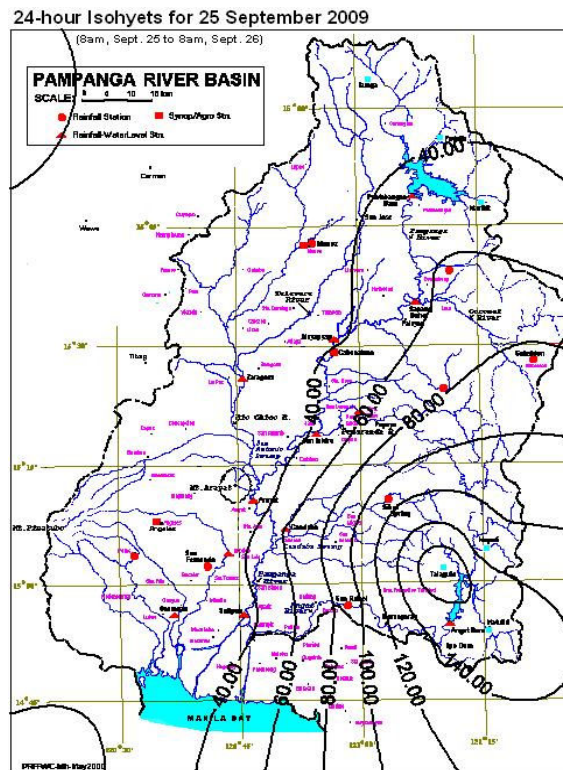


Figure 1-3.1 Sept. 25, 2009 Isohyets for PRB

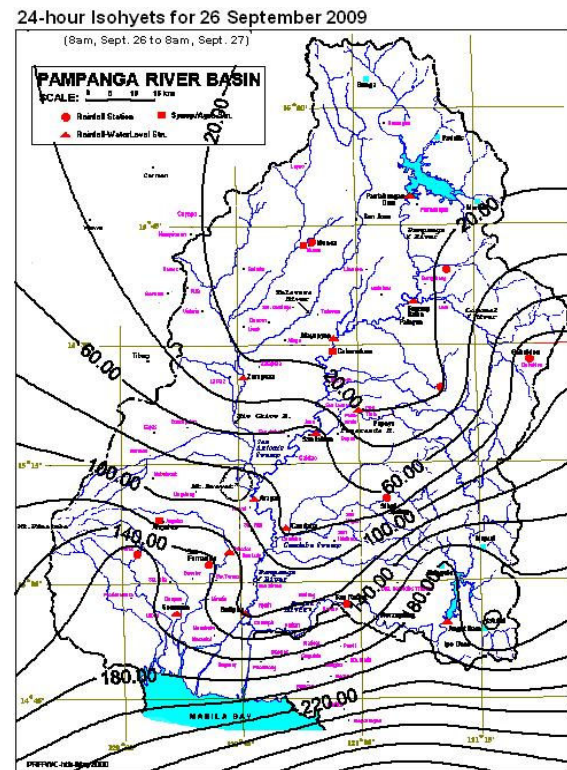


Figure 1-3.2 Sept. 26, 2009 Isohyets for PRB

Sept 25, 2009: Moderate rains on the southeastern parts of the basin were observed (figure 1-3.1) as T.S. Ondoy moved closer to the basin on the evening of 25th to early mornings of the 26th.

Sept 26, 2009: Occasionally moderate to heavy rains from the period between 10am to 4pm of the day were recorded at the lower portions of basin coinciding with the heavy rainfall intensity that was observed in Metro Manila on that same day (figure 1-3.2).

Sept 27, 2009: Generally light rains prevailed mostly over the basin with maximum distribution at the lower western portions of the basin

2.2 River Heights and Basin Situation during the Event

Table 1-3.0 Time/Date Station's Flood Assessment Gage Heights were reached

Station Point	(Pre-Alert Level) Time & Day attained	(Alert Level) Time & Day attained	Remarks
Sapang Buho	(3.7 m) not reached	(6.5 m) not reached	Peak WL based on telemetry reading was 3.38 m (53.592 m. AMSL) attained at about 1pm of 26 Sept.
Mayapyap	(3.0 m) not reached	(4.5 m) not reached	Peak WL recorded was at 1.72 m (27.417 m. AMSL) attained from 8pm to 10pm, 26 Sept.
Zaragoza	(1.0 m) already above this level prior to the event	(4.5 m) not reached	Peak WL recorded was at 3.93 (14.143 m. AMSL) attained at 2am of 28 Sept.
Peñaranda			Peak WL recorded was at 3.93 (estimated at 22.226 m. AMSL) attained at 7am of 26 Sept.
San Isidro	(3.2 m) attained before 10am, 26 Sept	(6.0 m) not reached	Recorded peak gage height of 3.89 m (13.475 m. AMSL) attained at about 11pm, 26 Sept.
Arayat	(5.0 m) already above this level prior to the event	(8.5m) not reached	Recorded peak gage height of 8.35 m (8.427 m. AMSL) attained at about 10am, 27 Sept.
Candaba	(3.0 m) already above this level prior to the event	(5.0 m) attained before 10am, 26 Sept	Recorded Peak of 6.40 m (6.243 m AMSL) attained at around 11pm, 27 Sept.
Sulipan	(3.6 m) not reached	(5.0 m) not reached	Peak gage height of 3.29 m (3.228 m AMSL) attained 3am, 27 Sept.
Mexico			Peak gage height of 2.81 m (estimated at 8.743 m AMSL) attained at about 2am, 27 Sept.
Sasmuan			Peak gage height of 3.03 m (estimated at 1.613 m AMSL) attained from 5-6am, 27 Sept.

Note: Elevation of "0" of staff gage at various stations was based on survey undertaken last August 2009.

Based on the preceding table, all WL stations, with the exception of Candaba, did not reached any of their respective established alert levels. There were no reported floods along the upstream and middle sections of the Pampanga River. However, there were floods reported over several municipalities of Bulacan province (within the Pampanga river basin) and for Pampanga province (mostly in Guagua river sub-basin). Table 1-9.0 shows a list of municipalities that were affected within the Pampanga river basin.

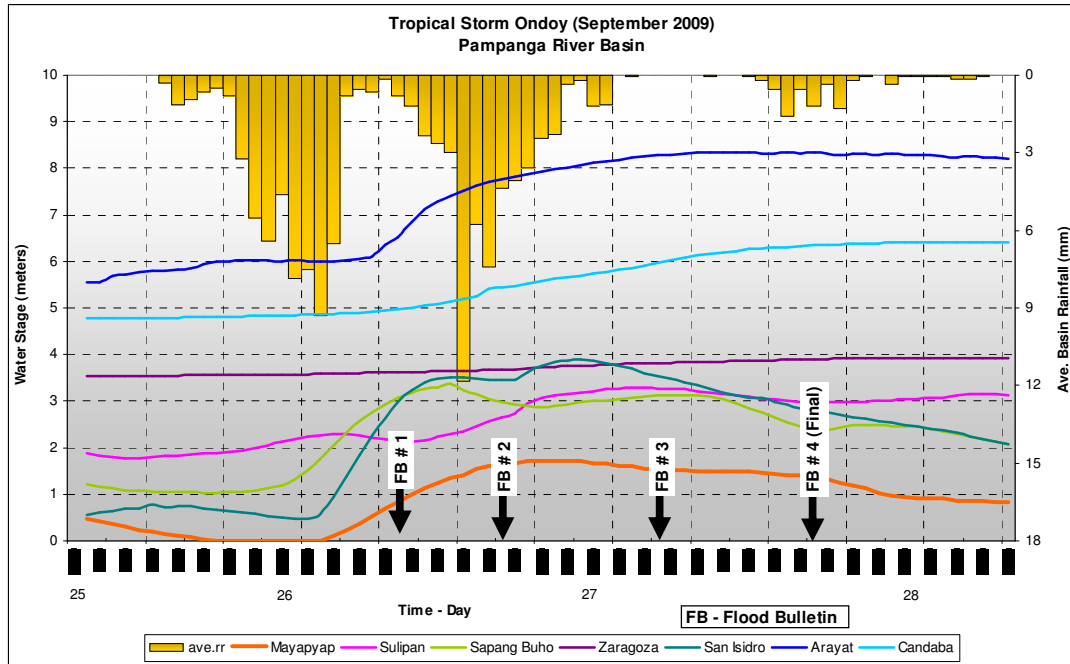


Figure 1-4.0 Pampanga River basin hyetograph and hydrograph for each river gauging station during Tropical Storm "Ondoy"

