



Pampanga River Basin Flood Forecasting & Warning Center (PRFFWC)
Philippine Atmospheric, Geophysical & Astronomical Services
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PRFFWC Post-Flood Report 2011-2¹

Event: Typhoons “PEDRING” (NESAT) and “QUIEL” (NALGAE)
September 26 to October 04, 2011



¹ Post-Flood Survey Report by H. Hernando and R. “Amang” O. Mendoza; Survey date: October 17-20, 2011.

Summary

Tropical Cyclone “Pedring” entered the Philippine Area of Responsibility (PAR) in the afternoon of September 24 as a tropical storm. It made landfall somewhere between the Provinces of Aurora and Isabela in the early morning of September 27 as a typhoon category having maximum winds of 140 kph (kilometer per hour) and gusts of more than 170 kph. It crossed Northern Luzon, roughly north of Pampanga River Basin (PRB), and exited PAR in the afternoon of 28 September.

Continuous moderate to occasionally heavy rains spawned by “Pedring” on the eastern part of PRB in the afternoon of September 26 until early morning of September 27 caused a flashy overflowing of the Digmala, Coronel, Cabu and the upper Pampanga Rivers. This rainfall condition progressed throughout the rest of the day of September 27 until early morning of the following day over the whole basin. By late afternoon of September 28, almost all floodwaters from the upper part of the basin had already inundated riverside areas along the Pampanga River from Cabanatuan City in Nueva Ecija down to Hagonoy in Bulacan. Flood levels attained at some of the forecasting points within the PRB have surpassed flood records in the last 2 decades of flood monitoring within basin.

With floods still on the verged of cresting in many parts of Northern and Central Luzon due to “Pedring”, another tropical cyclone “Quiel” entered the PAR as a tropical storm off the coast East of Northern Luzon on the morning of September 29. By late afternoon “Quiel” intensified into a typhoon category with winds of more than 120 kph as it threatened Northern Luzon, accelerating its speed to 22 kph. It made landfall over Dinapigue, Isabela early morning of October 01, cut across the Cordillera mountain range and exited through La Union in a period of just about 6 hours.

Unlike the flood levels attained as a result of “Pedring”, “Quiel’s” flood effects were relatively lower as its rains were not wholly directed over the PRB. Nonetheless, “Quiel” further prolonged inundation at the Candaba swamp area, the Rio Chico River sub-basin, and eventually the lower main Pampanga River. Angat Dam through the Ipo Dam spilled reservoir water starting in the afternoon of September 27 until the afternoon of September 30 during the two successive events. Maximum discharge from Angat Dam of 415 cumecs (m³/sec) was recorded midday of September 29. While this volume is comparatively small than the flood flows from the Main Pampanga River, it partly contributed to the floodwaters downstream of the Angat River.

The local Disaster Risk Reduction and Management Councils (DRRMCs) of several areas within the PRB, mainly the Province of Nueva Ecija and the Municipality of Calumpit in Bulacan, declared a state of calamity following these flood events. A total of about 32 fatalities were reported within PRB area mostly due to drowning. A nationwide total of 83 persons died as per NDRRMC report from the two events.

The Pampanga River Flood Forecasting and Warning Center (PRFFWC) issued a total flood information during both events as follows: 1 Flood Advisory (FA) and 18 Flood Bulletins (FB) covering the period from September 26 to October 04, being the longest flood watch operational period for the center since the start of the century.

1.0 Hydrological Area Background – Pampanga River Basin (PRB)²

The Pampanga River basin system is the 4th largest basin in the Philippines covering an aggregate area of 10,434 km² (square kilometer) and is broadly divided into three sub-basins, namely: (a) Pampanga main river basin with its catchment area of 7,978 km², (b) Pasac river basin (or alternatively known as the Pasac-Guagua allied river basin) with 1,371 km² and (c) Angat River basin with 1,085 km². These three basins originate from different mountain areas having separate river mouths to the Manila Bay but are interconnected by channels and their water resources management works are mutually and closely related. The basin spreads over the administrative area of eleven (11) provinces covering about 90 municipalities/cities. The substantial part of the basin area (about 95%) is, however, within the bounds of four provinces, namely, Nueva Ecija, Tarlac, Pampanga and Bulacan while the remaining fringe area (about 5%) is a part of the other seven provinces, Aurora, Zambales, Rizal, Quezon, Pangasinan, Bataan and Nueva Vizcaya.

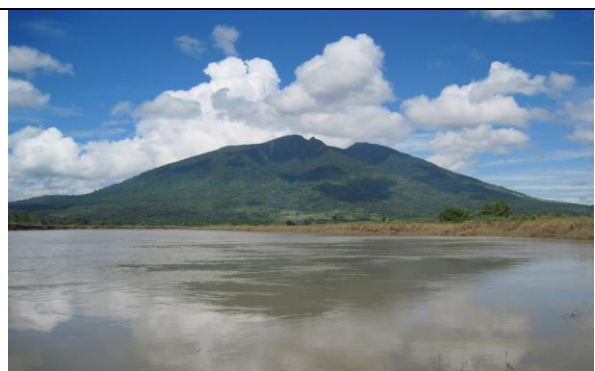


Figure 1.0 Pampanga River with Mt. Arayat in the background.

Pampanga River has a channel length of 265 kms with headwaters originating in the Caraballo Mountains north of the basin, and flows into Pantabangan storage dam. After the dam, it further flows southward meeting with several tributaries until emptying into Manila Bay. The major tributaries are Coronel, Peñaranda, and Rio Chico Rivers. Rio Chico has the largest catchment area at 2,895 km² and it joins the main stream of Pampanga nearby Mt. Arayat (elevation 1,026 m).

The Angat River system originates in the Sierra Madre Mountains and flows into Angat storage dam meandering through a narrow valley. From the dam, the river flows westward and finally empties into the Manila Bay through Labangan Floodway. There is a connecting channel with Pampanga River, the Bagbag River, situated in the towns of Pulilan and Calumpit in Bulacan.

The Pasac-Guagua River system includes various channels running on the eastern slope of Mt. Pinatubo, such as the Abacan-San Fernando, Pasig-Potrero and Porac-Gumain Rivers. All these rivers originate in Mt. Pinatubo and flow into Manila Bay. In the lower reaches, the river system is connected with Main Pampanga River by the Bebe-San Esteban Cut-off Channel. The morphologies of Pasac River have been much affected by the eruption of Mt. Pinatubo in 1991; river alignments have changed due to mudflow (lahar) movement, and serious sediment deposition in the river channel is progressively active.