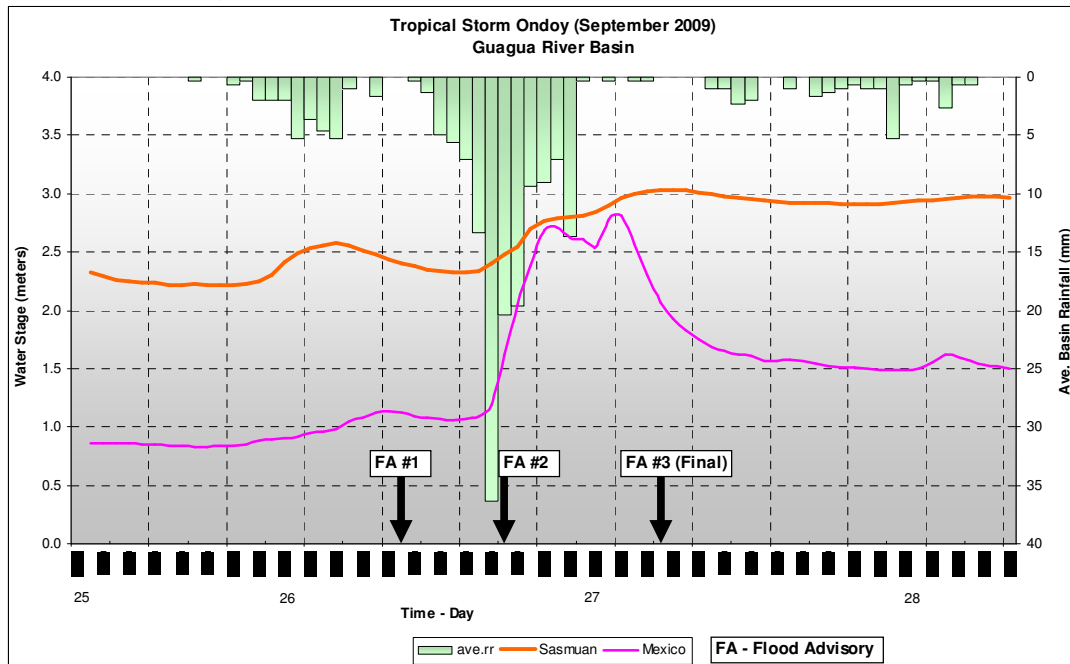


Figure 1-5.0 Guagua River Sub-basin hyetograph and hydrographs for Mexico and Sasmuan river gauging stations during Tropical Storm "Ondoy"

The worst affected area during the event, other than Metro Manila and Southern Tagalog provinces, was in the area of Sta. Maria-Marilao-Meycauyan River system which is actually outside of the Pampanga River Basin and an adjacent area, just north of Metro Manila area (A separate post-flood report will be presented for this area).

2.3 Tides

Tides may not have been a big factor in the floods in Guagua river sub-basin nor in the lower sections of Pampanga River as they are relatively small in magnitude and likewise did not coincide with the time of peaks attained at any of the lower section stations, particularly at Sulipan and Sasmuan stations. There was no report of a storm surge either at that time. Nonetheless, this flood event has relatively shorter flood duration as compared with other flooding event in the area in the previous years. Flooding was in the order of several hours to a day in most of the areas affected. This can be attributed to the short passage of “Ondoy” over Central Luzon, less than a day.

Table 1-4.0 High tide readings (highest for the day) September 2009

Day	Time	Height (meters)
25	12:36am	1.04
26	1:15am	1.01
27	2:07am	0.97
28	3:30am	0.94

Note: Based on Navotas port, Latitude 14° 41' N, Longitude 120° 56' E

2.4 Major Hydraulic Structures and Dam Releases

Pantabangan and Angat Dams are the two main hydraulic structures within Pampanga River Basin. Pantabangan Dam, located upstream of the upper main Pampanga River operates both as a hydropower and an irrigation dam. The Angat Dam, on the other hand, is located on the eastern portion of the lower main Pampanga River and drains through the Angat River via the Ipo Dam and operates mainly as a hydropower plant. Ipo Dam, which supports and partly regulates releases coming from the Angat Dam, is situated about 7 kilometers downstream of the latter. Ipo serves as an active reservoir for water supply requirements of Metro Manila. It is not an impounding reservoir but more of a diversion dam and relatively a lot smaller than the other two dam structures.

During the event, only Angat and Ipo dams released water from its spillways. Ipo, being relatively small started releasing reservoir water as early as past 12 midnight of September 26. However, releases were quite small at a rate of about 50 cumecs (cubic meters per second). Maximum discharge from the dam reached to more than 220 cumecs by noontime. At around past 9am of the following day, Ipo dam had already closed all its gates. On the other hand, Angat dam started releasing reservoir water at around 2pm of September 26 with more than 100 cumecs spill. Peak discharge spill of more than 570 cumecs by evening and eventually stopped by midnight of the same day at a reservoir elevation of 213.6 m (AMSL). (Figures 1-6.0 & 1-6.1 for Angat Dam Inflow-Outflow curves during “Ondoy”)³

³ Angat dam graph courtesy of Mr. Virgilio M. Garcia, Principal Hydrologist A, NPC, DRWD

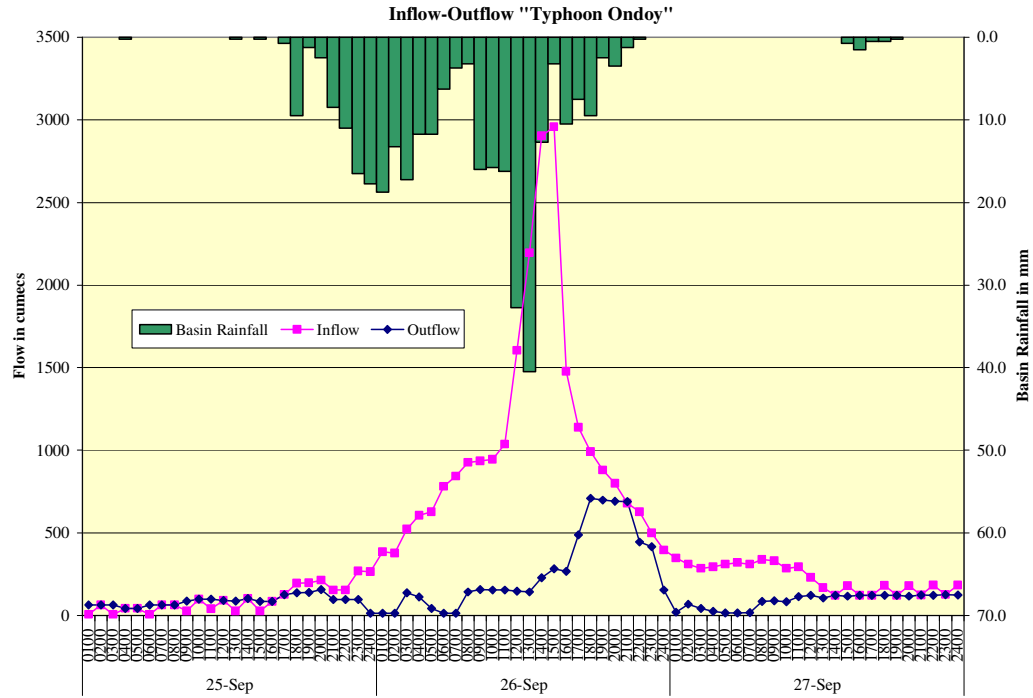


Figure 1-6.0 Angat dam reservoir hyetograph and inflow-outflow curves during the Tropical Storm "Ondoy"

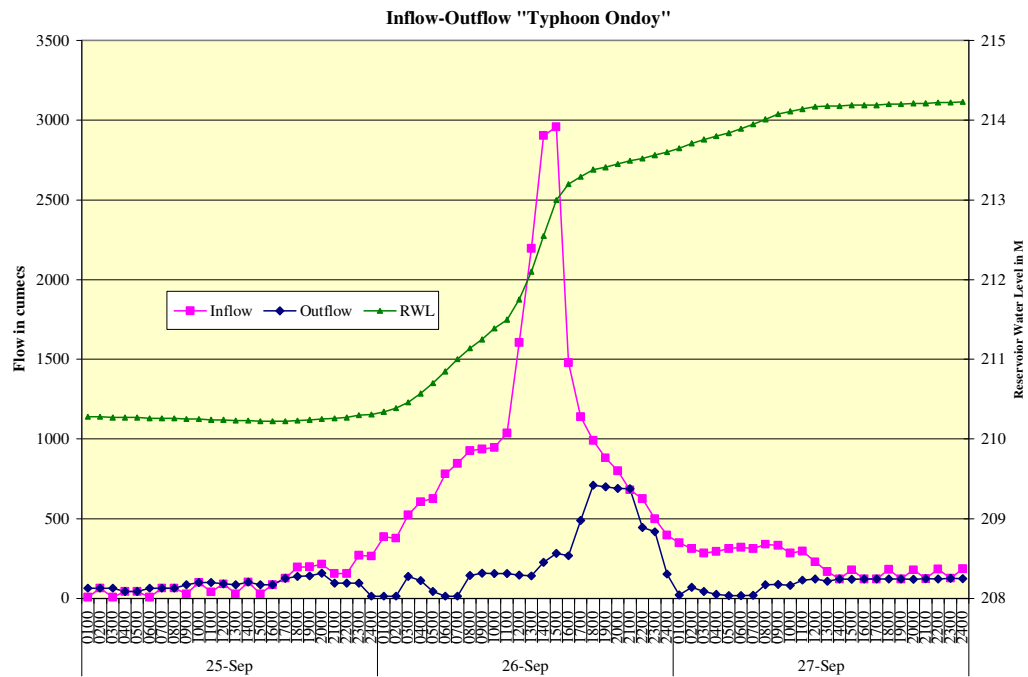


Figure 1-6.1 Angat Dam reservoir elevation with inflow-outflow curves during Tropical Storm "Ondoy"

3.0 Event-related Damages

As a result of the damage brought about by “Ondoy” over a large part of the country, particularly in Metro Manila and Luzon area, President Arroyo issued Proclamation No. 1891 dated September 26, 2009 “Declaring a State of Calamity in some Provinces, Cities and Municipalities in Luzon” to enhance all preparations for the oncoming Typhoon “Pepeng” and to hasten the rescue, relief and rehabilitation efforts of both government and private sector, and to effectively control the prices of basic goods.

For provinces within the Region 3, Bulacan was the worst area affected during the said event, in particular towns just south of the basin, however, on a basin-wide scale Pampanga had the biggest population affected.

Table 1-5.0 Breakdown of the population, towns / cities and barangays affected

Province	Total Towns / Cities affected	Total Barangays affected	Number of Families affected	Number of persons affected
Bulacan *	10	135	45,418	184,925
Pampanga	19	282	97,271	459,247
Nueva Ecija	3	22	4,850	23,709

(* for towns / cities within the basin only)

The overall casualties for Region 3 included 56 dead, 3 injured, and 7 missing. From the total dead for the region, 41 are in Bulacan province (mostly from towns outside the basin) however within the basin, there were 5 dead due to a landslide in DRT-Norzagaray area and 2 drowning incidents in Hagonoy. For Pampanga, there were 15 fatalities, 13 of which were due to a landslide that occurred in Bgy. San Juan Banyo, Arayat, situated at the slopes of Mount Arayat.

Table 1-6.0 Damaged to infrastructure in Million Pesos (Province wide)

Province	Roads / Bridges / Other Structures	Schools Damaged	Amount (Schools)	Remarks (affected areas)
Bulacan	63	3	3.08	Mostly in Malolos City
Pampanga	1,302	2	5.59	Angeles and SFDO
Nueva Ecija	25.337	4	1.5	UPRIIS
Tarlac	1.5	8		

Table 1-7.0 Damaged to agriculture in Million Pesos (Province wide)

Province	Rice / Corn	Livestock	Mango, Banana, Papaya, Vegetables	Fisheries	Facilities, Infra, Equipment Damaged
Bulacan	1,379.9		15.9	78.9	49.3
Pampanga	1,392.8	5.3	0.23	48.3	185.7
Nueva Ecija	693.9				2.5
Tarlac	787.4	0.25			18.4

Table 1-8.0 Damaged houses for areas within the basin (Province wide)

Province	Towns	Totally damaged houses	Partially damaged houses
Bulacan	6	308	398

Pampanga	7	61	100
Nueva Ecija	2	0	15

(all data from tables above were taken from NDCC Update SitRep No.27 on Humanitarian Coordination on Tropical Storm "Ondoy", as of report dated October 13, 2009)

4.0 Areas flooded during the event

Table 1-9.0 Areas flooded per province (within the basin) are as follows:

Province of Pampanga		
Town / City	Number of Barangays affected	Estimated flood depth observed within the area (m); maximum
Guagua	31	0.3 -1.0 (portions); 1.0 – 1.8
Candaba	10	0.3 – 0.5 (portions); 0.5 – 1.0
San Fernando	2	0.3 – 0.6
Sta. Rita	3	0.6 – 1.2
Sto. Tomas	7	0.6 – 1.0; 1.8 (portions)
Apalit	10	0.3 – 0.4; 0.6 – 1.0 (portions)
Sasmuan	12	0.3 – 1.0 (portions); 1.0
Lubao	29	0.3 – 0.6
Mexico	5	< 0.3
Sta. Ana	13	0.3 (portions); 0.6 – 1.0
San Luis	6	0.3 – 1.0; 1.0 – 1.8 (portions)
Masantol	26	0.7 – 1.2
Macabebe	22	0.3 (portions); 1.0 – 1.2
Minalin	15	0.3 – 0.6; 0.6 – 1.0 (portions)
San Simon	13	0.3 – 0.6 (portions); 0.6 – 1.0
Arayat	5	0.3 – 0.6 / Landslide affected
TOTAL	209	

Source: Pampanga PDCC Final Report on Tropical Storm "Ondoy" as of 02 October 2009.

Province of Bulacan (areas within the basin only)		
Town / City	Number of Barangays affected	Estimated maximum flood depth observed within the area (m)
Angat	1	
Baliuag	8	0.5
Bustos	10	0.3
Calumpit	29	0.3 - 1.0
DRT	1	Landslide affected
Hagonoy	25	0.3
Malolos	16	
Norzagaray	6	0.3
Paombong	14	0.3
Plaridel	12	
Pulilan	1	
San Ildefonso	12	
San Miguel	28	
San Rafael	29	0.6
TOTAL	192	

Source: Bulacan PDMO report as of 4pm, 29 September 2009.

No report of areas directly affected by floods in the province of Nueva Ecija. Likewise, there were no reported floods of areas within the basin for Tarlac province.

5.0 Flood Forecasting & Warning activities

The PRFFWC in San Fernando, Pampanga started its operational monitoring last March 2009 with a newly rehabilitated system. Data from the different RR and WL stations within the basin are observed hourly on a real-time basis. Unfortunately during event “Ondoy” there was a brief non-transmission of data still at the height of the disturbance, specifically between the period 2pm to 5pm of September 26 in most of the RR and WL stations within the basin. This just shows that even the new system can also fail at some time and hence, may be an issue for coming up with some back-up system. For the 3-day event (Sept. 25 to 27) monitoring during “Ondoy”, out of the 1224 stn-hrs RR dataset, there were 30 stn-hrs failed transmissions or a low 2.4% downtime. Likewise, for a 720 stn-hrs WL dataset, there were 10 stn-hrs failed transmissions or 1.38% downtime. By standards, this is quite negligible and did not pose as a problem during that time.

A total of 4 flood bulletins and 3 flood advisories were issued during the event (refer to figures 1-4.0 & 1-5.0). Initial flood advisory (FA) and flood bulletin (FB) were issued at 9am of September 26, 2009 for Guagua river sub-basin and Pampanga river basin, respectively. Subsequent FA (no. 2) and FB (no. 2) were issued at 5pm of the same day. The fact that Ondoy was a relatively short event and that floodwaters did not stay long over the Guagua river sub-basin area, final FA (no.3) for Guagua river sub-basin area was immediately issued at 5am of the following day. Likewise, final FB (no.4) for Pampanga river basin was issued in the afternoon of September 27.

Flood bulletins are issued over basins that have telemetered rainfall and water level stations. Flood advisories are issued in relatively small basins that are not supported by a telemeterized monitoring system. FA is still issued for Guagua river sub-basin inasmuch as the present telemetered stations now in the basin have just been recently put-up (operational as of March 2009), with the exception of Sasmuan station. Hence, the process of establishing assessment levels for flood warnings and info / data protocols to target communities are still being worked-out.

Flood Event 2.0 TYPHOON “PEPENG”

1.0 Meteorological Aspect

TY “PEPENG” (International codename: PARMA, {0917})⁴

Typhoon **PEPENG** developed from a broad area of low pressure over at the Marianas Islands. It gradually moved almost westward and entered over the eastern border east of northern Mindanao as a full-blown typhoon late afternoon of September 30. **PEPENG** gained more strength as it moved closer to eastern Visayas then slightly weakened as it approached the landmass of northern Luzon and made landfall over Cagayan afternoon of October 03. **PEPENG** has moved west northwest and traversed the mountainous terrain of extreme northern Luzon the whole evening of October 03 as it stepped out over the Luzon Strait (Northern Tip of Ilocos Norte) early morning of October 04.

Typhoon **PEPENG** had slowed down and remained almost stationary over the Luzon Strait due to the expected interaction with the approaching typhoon (**NEPARTAK**) behind of typhoon **PEPENG** and abruptly weakened to Tropical Storm intensity the following day due to friction of the landmass of northern Luzon.

PEPENG has slightly intensified again over at the off shore of Ilocos Norte and has moved south southwestward and made its 2nd landfall over the northern tip of Ilocos Norte causing heavy downpour over northern and central Luzon resulting to flashfloods and landslides to most parts of northern Luzon. Storm **PEPENG** again traversed the terrain of extreme northern Luzon and stepped out over the coast of Cagayan early morning of October 08.

Again **PEPENG** has remained almost stationary as it changed its course to the west southwestward and made its 3rd landfall over Cagayan. **PEPENG** had weakened into a tropical depression as It crossed northern Luzon for the whole evening which brought continues rains again over the provinces of Cordilleras, Ilocos region, Cagayan Valley and central Luzon forcing the major dams of Luzon to open their gates for spillage that resulted to flashfloods and landslides killing more than 300 people and severely damaging a lot of properties. **TD PEPENG** stepped out over the coast of La Union as it moved farther away from the country and exited the northwestern border on the eve of October 10.