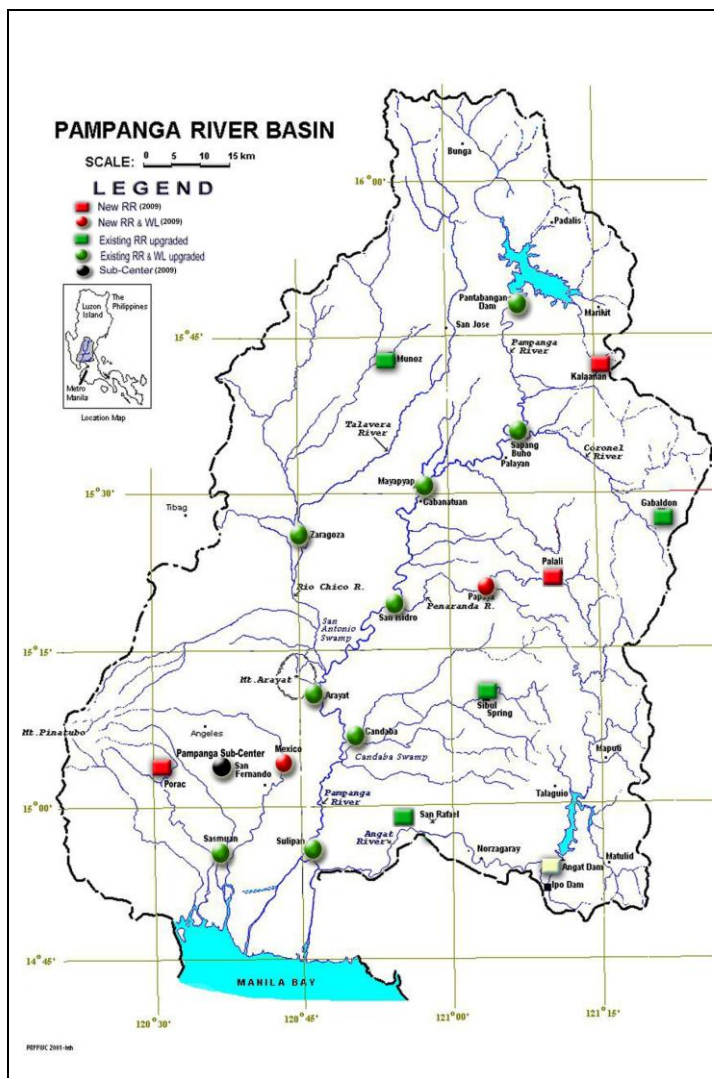
The basin has two swamp areas, the Candaba and the San Antonio Swamps with an area of about 250 and 100 km², respectively. Candaba Swamp has the maximum inundation area of about 330 km² during rainy season.

² Major Parts taken from the Draft Final Report "The Study on Integrated Water Resources Management for Poverty Alleviation and Economic Development in the Pampanga River Basin". NWRB-JICA Project, December 2010. (PRFFWC is a project TWG member)

The two major hydraulic structures within the basin are Pantabangan and Angat Dams. Pantabangan is located upstream of the upper main Pampanga River and operates both as hydropower and as an irrigation dam. Angat is located on the eastern portion of the lower main Pampanga River and drains through the Angat River via Ipo and Bustos Dams. Angat operates as a hydropower plant while Ipo and Bustos as water supply reservoir and irrigation dams, respectively.

The long-term average annual precipitation in the study area is estimated at about 2,155 mm/year, and about 83% of this is concentrated during the rainy season from May to October.

Figure 2.0 (Right) - The Pampanga River Basin Map showing locations of the network of telemeterized rainfall and water level stations in the present system (2009) of PRFFWC.



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

The PRFFW system consists of 17 rainfall (RR) and 10 water level (WL) stations within its monitoring network and is complemented with several RR observations in Bulacan and Pampanga. There are 2 synoptic and 1 agrometeorological stations within the basin. These stations are not, however, transmitting data on a real-time basis to the center. The PRFFW operations center is located in the DOST Region 3 compound in the city of San Fernando, Province of Pampanga.

Table 1.0 RR and WL Stations within the Pampanga River Basin System

Station	Station Type	Coordinates
Muñoz	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
Gabalton	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 & WL	14°56'11"N, 120°37'23"E
San Fernando	Digital tipping-bucket RR	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, Muñoz	Agrometeorological	15°43'N, 120°54'E

3.0 Meteorological Aspect

3.1 Typhoon "PEDRING" (*International name: NESAT*)

"Pedring" entered the Philippine Area of Responsibility (PAR) as a tropical storm East of Southern Luzon in the afternoon of September 24 about a thousand kilometers ENE of Virac, Catanduanes, packing maximum winds of 65 kph and gusts of up to 80 kph moving West Northwest at 19 kph which is relatively fast for a tropical cyclone movement. PAGASA issued initial weather bulletin (no. 1) in the afternoon of that day.

Before noon of September 25, "Pedring" has intensified its center winds just short of a 100 kph and gusts of 120 kph and was located about 600 kms ENE of Virac. It increased its speed at 22 kph on a westward direction. Public Storm Warning Signals (PSWS) were now raised in several of the Bicol region provinces. Towards night time, PSWS were further issued at other surrounding provinces.

"Pedring" had further intensified into a typhoon category before noon of September 26. With maximum winds of 120 kph and gusts of up to 150 kph, it was now moving on a WNW direction between 17 to 19 kph as it now threatens the Isabela-Aurora Area. PSWS no. 1 was raised over the provinces of Region 3 except in Aurora which was placed under PSWS no. 2.

Typhoon "Pedring" made landfall between the boundary of Aurora and Isabela Provinces before dawn of September 27 with maximum winds of 140 kph and gusts of up to 170 kph maintaining a WNW direction on a 19 kph movement. PSWS no. 3 was raised over Aurora, Tarlac, Nueva Ecija and Zambales for Region 3 while PSWS no. 2 over the rest of the provinces in the region. "Pedring" had weakened considerably before noon as it crossed the rugged terrain of the Sierra Madre mountain range to a 120 kph maximum winds and gusts down to 150 kph without changing its direction and movement. Before nightfall, the typhoon had already crossed Northern Luzon via Casiguran, Baguio and exiting south of San Fernando, La Union towards the West Philippine Sea.

By noon of September 28 as it trekked within the West Philippine Sea and moved away from the country, "Pedring" eventually re-intensified back into 130 kph winds and gusts of 160 kph maintaining its speed and direction. By late afternoon of that day, final weather bulletin for Typhoon "Pedring" was issued as it moved further away from the country and eventually exited the PAR.

"Pedring" was the 16th tropical cyclone to pass through the PAR. PAGASA issued 16 weather bulletins during its passage through the PAR. It struck the country with a maximum observed 1-min sustained wind speed of 105 knots (194 kph; 121 mph) early of September 27. NDRRMC stated

“Pedring” as one of the costliest typhoons to have affected the nation by putting the total damage to both agriculture and infrastructure at US\$ 201,749,712.³

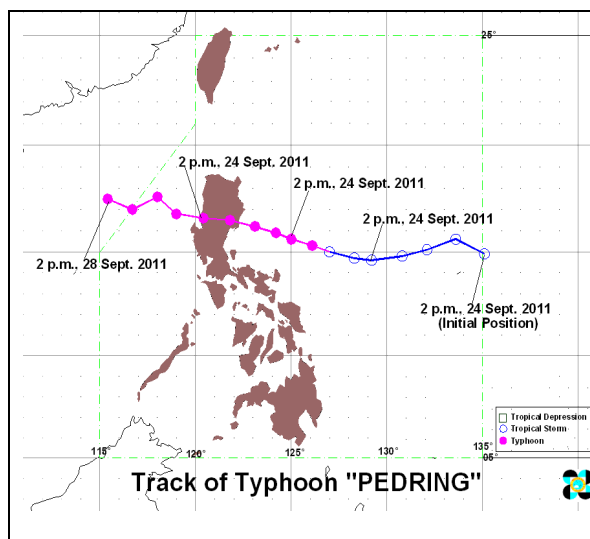


Figure 3.0 Track of Typhoon “Pedring” during its course within the PAR (Sept 24 to 28).⁴

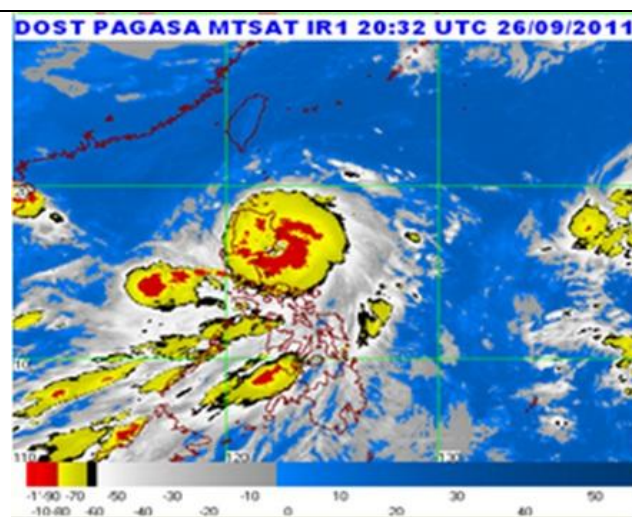


Figure 3.1 The enhanced IR satellite image of “Pedring” as of 0432H (LST), September 27, 2011 as it made landfall over at the Isabela-Aurora boundary.