Maximum winds observed: 39 mps (140 kph), Tuguegarao at 5-6pm, 03 October.
Lowest Mean Sea Level Pressure recorded (hPa): 978.5 at Tuguegarao, Cagayan, 2pm, on 03 October.

Maximum 24-hr Rainfall (mm): 685 at Baguio Synop station, 08 October.

PSWS # 3 hoisted over Catanduanes, Cagayan including Babuyan and Calayan Group of Islands, Northern Isabela, Batanes group of Islands, Ilocos Norte, Abra, Apayao, Kalinga, Ilocos Sur and Mt. Province.

PSWS # 2 hoisted over Camarines Norte, Camarines Sur, Aurora, Northern Quezon including Polillio Island, Quirino, Southern Isabela, Ifugao, Nueva Vizcaya, La Union and Benguet.

⁴ (2009 Tropical Cyclone Summary by Weather Forecasting Section, Weather Division, PAGASA, DOST)

PSWS # 1 hoisted over Albay, Burias Island, Sorsogon, Nrn Samar, Rest of Quezon, Pangasinan, Tarlac, Zambales, Pampanga, Bulacan, Bataan, Rizal, and Metro Manila.

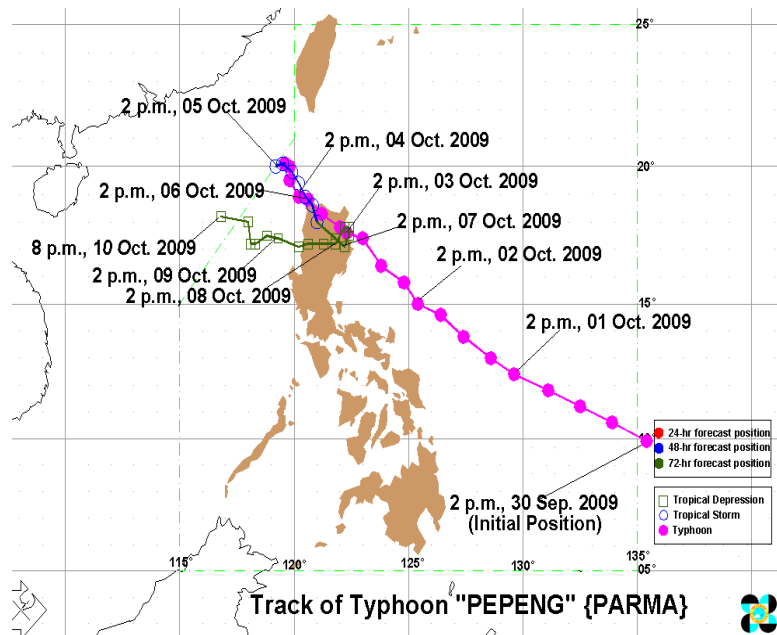


Figure 2-1.0 Track of Typhoon Pepeng (October 2009)

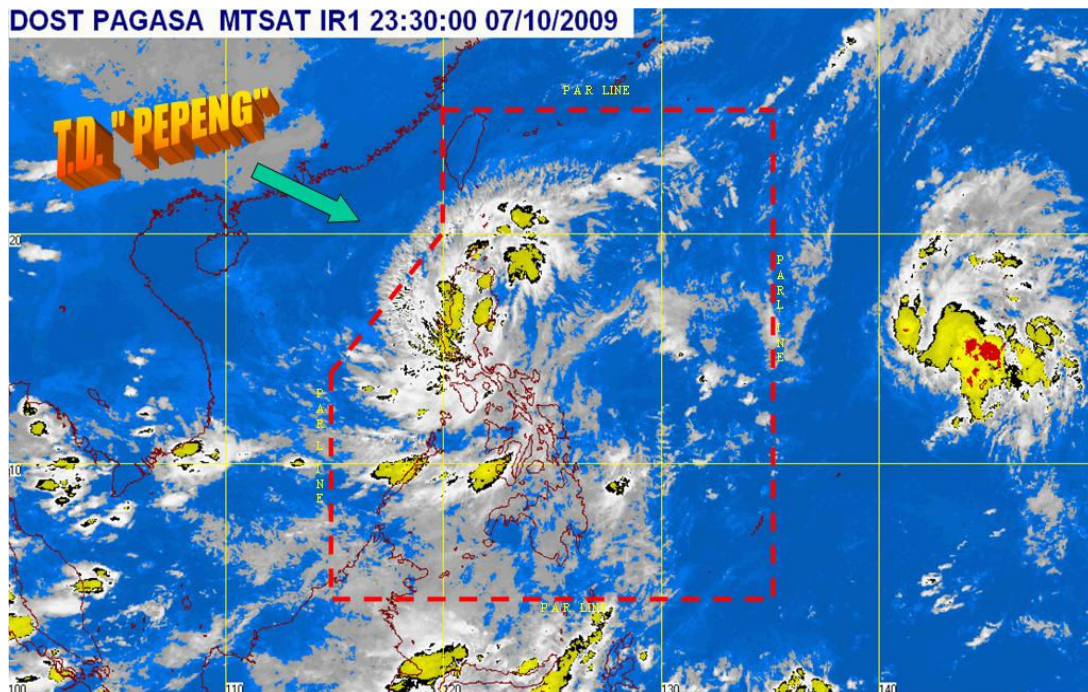


Figure 2-2.0 Satellite Image of "Pepeng" at 7:30am (LST), 08 October 2009

2.0 Basin Hydrological Aspect

2.1 Rainfall

Table 2-1.0 24-Hour (8 AM - 8 AM) Rainfall Totals in mm during Typhoon “Pepeng” (first episode) - Pampanga River Basin (October 2009)

Stations	2nd	3rd	4th	5th
Muñoz	16.0	56.0	0.0	0.0
Sapang Buho	30.0	63.0	0.0	0.0
Calaanan	30.0	107.0	1.0	0.0
Mayapyap	19.0	78.0	0.0	1.0
Gabaldon	84.0	89.0	1.0	0.0
Palali	46.0	77.0	0.0	0.0
Zaragoza	36.0	63.0	0.0	0.0
Peñaranda	26.0	58.0	0.0	0.0
San Isidro	40.0	51.0	0.0	0.0
Sibul Spring	41.0	58.0	0.0	0.0
Arayat	19.0	65.0	0.0	1.0
Candaba	21.0	34.0	0.0	0.0
San Rafael	28.0	28.0	0.0	0.0
Sulipan	17.0	31.0	0.0	0.0
Ave.Basin RR	32.36	61.29	0.14	0.14
Accumulated Daily Basin Rainfall	32.36	93.64	93.79	93.93
Guagua River Sub-Basin				
Porac	6.0	46.0	0.0	0.0
Mexico	25.0	31.0	0.0	0.0
Sasmuan	6.0	31.0	0.0	0.0
San Fernando	8.1	45.0	1.3	0.0
Ave.Basin RR	11.28	38.25	0.33	0.00
Accumulated Daily Basin Rainfall	11.28	49.53	49.85	49.85

Table 2.2.0 24-Hour (8 AM - 8 AM) Rainfall Totals in mm during Typhoon “Pepeng” (Second episode) - Pampanga River Basin (October 2009)

Stations / Date	6th	7th	8th	9th	10th	11th
Muñoz	9.0	65.0	190.0	0.0	0.0	0.0
Sapang Buho	7.0	53.0	129.0	0.0	0.0	0.0
Calaanan	12.0	79.0	172.0	0.0	0.0	0.0
Mayapyap	1.0	56.0	103.0	1.0	0.0	0.0
Gabaldon	8.0	99.0	91.0	0.0	0.0	0.0
Palali	0.0	78.0	68.0	0.0	0.0	0.0
Zaragoza	1.0	37.0	76.0	1.0	0.0	0.0
Peñaranda	0.0	52.0	66.0	0.0	0.0	0.0
San Isidro	0.0	41.0	62.0	0.0	0.0	0.0
Sibul Spring	0.0	48.0	39.0	0.0	0.0	0.0
Arayat	0.0	21.0	39.0	0.0	0.0	0.0

Candaba	0.0	19.0	23.0	0.0	0.0	0.0
San Rafael	0.0	13.0	11.0	0.0	0.0	0.0
Sulipan	1.0	7.0	7.0	0.0	0.0	0.0
Cabanatuan	2.0	55.4	96.2	1.0	0.0	0.0
Ave.Basin RR	2.73	48.23	78.15	0.20	0.00	0.00
Accumulated Daily Basin Rainfall	2.73	50.96	129.11	129.31	129.31	129.31

Stations / Date	12th	13th	14th	15th	16th	Max 1-hr observed	Time/Date of observation
Muñoz	0.0	24.0	30.0	4.0	0.0	23.0	3pm, 13 Oct
Sapang Buho	0.0	0.0	34.0	6.0	4.0	16.0	6am, 14 Oct
Calaanan	0.0	0.0	54.0	4.0	0.0	25.0	6am, 14 Oct
Mayapyap	0.0	0.0	20.0	8.0	1.0	15.0	5am, 07 Oct
Gabaldon	0.0	0.0	48.0	6.0	1.0	21.0	6am, 14 Oct
Palali	0.0	0.0	36.0	33.0	4.0	24.0	6am, 14 Oct
Zaragoza	0.0	14.0	12.0	5.0	0.0	14.0	6pm, 13 Oct
Peñaranda	0.0	0.0	34.0	16.0	0.0	13.0	6am, 14 Oct
San Isidro	0.0	0.0	27.0	6.0	0.0	12.0	6am, 14 Oct
Sibul Spring	0.0	1.0	52.0	1.0	2.0	24.0	5am, 14 Oct
Arayat	0.0	1.0	28.0	1.0	0.0	7.0	5am, 14 Oct
Candaba	0.0	0.0	21.0	0.0	0.0	9.0	5pm, 14 Oct
San Rafael	0.0	0.0	62.0	0.0	0.0	18.0	4am, 14 Oct
Sulipan	0.0	0.0	52.0	0.0	0.0	13.0	4am, 14 Oct
Cabanatuan	0.0	0.0	29.2	12.6	0.0		
Ave.Basin RR	0.00	2.67	35.95	6.84	0.80		
Accumulated Daily Basin Rainfall	129.31	131.97	167.92	174.76	175.56		

Guagua River Sub-Basin (October 2009)

Station / Date	6th	7th	8th	9th	10th	11th
Porac	0.0	8.0	21.0	0.0	0.0	0.0
Mexico	0.0	11.0	21.0	0.0	0.0	0.0
Sasmuan	1.0	7.0	9.0	0.0	0.0	0.0
San Fernando	0.0	10.9	23.1	0.0	0.0	0.0
Clark	6.8	12.4	32.4	0.0	0.0	0.0
Ave.Basin RR	1.56	9.86	21.30	0.00	0.00	0.00
Accumulated Daily Basin Rainfall	1.56	11.42	32.72	32.72	32.72	32.72

Station / Date	12th	13th	14th	15th	Max 1-hr observed	Time/Date of observation
Porac	0.0	0.0	30.0	0.0	10.0	5am, 14 Oct
Mexico	0.0	0.0	43.0	0.0	14.0	4am, 14 Oct
Sasmuan	0.0	0.0	39.0	0.0	9.0	5am, 14 Oct
San Fernando	0.0	0.0	36.1	0.3	-	-

Clark	0.0	0.0	24.2	0.6	-	-
Ave.Basin RR	0.00	0.00	34.46	0.18		
Accumulated Daily Basin Rainfall	0.00	0.00	34.46	34.64		

Table 2-3.0 24-Hour (8 AM - 8 AM) Rainfall Totals (in mm)
Typhoon Pepeng (October 2009)

Auxiliary Stations within and around PRB

Stations / Date	6th	7th	8th	9th	10th	11th
San Miguel	0.0	15.5	24.6	0.0	0.0	0.0
Calumpit	0.8	4.8	3.0	0.5	0.0	0.0
Pulilan	0.0	5.3	0.8	0.5	0.0	0.0
Sta. Maria	0.0	6.9	5.1	0.0	0.0	0.0
Parada, Sta. Maria	0.0	11.2	10.6	7.3	0.0	0.0
Meycauayan	0.0	6.4	0.3	27.7	0.0	0.0
Marilao	3.6	2.0	0.3	14.7	0.0	0.0
Other Stations adjacent to Pampanga River Basin						
Baler Synop	0.5	10.5	33.5	0.0	0.0	0.0
Iba Synop	3.4	19.7	47.4	13.6	0.0	0.0
Subic Synop	10.0	13.3	15.4	0.4	2.0	0.0
Dagupan Synop	36.2		443.5	35.0	0.0	0.0
Baguio Synop	260.0	276.0	685.0		0.0	0.0
Casiguran Synop		54.3	35.0	0.0	0.0	0.0
Quezon City *	1.5	5.6	2.3	3.6	1.3	0.0

Auxiliary Stations within and around PRB

Stations / Date	12th	13th	14th	15th	16th
San Miguel	0.0	0.0	60.5	1.5	8.9
Calumpit	0.0	0.8	50.3	0.0	0.0
Pulilan	0.0	0.5	48.5	1.0	0.0
Sta. Maria	0.0		26.7	2.0	3.3
Parada, Sta. Maria	0.0	3.0	33.0	1.8	
Meycauayan	0.0	1.3	22.6	18.3	0.0
Marilao	0.0	0.0	20.3	0.5	0.0
Other Stations adjacent to Pampanga River Basin					
Baler Synop	0.0	0.0	35.0	72.5	11.0
Iba Synop	0.0	8.2	13.4	0.0	0.0
Subic Synop	0.0	T	18.0	0.2	0.0
Dagupan Synop	0.0	0.0	T	0.4	2.0
Baguio Synop	T	T	2.0	0.4	0.0
Casiguran Synop	0.0	0.0	34.4	22.0	0.4
Quezon City *	11.4	6.6	46.0	5.3	0.0

Note: Rainfall values from auxiliary stations (Bulacan) are observed at random using tipping bucket rain gauges and observed by LGU personnel

** Independent rainfall observation station; Red values require verification*

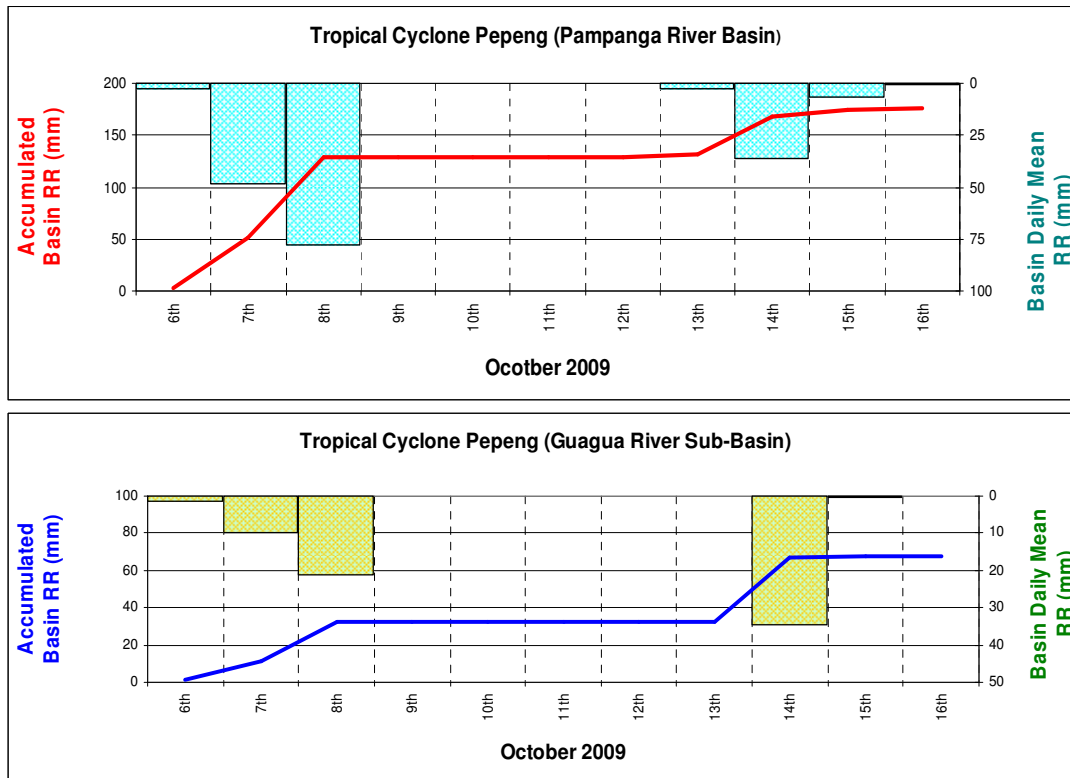


Figure 2-3.0 Accumulated and Mean Rainfall for both basins during the event.

General rainfall pattern during the passage of “Pepeng” over the northern part of the basin are as follows:

Oct 2 to 3, 2009: Light to occasionally moderate rains prevailed over most parts of the basin.

Oct 4 to 5, 2009: Generally very light rains experienced over the whole basin with no rains for most of the periods.

Oct 6, 2009: Still light rains were observed over the basin concentrated mostly at the upstream areas.

Oct 7, 2009: Moderate to heavy rains were concentrated at the north northwest adjacent areas of the basin, in particular over at the Agno river basin (Figure 2-4.0).

Oct 8, 2009: Heavy rains were concentrated at the northern part of the basin, in particular over at the Pantabangan watershed and at the Rio Chico river sub basin area (Figure 2-4.1).