3.2 Typhoon “QUIEL” (*International name: NALGAE*)

“Quiel” was the 17th tropical cyclone to hit the country for the year 2011. With floods still on the verged of cresting in many parts of Northern and Central Luzon due to “Pedring”, “Quiel” entered the PAR as a tropical storm at the East of Northern Luzon, about 1,240 kms East of Aparri, Cagayan, on the morning of September 29. It was packing maximum winds of 105 kph near its center and gusts of up to 135 kph moving West at 10 kph. By late afternoon, “Quiel” intensified into a typhoon category and increased its threat to Northern Luzon as it accelerated to a 22 kph movement.

By afternoon of September 30, “Quiel” was already 490 kms East of Tuguegarao, Cagayan now with winds of 140 kph and gusts of 170 kph moving westward at 26 kph. Various PSWS were now raised at almost all the provinces of Northern Luzon.

Apparently in the usual way of maintaining a westward direction, “Quiel” unexpectedly changed its course to West Southwest before dawn of October 01 and now threatened the Aurora-Isabela area. More serious was that its winds increased to 160 kph and gusts now close to 200 kph. PSWS no. 2 was raised over 6 provinces of Region 3 except for Bataan which was under PSWS no. 1.

Typhoon “Quiel” made landfall over Dinapigue, Isabela at around past 1000H (LST) of October 01 and cut across the Cordillera mountain range exiting through La Union Province in just about 6

³ Portions taken from [http://en.wikipedia.org/wiki/Typhoon_Nesat_\(2011\)](http://en.wikipedia.org/wiki/Typhoon_Nesat_(2011))

⁴ Track of Tropical Cyclone “Pedring” courtesy of “dyuwi@yahoo.com”

hours. Before midnight, the typhoon was over the West Philippine Sea. “Quiel” left the PAR in the morning of October 2 as a tropical storm but not after toppling fairly a number of structures, caused landslides and further aggravating the already flooded areas in many parts of Northern and Central Luzon.

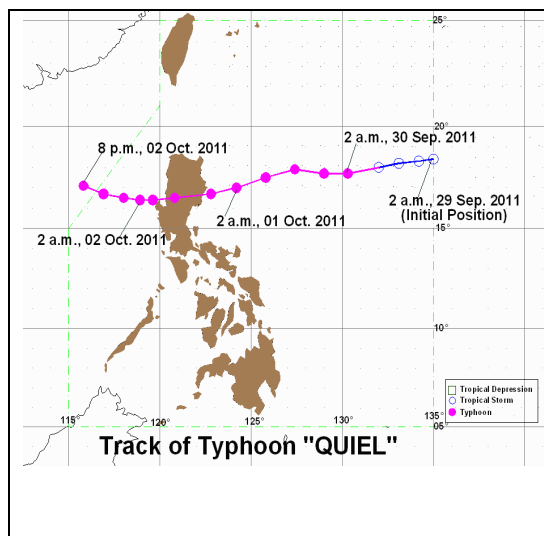


Figure 4.0 Track of Typhoon “Quiel” within the PAR (Sept 29 to Oct. 02).⁵

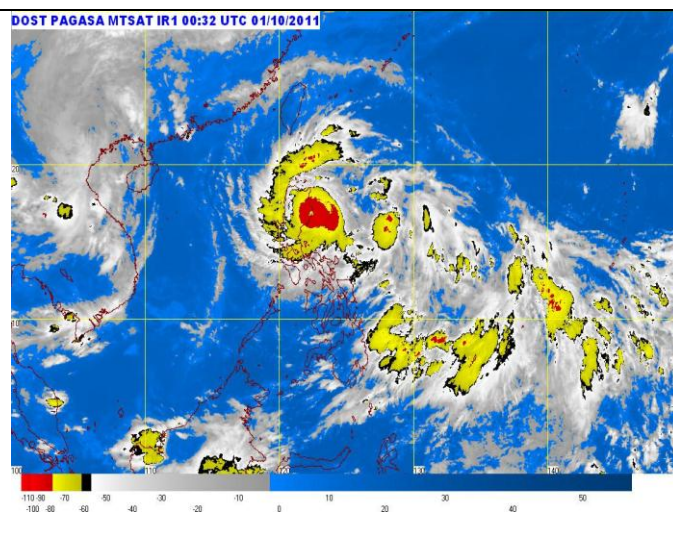


Figure 4.1 Enhanced IR satellite image of “Quiel” taken at about 0832H (LST), October 01, 2011.

4.0 Basin Hydrological Aspect

Table 2.0 Rainfall Intensity Classification Table (mm/hr)

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

4.1 Rainfall (“Pedring”)

Table 2.1 Pampanga River Basin 24-hr rainfall for the period Sept 26 to 28.

Stations	September 2011			Maximum observed 1-hr RR	Time (LST) / Day of maximum 1-hr RR for the period September 26 to 28, 2011
	26	27	28		
Muñoz	66	175	6	35	1400H / Sept 27
Sapang Buho	141	182	8	26	1300H / Sept 27
Gabaldon	422	184	4	37	0300H / Sept 27
Zaragoza	46	170	6	33	1300H / Sept 27
Mayapyap	82	170	15	26	1300H / Sept 27
Peñaranda	108	199	8	36	1100H / Sept 27
Calaanan	177	211	5	28	1300H / Sept 27
Palali	248	156	1	25	1500H / Sept 27
San Isidro	73	187	9	35	1100H / Sept 27

⁵ Track of Tropical Cyclone “Quiel” courtesy of “dyuwi@yahoo.com”

Arayat	49	221	15	49	1400H / Sept 27
Candaba	49	200	12	52	1300H / Sept 27
Sibul Springs	108	261	2	55	1300H / Sept 27
Sulipan	34	158	14	26	1300H / Sept 27
San Rafael	61	245	4	35	1300H / Sept 27
Basin Average	118.8	194.2	7.8		

Table 2.2 Pasac-Guagua River Basin (Allied basin) RR for the same period

Stations	September 2011			Maximum observed 1-hr RR	Time (LST) / Day of maximum 1-hr RR for the period September 26 to 28, 2011
	26	27	28		
Sasmuan	27	152	19	19	1000H / Sept 27
Mexico	35	227	23	42	1300H / Sept 27
Porac	30	207	32	36	1300H / Sept 27
San Fernando	23	190	20	38.1	1300H / Sept 27
Basin Average	28.7	194.0	23.5		

Rainfall observations mainly from various stations within PRB were used to produce the 24-hr meteorological day (met-day) isohyets for September 26 and 27. From the above tables, the highest basin average rainfall was on the met-day of September 27. Maximum 1-hr rainfall in most of the stations generally occurred before and after noontime of the 27th except for Gabaldon station, which was on the early morning of the 27th falling within the met-day of September 26.