24-hour Isohyets for October 07, 2009

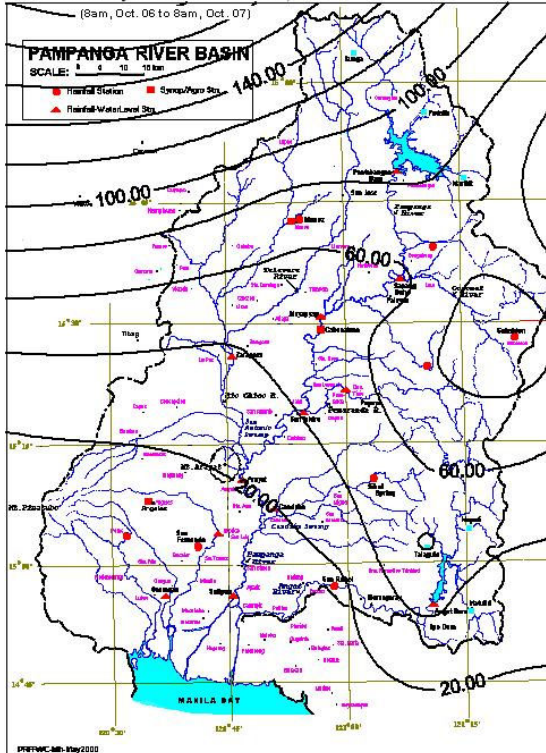


Figure 2-4.0 24-hr Isohyets for 07 Oct 2009

24-hour Isohyets for October 08, 2009

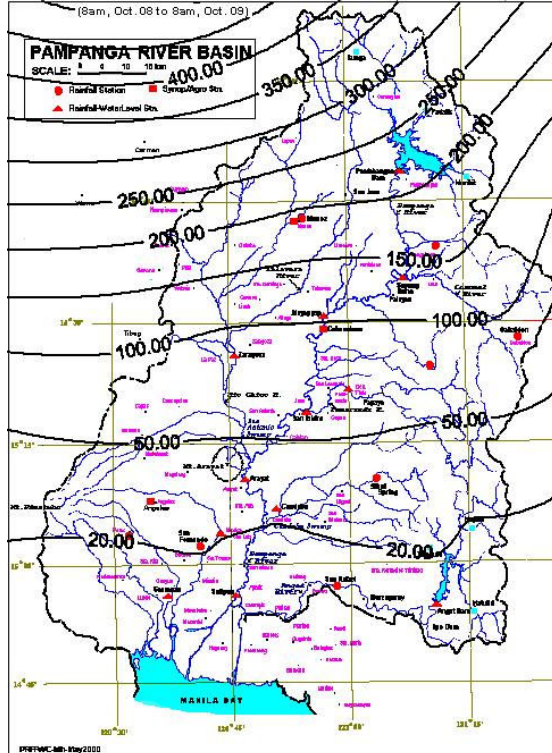


Figure 2-4.1 24-hr Isohyets for 08 Oct 2009

Oct 9, 2009: Isolated light rains prevailed over the basin.

Oct 10 to 12, 2009: A break in rains during this period, registering no rainfall observation at all stations.

Oct 13, 2009: No significant rains were observed during the day.

Oct 14, 2009: Moderate rains were observed mostly at the east southeast part of the basin particularly centering over the Angat watershed. (Figure 2-4.2)

Oct 15, 2009: Generally light rains prevailed over the basin for the rest of the day as "Pepeng" moved farther away from the country. Eventually, flood monitoring activities over the basin was terminated.

Oct 16, 2009: Isolated brief light rains prevailed over the basin.

24-hour Isohyets for 14 October 2009

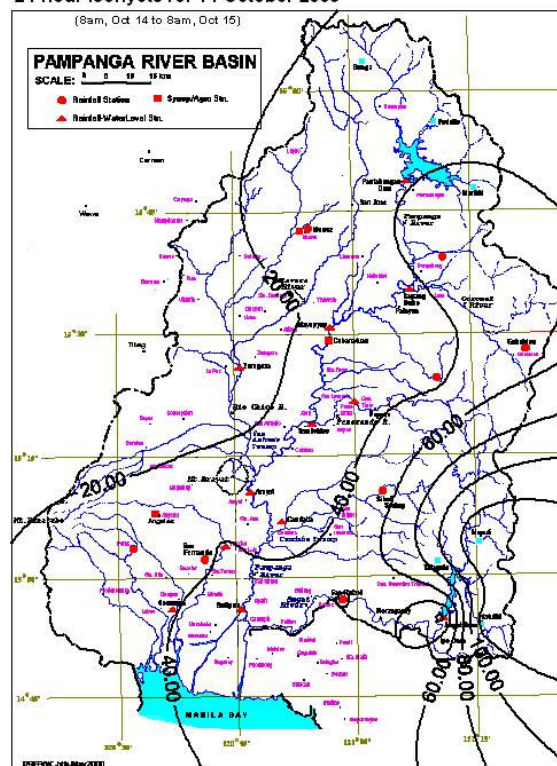


Figure 2-4.2 24-hr Isohyets for 14 Oct 2009

2.2 River Heights and Basin Situation during the whole Event

Table 2-4.0 Time/Date Station's Flood Assessment Gage Heights were reached

Station Point	(Pre-Alert Level) Time & Day attained	(Alert Level) Time & Day attained	Remarks
Sapang Buho	(3.7 m) around 6 to 7am, 08 Oct	(6.5 m) not reached	Peak WL based on telemetry reading was 6.29 m (56.502 m. AMSL) attained from 3 to 4am of 09 Oct.
Mayapyap	(3.0 m) around 5 to 6pm, 08 Oct.	(4.5 m) before 1am of 09 Oct.	Peak WL recorded was at 5.46 m (31.157 m. AMSL) attained at 12 noon of 09 Oct.
Zaragoza	(1.0 m) already above this level even prior to Oct. 2	(4.5 m) 5am of 09 Oct.	Peak WL recorded was at 5.47 (15.683 m. AMSL) attained at 8pm of 09 Oct.
Peñaranda			Peak WL recorded was at 2.79 (estimated at 21.088 m. AMSL) attained at 12 noon of 15 Oct.
San Isidro	(3.2 m) around 2 to 3pm, 08 Oct.	(6.0 m) around 1 to 2pm, 09 Oct	Recorded peak gage height of 6.46 m (16.045 m. AMSL) attained at about 2am, 10 Oct.
Arayat	(5.0 m) already above this level prior to Oct. 2	(8.5m) 1am of 09 Oct.	Recorded peak gage height of 9.66 m (9.737 m. AMSL) attained at about 8am, 11 Oct.
Candaba	(3.0 m) already above this level prior to Oct. 2	(5.0 m) already above this level prior to the event	Recorded Peak of 7.02 m (6.8633 m AMSL) attained at around 10pm, 11 Oct.
Sulipan	(3.6 m) 5am, 11 Oct.	(5.0 m) not reached	Peak gage height of 4.03 m (3.968 m AMSL) attained from 8am to 3pm, 12 Oct.
Mexico			Peak gage height of 1.41 m (estimated at 7.343 m AMSL) attained at 8am, 09 Oct
Sasmuan			Peak gage height of 2.73 m (estimated at 1.313 m AMSL) attained at 2am, 10 Oct.

Note: Elevation of "0" of staff gage at various stations was based on survey undertaken last August 2009.

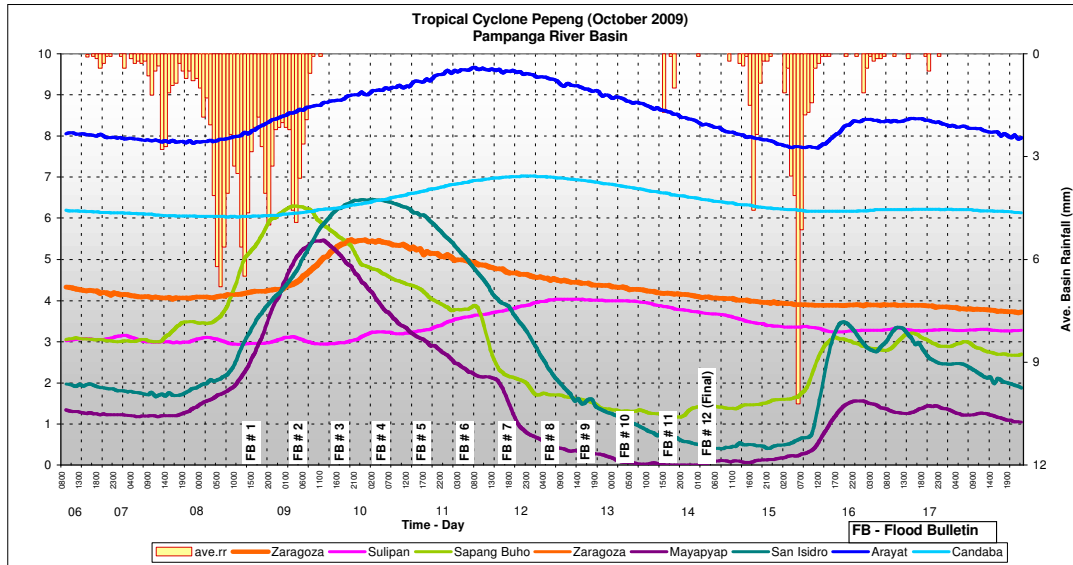


Figure 2-5.0 Pampanga River basin hyetograph and station hydrographs during Tropical cyclone "Pepeng".