Table 2.3 Other stations (Synoptic) RR for the period

Stations	September 2011		
	26	27	28
Clark, Pampanga			28.8
Cabanatuan, Nueva Ecija	97	189	16.2
Baler, Aurora	48	160	2.8
Subic, Zambales		401	113.4
Iba, Zambales	55	178	77.8
Carmen, Pangasinan (ARB)	31	133	22
Sta. Barbara, Pangasinan (ARB)	19	137	13
Tibag, Tarlac (ARB)	39	89	21
Shaded cells are as per available FFWS-HMD info. ARB - Agno River Basin; Blanks – no data provided			

Isohyets for September 26, which is the 24-hour rainfall total ending at 8 am of September 27 (Figure 4.2 left side), shows a fairly tight contour at the eastern part of the basin, particularly at the Gabaldon area in Nueva Ecija. The 24-hour rainfall total for Gabaldon station during that period was 422 mm. Likewise, Palali (Gen. Tinio) and Calaanan (Bongabon) stations have considerably higher rainfall totals as well, 248 mm and 177 mm, respectively. Heavy rains at the eastern part of the basin started in the afternoon of September 26. On the other hand, September 27 isohyets, which is the 24-hour rainfall totals ending at 8 am of September 28 (Figure 4.2 right side), shows a shift of tight isohyets towards the southwest part of the basin.

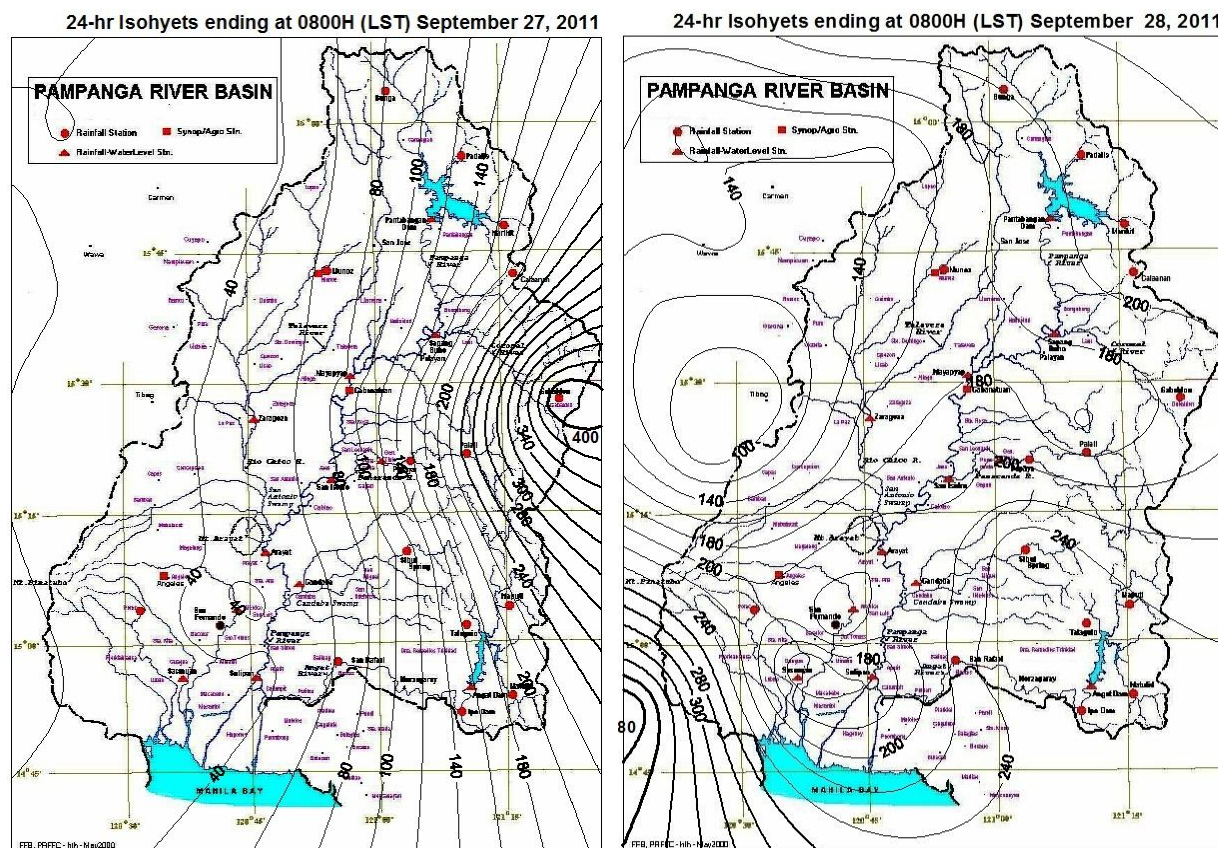


Figure 4.2 The 24-hour met-day (meteorological day) isohyets for September 26 (top left) and September 27 (top right) during the passage of Typhoon “Pedring”.

4.2 Rainfall (“Quiel”)

Table 3.1 Pampanga River Basin RR total for the period Sept 30 to Oct 02

Stations	Sept.	October 2011		Maximum observed 1 –hr RR	Time (LST) / Day of maximum 1-hr RR for the period Sept. 30 to Oct 3, 2011
	30	01	02		
Muñoz	1	164	7	26	1800H / Oct 01
Sapang Buho	1	97	11	20	1300H / Oct 01
Gabaldon	4	74	15	23	1200H / Oct 01
Zaragoza	0	102	12	23	1900H / Oct 01
Mayapyap	0	68	5	11	1300H / Oct 01
Peñaranda	0	37	3	9	1400H / Oct 01
Calaanan	6	112	14	28	1400H / Oct 01
Palali	1	36	5	9	1300H / Oct 01
San Isidro	0	40	23	9	1600H / Oct 02
Arayat	3	25	57	22	0500H / Oct 03
Candaba	0	11	5	2	1300H / Oct 01
Sibul Springs	0	15	1	4	2100H / Oct 03
Sulipan	2	13	8	3	1200H / Oct 01
San Rafael	0	10	3	4	1500H / Oct 01
Basin Average	1.3	57.4	12.1		

Table 3.2 Pasac-Guagua River Basin (Allied basin) RR for the same period

Stations	Sept.	October 2011		Maximum observed 1 –hr RR	Time (LST) / Day of maximum 1- hr RR for the period Sept. 30 to Oct 3, 2011
	30	1	2		
Sasmuan	0	33	30	13	0400H / Oct 03
Mexico	14	13	33	19	0500H / Oct 03
Porac	9	65	55	42	0300H / Oct 03
San Fernando	5	19	58		
Basin Average	7.0	32.5	44.0		

Table 3.3 Other stations (Synoptic) RR for the period

Stations	Sept.	October 2011	
	30	1	2
Clark, Pampanga		40	
Cabanatuan, Nueva Ecija		87.8	4.2
Baler, Aurora	6.8		23
Subic, Zambales	0.5	88	
Iba, Zambales	12.6	160	48.2
Carmen, Pangasinan (ARB)	1	137	0
Sta. Barbara, Pangasinan (ARB)	32	111	0
Tibag, Tarlac (ARB)	1	150	1
Shaded cells are as per available FFWS-HMD info. ARB - Agno River Basin; Blanks - no data provided			

Basin average rainfall during the event “Quiel” was highest on the met-day October 01 for the PRB, although the allied basin of Pasac-Guagua had a maximum basin average on October 02. The 24-hour isohyets for met-day October 01 is shown on the figure on the right (Figure 4.3). Rainfall distribution shows higher amounts at the upper part of the basin, in particular at the sub-basin of Rio Chico situated on the northwest corner of PRB. The rainfall effects of “Quiel” were mainly concentrated over at the Agno River Basin (ARB) which adjacently bounds PRB on the northwest to its north northwest corner side. A relatively lower average rainfall distribution prevailed over the PRB for met-day October 02; also, the 3 adjacent stations of ARB during that same period (Table 3.3) recorded almost no rainfall.

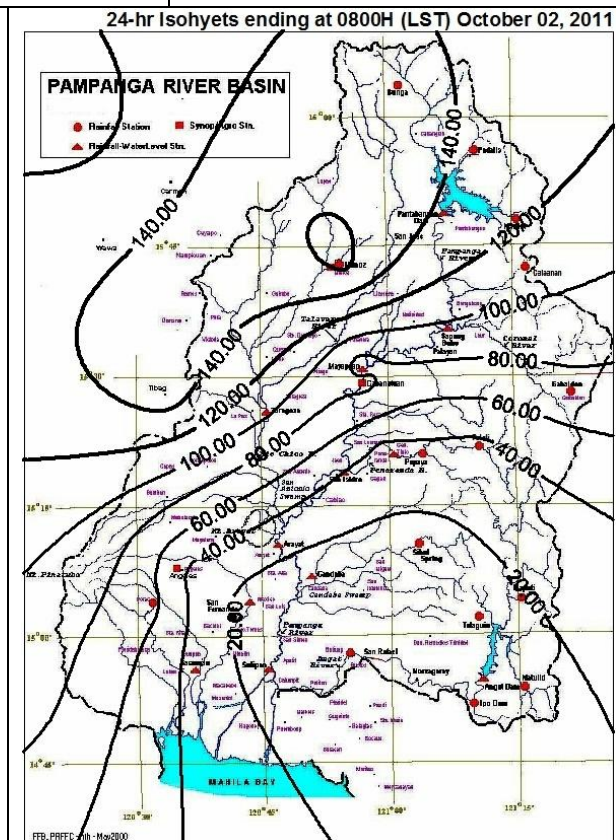


Figure 4.3 Isohyets for the met-day October 01.

5.0 River Heights during the events

5.1 Station gauge heights during “Pedring”

Table 4.0 Time / Date of Station’s Flood Assessment Gage Heights were reached during “Pedring”

Station Point	Alert Level	Alarm Level	Critical Level	Remarks
Sapang Buho	(3.70 m) Before 0600H of Sept. 27	(4.50 m) Between 0800H-0900H, Sept. 27	(6.50 m) Before 1400H of Sept. 27	Peak WL based on telemetry reading was 7.17 m (57.364 m AMSL) attained at about 1600H of Sept 27.
Mayapyap	(3.00 m) Around 1300H of Sept. 27	(3.50 m) Before 1500H of Sept. 27	(4.50 m) Around 1600H of Sept. 27	Peak WL based on telemetry reading was 6.86 m (32.66 m AMSL) attained at around 2100H of Sept 27.
Zaragoza	(11.00 m) Already above this level prior to the event	(12.50 m) Already above this level prior to the event	(14.50 m) Before 1100H of Sept. 28	WL crested as per telemetry records at 5.19 m (15.403 m AMSL) attained on 0800H, Sept 29.
Peñaranda	No assigned assessment levels at the moment			Maximum telemetry reading of 6.01 m (24.306 m TBM based) recorded on 1700H of Sept. 27.
San Isidro	(3.20 m) Before 0500H of Sept 27	(4.50 m) Before 1100H of Sept 27	(6.00 m) Before 1500H of Sept 27	Peak WL based on telemetry records was 7.75 m (17.335 m AMSL) attained at around 0800H of Sept 28.
Arayat (station out of order)	(5.00 m)	(6.00 m)	(8.50 m)	As per interview at the site, all assessment levels were reached and WL crested as per estimated flood marks at 10.60 m (10.677 m AMSL) attained around morning of September 30.
Candaba	(3.00 m) Already above this level prior to the event	(4.50 m) About 1300H of Sept 27	(5.00 m) Before 2000H of Sept 27	Swamp water crested, as per telemetry records, at 7.62 m (7.463 m AMSL) reached on 2000H, Sept 29th and remained above the 7.00 m level until 0600H of Oct. 02
Mexico	No assigned assessment levels at the moment			Maximum WL based on telemetry readings was 3.30 m (9.233 m TBM based) and was attained on 1800H of Sept 27.
Sasmuan	No assigned assessment levels at the moment			Guagua River at Sasmuan station crested, as per telemetry records, at 3.09 m (1.673 m AMSL) attained on 0100H of Sept 28.
Sulipan	(3.60 m) Around 0400H of Sept 29	(4.20 m) Around 1300H of Sept 29	(5.00 m) Not reached	Maximum WL based on telemetry readings was 4.85 m (4.788 m AMSL) attained on 1900H of Sept 30.
<i>Note: Elevation of “0” of staff gages were based on surveys undertaken on August 2009. TBM – Temporary Bench Mark</i>				

Water level stations with assessment levels were all reached during the event “Pedring” with the exception only of Sulipan station’s which fell short by 15 centimeters from its designated critical level of 5.0 meters. Mexico and Sasmuan stations, the only two WL stations in the allied river basin of Pasac-

Guagua, have relatively lower flood crest levels as compared to a previous event “Falcon” (June 23-29) on the same year. On the other hand, a much lower stage levels were recorded for WL stations within the PRB during the said event (“Falcon”). This clearly shows that floodwaters brought by event “Pedring” were concentrated more towards the PRB rather than in its allied river basin, Pasac-Guagua.

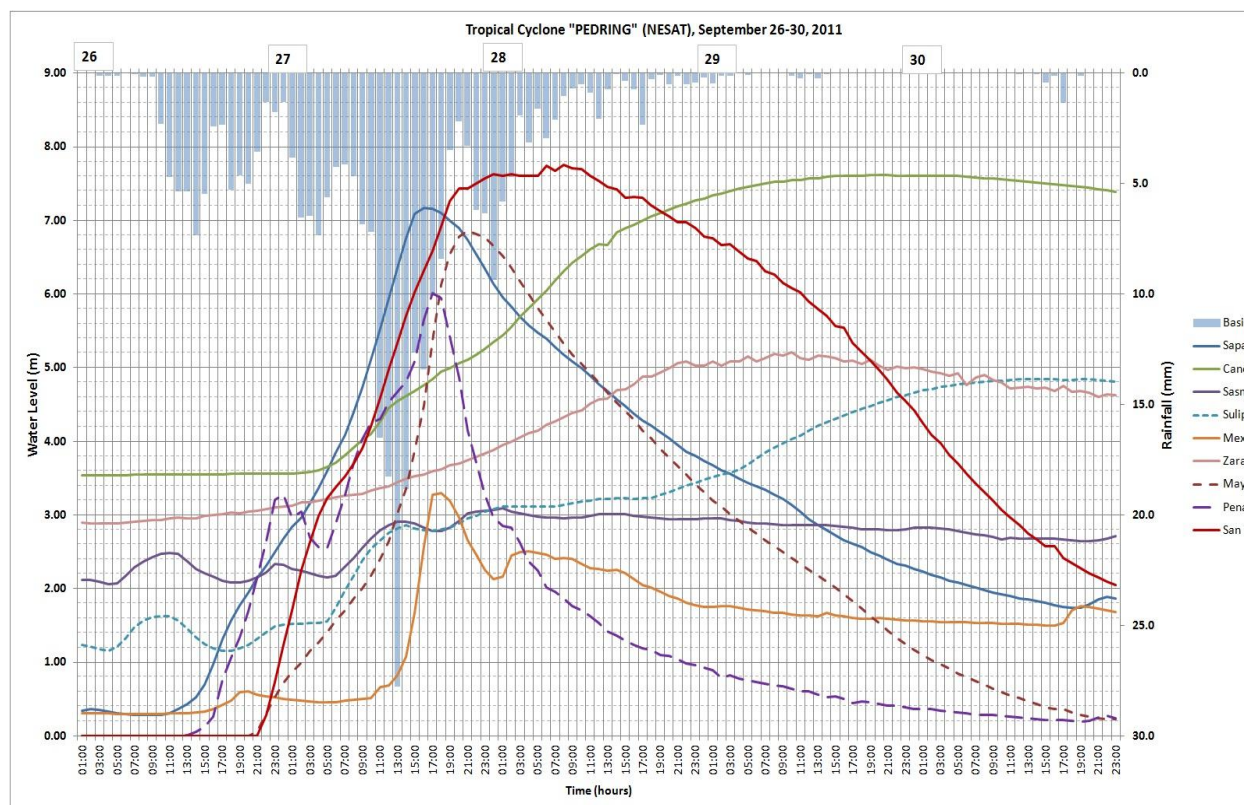


Figure 5.0 Hyetograph (mean basin rainfall) and hydrographs at various forecasting points within the basin covering the period from September 26 to October 30 during event “Pedring”.