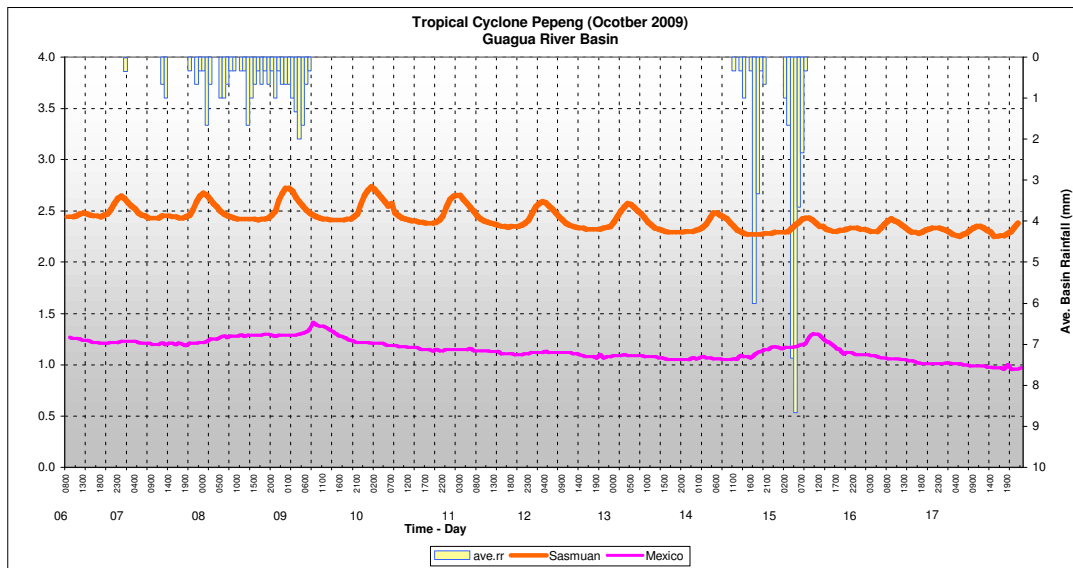


Figure 2-5.1 Guagua River sub-basin hyetograph and hydrographs of Sasmuan and Mexico during Tropical cyclone "Pepeng".

2.3 Tides

There was no significant flooding within the Guagua river sub-basin during "Pepeng" as can be seen from the sub-basin hydrographs (Figure 2-5.1). Floodwaters left by "Ondoy" still remained at that time. Tides generally maintained its normal effects on the rivers. As expected, tides had affected the usual low-lying riverside areas at the downstream sections of Guagua River sub-basin waterways.

Likewise, effects on the outflow of Pampanga river were insignificant as can be seen on the hydrograph of Sulipan station (Figure 2-5.0).

Table 2-5.0 High tide readings (highest for the day) October 2009

Day	Time	Height (meters)
5	10:00pm	1.02
6	10:22pm	1.10
7	10:53pm	1.15
8	11:33pm	1.18
9	8:47am	0.13
10	12:18am	1.19
11	1:11am	1.19
12	2:24am	1.16
13	4:01am	1.13
14	5:33am	1.09
15	6:58am	1.04
16	8:19am	0.97

Note: Based on Navotas port, Latitude 14° 41' N, Longitude 120° 56' E

2.4 Major Hydraulic Structures and Dam Releases

Both major dams in the basin, Pantabangan and Angat, released reservoir water through their respective spillways. Spillway releases from Angat dam goes down directly towards the relatively smaller Ipo dam reservoir and as expected during the event had also spilled reservoir water.

Angat dam started releasing reservoir water even before the event “Pepeng”, specifically before midday of 29 September. The pre-released activity was due to the subsequent increase of reservoir water level since “Ondoy” and in preparation to “Pepeng”. Peak discharge outflow was a little over 400 cumecs (m^3/s). Dam releases lasted until midday of 03 October (see figure 2-6.0 below for part releases on Oct 2 to 4). It is quite unfortunate though that data on subsequent releases particularly during the peak activity of the Pepeng (October 6 and onwards) are still not available as of this writing. Likewise, data on Ipo dam releases during the event have not yet been received.

Reservoir releases from Pantabangan Dam are difficult to obtain, as dam authorities (Pantabangan FFWSO) have not responded to (several) requests made by the PRFFWC. Based on event notes, logs, and estimates by the PRFFWC, Pantabangan started its reservoir releases about midday of 08 October. It is estimated that releases continued for several days to weeks as reflected on the river level at Sapang Buho station. It is also estimated that releases may have reached more than 500-700 cumecs at some point in time. The relatively long position of river stage above the 1-meter gage reading in Sapang Buho (in particular from October 11 to 15) considering that there were no more rains from October 10 to 12 and generally light on the succeeding days clearly indicates continued releases by the dam. This eventually contributed to the rather slow recession of floodwaters at the middle and lower sections of main Pampanga River.

Damage report by NDCC specifically mentioned that reservoir water releases from Pantabangan dam had washed-out 6 spans of Calaoacan Overflow Bridge and a detour bridge in Nueva Ecija (*NDCC Update SitRep No.27 on Typhoon “Pepeng”, as of report dated October 14, 2009*).

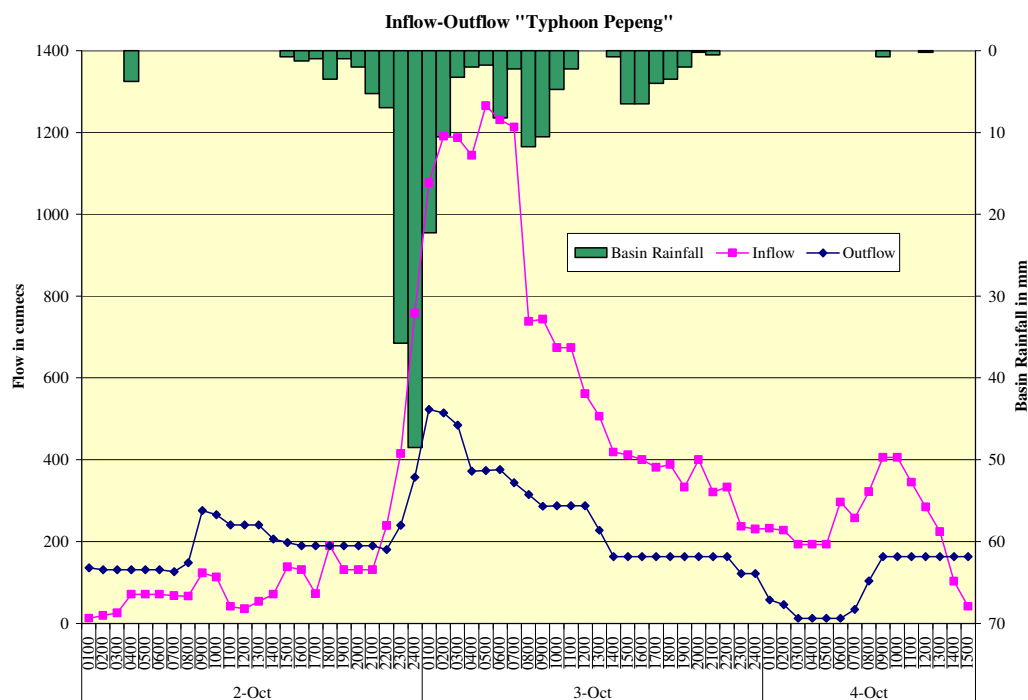


Figure 2-6.0 Angat dam hyetograph and inflow-outflow hydrographs during October 2-4, 2009 of Tropical cyclone "Pepeng".⁵

3.0 Event-related Damages

Table 2-6.0 Breakdown of the population, towns / cities and barangays affected

Province	Total Towns / Cities affected	Total Barangays affected	Number of Families affected	Number of persons affected
Bulacan *	7	49	27,989	115,958
Pampanga	14	156	43,818	210,726
Nueva Ecija	29	323	89,812	479,884
Tarlac	9	106	22,534	99,150

(* towns and cities within the basin only)

The overall casualties for Region 3 included 8 dead and 2 missing. Breakdown of dead for the region includes 3 in Nueva Ecija, 3 in Pampanga and 2 in Tarlac. Missing person accounts for 1 each for Nueva Ecija and Pampanga.

Table 2-6.1 Damaged to infrastructure and agriculture in Million Pesos (Province wide)

Province	Roads / Bridges	Flood Control	Crops: Rice / Corn
Bulacan	63		540.5
Nueva Ecija	4.5	30	31.2
Pampanga	1.2	5	
Tarlac	1.0		
PRCS-PMO		10	
MPR-PMO		25	

⁵ Angat dam graph courtesy of Mr. Virgilio M. Garcia, Principal Hydrologist A, NPC, DRWD

Table 2-6.2 Damaged houses for areas within the basin (Province wide)

Province	Towns	Totally damaged houses	Partially damaged houses
Nueva Ecija	3	61	122
Pampanga	1	2	-

(all data of tables above were taken from NDCC Update SitRep No.27 on Typhoon "Pepeng", as of report dated October 14, 2009)

4.0 Areas flooded during the event

Table 2-7.0 Areas flooded per province within the basin are as follows:

Province of Pampanga		
Town / City	Number of Barangays affected	Estimated maximum flood depth observed within the area (m)
Masantol	20	0.3 – 0.8
Guagua	31	0.2 - 0.6
Sta. Ana	9	0.3 – 1.0
San Luis	7	0.3 – 0.6
Sto. Tomas	1	0.6
Macabebe	14	0.3 – 0.6
Candaba	9	0.3 – 0.6; 1.2 – 1.5 (portions)
Minalin	12	0.3 – 0.6
Apalit	6	0.3 – 0.6
San Simon	9	0.3 – 0.6; 0.6 – 1.0 (portions)
TOTAL	118	

Source: Pampanga PDCC Final Report dated 2000H, 06 October 2009.