5.2 Station gauge heights during “Quiel”

Table 4.1 Time / Date of Station’s Flood Assessment Gage Heights were reached during “Quiel”

Station Point	Alert Level	Alarm Level	Critical Level	Remarks
Sapang Buho	(3.70 m) Before 1800H of Oct. 01	(4.50 m) Before 1900H of Oct. 01	(6.50 m) Not reached	Peak WL based on telemetry reading was 4.83 m (55.024 m AMSL) attained at about 2100H of Oct. 01.
Mayapyap	(3.00 m) Just after midnight of Oct. 02	(3.50 m) About 0300H of Oct. 02 (peak)	(4.50 m) At 2100H of Oct. 01	Peak WL based on telemetry reading was 3.49 m (29.29 m AMSL) attained at around 0300H of Oct. 02
Zaragoza	(11.00 m) Already above this level prior to the event	(12.50 m) Already above this level prior to the event	(14.50 m) Before 1100H of Sept. 28	WL crested as per telemetry records at 5.18 m (15.393 m AMSL) attained on 0200H, Oct. 03.
Peñaranda	No assigned assessment levels at the moment			Maximum telemetry reading of 0.77 m (19.066 m TBM based) recorded on 1900H of Oct. 01.

San Isidro	(3.20 m) Before 0600H of Oct 2	(4.50 m) Was not reached	(6.00 m) Was not reached	Peak WL based on telemetry records was 4.38 m (13.965 m AMSL) attained on 1600H of Oct. 02.
Arayat (station out of order)	(5.00 m)	(6.00 m)	(8.50 m)	As per estimates peak WL reached above alarm but no longer reached critical level.
Candaba	(3.00 m) Already above this level prior to the event	(4.50 m) Already above this level prior to the event	(5.00 m) Already above this level prior to the event	Swamp water level was still above the critical level coming from the previous flood event – “Pedring” and river was receding slowly.
Mexico	No assigned assessment levels at the moment			Maximum WL based on telemetry readings was 2.42 m (8.353 m TBM based) and was attained on 0600H of Oct 03.
Sasmuan	No assigned assessment levels at the moment			Guagua River at Sasmuan station crested, as per telemetry records, at two same peak values of 2.92 m (1.503 m AMSL) attained on 0300H of Oct 02 and 0400H of Oct. 03.
Sulipan	(3.60 m) Already above this level prior to the event	(4.20 m) Already above this level prior to the event	(5.00 m) Not reached	Water level was still above the alarm level coming from the previous flood event - “Pedring” and river was receding slowly.
<p><i>Note: Elevation of “0” of staff gages were based on surveys undertaken on August 2009.</i></p> <p><i>TBM – Temporary Bench Mark</i></p>				

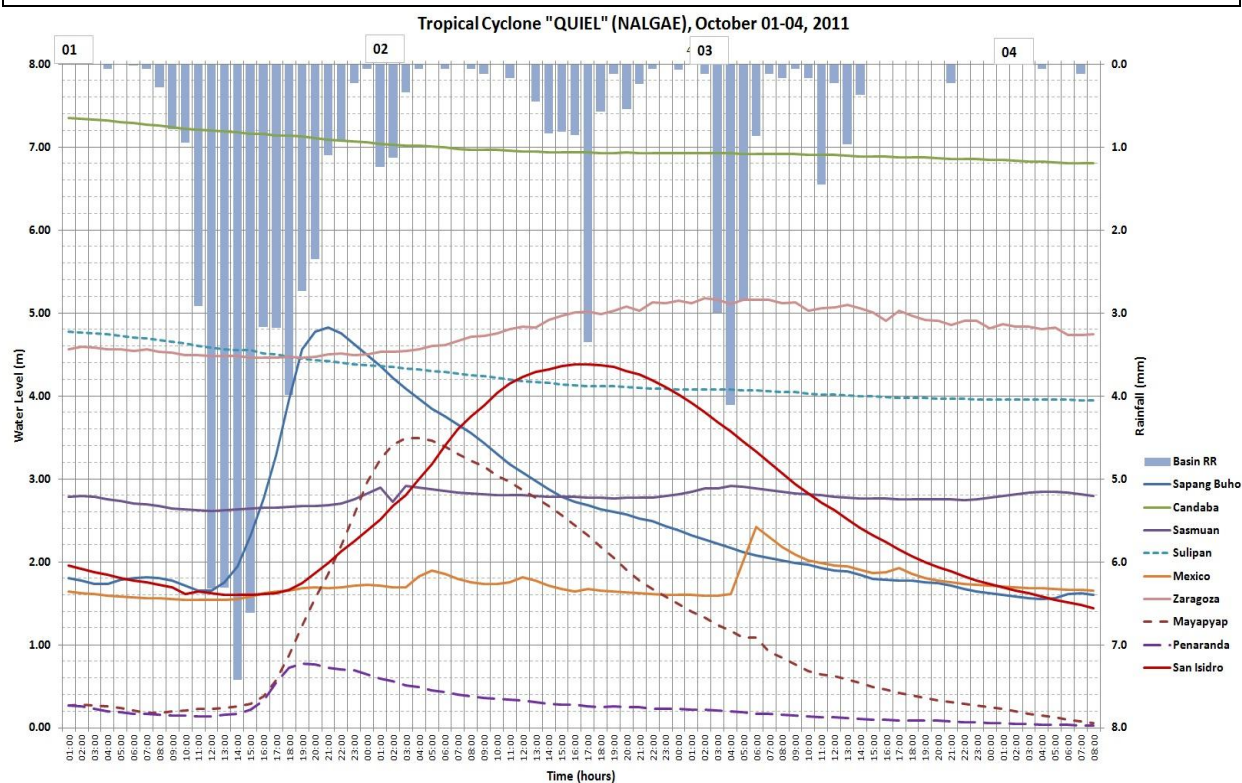


Figure 5.1 Hyetograph (mean basin rainfall) and hydrographs at various forecasting points within the basin covering from the period October 01 to 04 during event “Quiel”.

Floodwaters during event “Quiel” (Table 4.1) were generally quite lower than with event “Pedring” (Table 4.0). Zaragoza WL is more or less equal for both events. “Quiel’s” effect may not have equalled the floodwaters during the former (“Pedring”) event but it did prolonged floods at the downstream sections of PRB where most of the water levels are still either above the alarm or critical levels. This can be clearly seen at Figure 5.1 where hydrographs for Candaba and Sulipan are just starting on its falling trend on October 01.

5.3 Coastal Flooding: Tides and Storm Surge

Tides were at moderately high during the flood periods for both events. This may have contributed partly in the delay of floodwaters at the downstream sections of the basin in reaching its outlet in Manila Bay. High tide effects in the basin can sometimes reached further upstream of Sulipan station up to Arayat station during low flow conditions of the Pampanga River.

Table 5.0 High Tide (highest for the day) September 26 to October 04, 2011

Day	Time	Height (in meters)
Sept. 26	8:37 AM	1.15
27	9:33 AM	1.10
28	10:32 AM	1.00
29	10:36 AM	1.04
30	11:10 AM	1.10
Oct. 01	11:48 AM	1.13
02		
03	12:32 AM	1.13
04	1:21 AM	1.10

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

As per survey undertaken by a PAGASA team along Manila Bay (Roxas Blvd. Area, Metro Manila) and at the coastal areas of Navotas, it reported that a storm surge affected these areas on the morning of September 27 between the time period 0700H-1000H. ⁶ This coincided with the projected high tide occurring at around 0900H of the same day.

Surveys made at some coastal barangays in the towns of Obando and Bulacan (Sitio Parihan in Bgy. Taliptip) in the Province of Bulacan, similar high splashing of seawater and strong winds (storm surge effects) were experienced between the period 0800H-1000H. It was reported also that it was at this time period that these areas experienced the start of flooding in their areas. It is also likely that coastal areas of Hagonoy, Malolos, and Paombong in Bulacan, Macabebe, Masantol, and Sasmuan in Pampanga have been affected by the storm surge generated by “Pedring”.

5.4 Hydraulic Structures / Dam Releases

Pantabangan and Angat Dams are the two major hydraulic structures within PRB. Pantabangan Dam is located upstream of upper main Pampanga River and operates both as hydropower and as an irrigation reservoir. Conversely, Angat Dam is located on the eastern portion of the lower main Pampanga River and drains through the Angat River via the Ipo and Bustos Dams. It operates chiefly

⁶ Powerpoint presentation: “Storm Surge in Manila Bay, Typhoon “Pedring” (Sept. 26-28, 2011)” presented by N. Nimes, J. Nimes & W. Tuazon.

as a hydropower plant. Ipo Dam, which supports and minimally regulates releases coming from the Angat Dam, is situated about 7 kms 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 quite smaller than Angat Dam. Bustos Dam is located around 38 kms downstream of Ipo and serves mainly as an irrigation reservoir.

A small tributary, the Bayabas River, joins the Angat River in between the river stretch from Ipo Dam to Bustos Dam, about 28 kms downstream of the former. It contributes additional water to Bustos Dam whenever there are relatively significant flows coming from the mountainous area of DRT.

During “Pedring” spilling operations from Angat dam commenced at around 1600H of September 27. Maximum Q (discharge) attained during the whole spilling period occurred at 0900H of September 29 at 414.75 cumecs (or a total outflow of about 507 cumecs including outflows to the main and auxiliary turbines). Based on available info (Table 6.0) maximum Q at Ipo was 560.2 cumecs occurring around noontime of the 26th and for Bustos a peak outflow of 1,300 cumecs at around 1400H of September 27. The relatively big outflow at Bustos Dam can be attributed mainly to the significant contributions of Bayabas River coming in to the mainstream of Angat River prior to Bustos Dam.

Table 6.0 Dam spilling report during the event

Date	Angat Dam			Ipo Dam			Bustos Dam		
	Time	Gates opened & opening	Spill Q (cumecs)	Time	Gates opened	Spill Q (cumecs)	Time	Gates opened	Spill Q (cumecs)
Sept 26				1220H	3	560.2	1200H	4	725
Sept 27	1700H	1 @ 1m.	116	1600H	3	662	1400H	5	1300
	1900H	2 @ 1m.	237						
	2100H	1 @ 0.5	60	2115H	2	170	2200H	5	1200
Sept 28	0500H	1 @ 0.5	60	0400H	2	170	0500H	2	430
	1100H	2 @ 0.5	204	1100H	2	270			
	1600H	3 @ 0.5	207						
	1700H	3 @ 0.5	207				1700H	2	400
Sept 29	0600H	3 @ 0.5	207	0600H	3	387.7	0600H	2	400
	0900H	3 @ 1m.	415						
	1800H	3 @ 1m.	404						
Sept 30	0100H	3 @ 1m.	395						
	0800H	3 @ 1m.	384	1100H	closed				
	1600H	closed					1900H	3	200
Oct 01		closed			closed		0600H	1	17.35
Oct 02		closed			closed		1000H	1	65
Oct 03		closed			closed		0800H	1	65
							1700H	1	65

Note: Ipo and Bustos Dam spilling information were taken from Province of Bulacan presentation entitled “Effects of Typhoon Pedring and Tropical Storm Quiel” dated Oct. 17, 2011; Angat Dam data/ info were taken from Angat Dam FFWSDO data sheet. Red values under Angat Dam are the maximum Q for that day.

Ipo and Angat Dams both closed their gates on September 30, around 1100H and 1600H, respectively. No information is available as to when Bustos Dam closed its sector gates.

Bulu Dam is a small impounding reservoir for irrigation and is situated in the town of San Miguel, Bulacan along the Bulu River. Bulu Dam breached on the afternoon of September 27 (1430H) inundating almost all barangays at its downstream sections up to the Maharlika Hi-Way in San Miguel, Bulacan and eventually towards the Candaba swamp area.

6.0 Basin Hydrological Situations during the Events “Pedring” and “Quiel”

“Pedring’s” effect over the PRB generally started in the afternoon of September 26 as continuous moderate to occasionally heavy rains spawned by the disturbance on the eastern part of PRB until the morning of the next day, September 27, caused overflowing of rivers and streams in the upper PRB starting in the morning until afternoon of that day. In particular, Digmala River in Bongabon, Coronel River in Gabaldon and Laur, Cabu River in Palayan City, Upper main Pampanga River in Palayan and Cabanatuan, Chico and Penaranda Rivers in Gen. Tinio and Penaranda, respectively.