Province of Bulacan (areas within the basin only)		
Town / City	Number of Barangays affected	Estimated maximum flood depth observed within the area (m)
Calumpit	21	0.3 – 1.8
Hagonoy	15	0.3 – 1.0
Pulilan	5	0.3 – 0.6
TOTAL	41	

Source: Bulacan PDMO report as of 1pm, 16 October 2009.

Province of Nueva Ecija			
Town / City	Number of Barangays affected	Town / City	Number of Barangays affected
Gabaldon	2	Talavera	5
Cuyapo	17	Zaragoza	6
Guimba	15	Gapan City	1
Carrangaln	3	Quezon	9
Gen. Natividad	11	Aliaga	4
San Leonardo	5	Cabiao	6
Rizal	8	Laur	3
Bongabon	9	Sta. Rosa	3
Lupao	3	Talugtug	9
Licab	9	Jaen	8
Sto. Domingo	5	Munoz City	7
Llanera	9	Palayan City	4

San Jose City	14	Nampicuan	
Pantabangan	1	Cabanatuan	54
San Isidro	2		
Total Towns / Cities affected = 29; Total Barangays affected = 232			

Source: Nueva Ecija PDCC report as of 16 October 2009.

Province of Tarlac

As per reports and partly on survey for some areas affected (flooded) in Tarlac falling within the Pampanga river basin: La paz with 21 barangays, Concepcion with 1 barangay, and Pura with 2 barangays

The town of La Paz was the worst affected area for the province of Tarlac in that part of the basin during “Pepeng”.

5.0 Flood Forecasting & Warning activities

Event Pepeng was divided into 2 parts since it took the disturbance a little over 10 days pass within the Philippine Area of Responsibility (PAR). After staying for about a day over land (October 03) it almost went out of the PAR on October 05 but unusually went back for an extended 2 days over the northern part of the country.

PRFFWC issued a total of 6 FB and 3 FA on “Pepeng’s” first passed over northern Luzon. Initial FB and FA were issued on the afternoon (4pm) of October 03 with subsequent issuance of 2 more FA’s and 5 FB’s following a 12-hourly interval issuance (5am, 5pm) protocol.

On “Pepeng’s” second passed over northern Luzon, PRFFWC issued 12 FB more. No FA was issued for Guagua river sub-basin. Flood watch monitoring and issuance of FB was reinstituted at 3pm of October 08 as moderate to occasionally heavy rains were monitored mostly at the upstream portions of the basin as well as in adjacent northern basins – Agno and Cagayan. Pantabangan dam was also set to release reservoir water at that time. Subsequent FB (no.2) was issued the following day at 5am and succeeding FB’s at a regular 12-hourly interval issuance protocol of 5am and 5pm. Final FB (no.12) was issued on the morning (5am) of October 14.

During event “Pepeng”, data received at the center was 100% for both RR and WL. The system worked perfectly well during the whole period with absolutely no data transmission downtime.

6.0 Event highlights

Some important information and area observations from the post-flood survey carried out almost a week after the event are summarized as follows:

1. Cabiao Floodway: Pampanga River overflowed through the floodway at around 5 to 6am of October 09. This coincided with a river stage reading of 4.87m and 8.65m for San Isidro and Arayat stations, respectively. By afternoon of that day, the Gapan-Olongapo Hi-way along that stretched was no longer passable to any type of land vehicle.
2. La Paz, Tarlac: Floodwaters reached the frontage of La Paz Municipal Hall at about 7am of October 09. Estimated maximum depth of 1-meter was attained at around 4pm of that same day. Floodwaters totally subsided by midday of October 12. Floodwaters were reported to have come from the north side of the town, from the right banks of the Rio Chico River.

3. Caniogan staff gauge at Calumpit, Bulacan: A manually observed gauge at Bgy. Caniogan in Calumpit was part of the monitoring system for the town in connection with the CBFMMP of the province of Bulacan. A graph of the observations taken during the latter part of “Pepeng” was made and compared with water levels at Zaragoza, Arayat, Sulipan and Candaba (Figure 2-7.0 below).

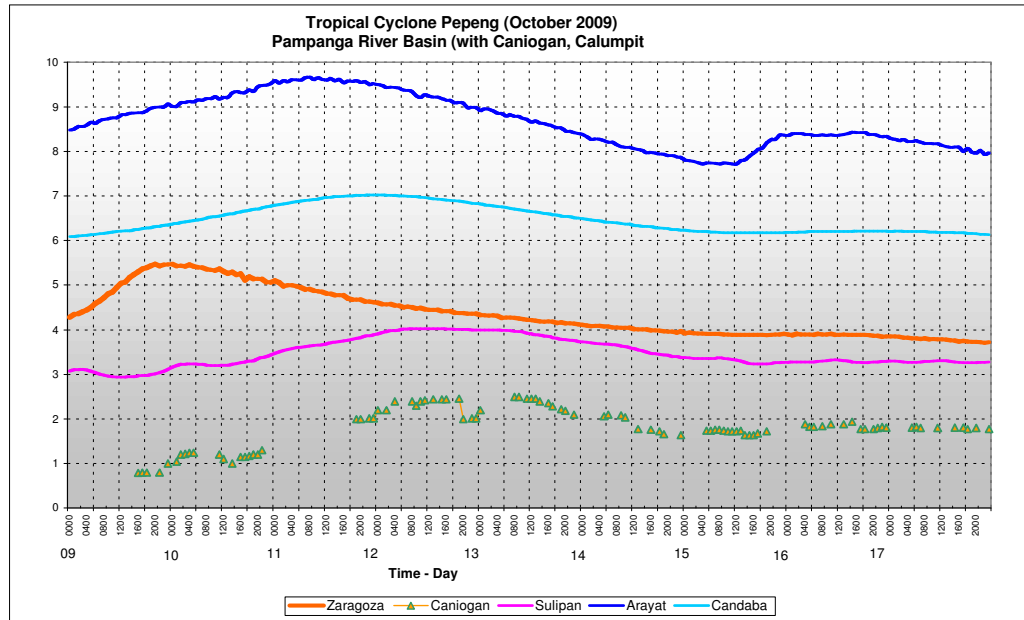


Figure 2-7.0 Caniogan water level observations compared with monitored water levels at Zaragoza, Arayat, Sulipan and Candaba.

The graph shows few inconsistencies at some point but generally follows the trend taken at Sulipan station.

4. Flood Marker at Bgy. Calizon, Calumpit, Bulacan: Floodwaters started to affect the flood marker along the Calumpit-Hagonoy road at Bgy. Calizon, Calumpit at around midnight of October 08. Peak was observed on October 12 and floodwaters lasted for almost a week at barangay area proper. The flood marker also registered floodwaters during “Ondoy” on September 26.

Photo 1.0 Floodwaters along the Calumpit-Hagonot road stretched at Barangay Calizon in Calumpit taken 27 September 2009, during “Ondoy”. (courtesy of the Municipal Administrator of Calumpit)



5. Barangay San Anton, San Leonardo, Nueva Ecija: Floodwaters started to arrive at around 8am of October 09 and peaked at about 10pm of that same day. Floodwaters subsided at around 12noon of October 11. Floodwater depth was estimated at 1-meter depth within the barangay proper.



Photo 2.0 Perlita Tinio, a resident of Bgy. San Anton, San Leonardo, N.E., points to a flood mark attained in their area. Further, the flood of November 2004 was higher than “Pepeng” event according to residents in the area.

6. Barangay Niugan, Jaen, Nueva Ecija: Floodwaters started to arrive at the area at around noontime of October 09 and peaked on November 11. Floodwaters subsided eventually after more than a day in the area.
7. Barangays San Isidro and San Juan in Hagonoy, Bulacan: Floodwaters arrived at the area at around 4am of October 11. It peaked at around 11am, October 13, and subsided at about morning of October 15.

References:

Reports

Post-Flood Investigation Report – Pampanga River Basin: Flood of August 2004 (Southwest Monsoon as enhanced by Typhoon “Marce”). PRFFWC, Flood Forecasting Branch, PAGASA, DOST. September 2004.

Resource Entities:

1. Regional Disaster Coordinating Council, Region 3, SFDO, Pampanga
2. Bulacan Provincial Disaster Management Office, Malolos, Bulacan
3. Pampanga Provincial Disaster Coordinating Council, San Fernando, Pampanga
4. Nueva Ecija Provincial Disaster Coordinating Council, Cabanatuan, Nueva Ecija
5. La Paz Municipal Social Welfare Services, La Paz, Nueva Ecija
6. Hagonoy Municipal Disaster Coordinating Council, Hagonoy, Bulacan
7. Calumpit Municipal Disaster Coordinating Council, Calumpit, Bulacan