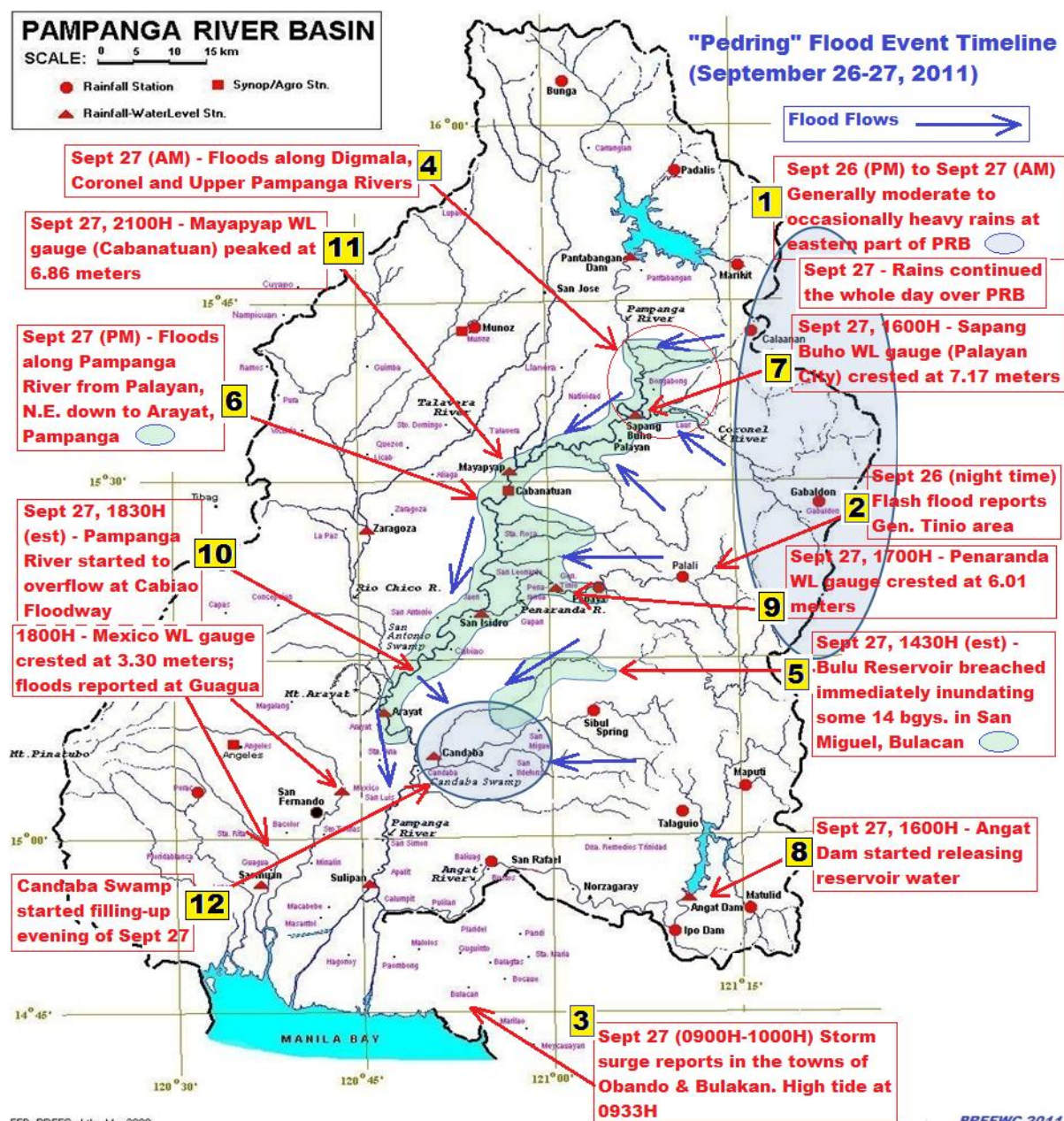


Figure 6.0 “Pedring” flood event timeline map from September 26 to 27, 2011.

Subsequent deteriorating hydrological situations ensued in the afternoon of September 27 and are basically summarized by the flood event timeline (Figure 6.0). By September 28, floods have already spilled downwards the basin inundating the Candaba swamp area and its adjacent areas. Overflowing of the main Pampanga River at its middle and lower sections inundated various municipalities along its river length. Floodwaters covered the Maharlika Hi-way along Sta. Rosa and San Leonardo, riverside areas of Jaen, Gapan City, San Isidro, San Antonio and Cabiao all in Nueva Ecija Province; riverside areas of Arayat, Candaba, San Luis, San Simon and Apalit in Pampanga Province; Calumpit, Hagonoy and Paombong in the Province of Bulacan.

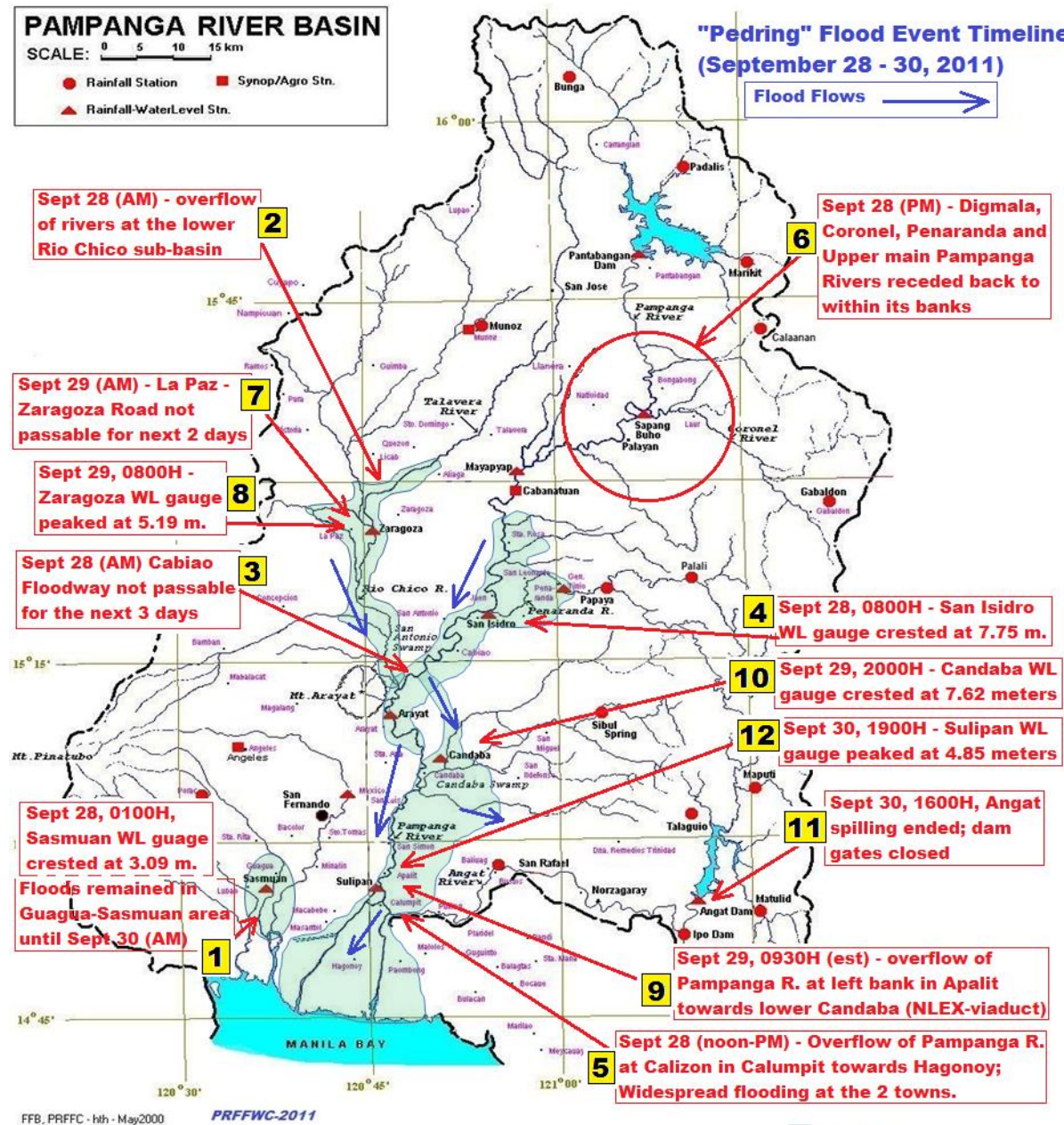


Figure 6.1 "Pedring" flood event timeline map from September 28 to 30, 2011.

Flood event timeline for "Quiel" covered the period from October 01 to 03. Heavy rains observed at the northwest part of the basin started in the afternoon of October 01 whilst almost the downstream part of the basin still remains inundated due to "Pedring". The rains spawned by

“Quiel” were mainly focused on the adjacent river basin of Agno and generally affecting the sub-basin of Rio Chico in the northwest corner of PRB. The Talavera, Ilog Baliwag, and mainly the Rio Chico Rivers are some of the waterways that were affected at that part of the basin. Areas that were partly and/or generally affected by floods that time were Victoria, Concepcion, portions of Tarlac City and La Paz all in Tarlac province, with the latter being the worst-affected area; Quezon, Licab, Aliaga, Talavera, Zaragoza and San Antonio all in Nueva Ecija Province.

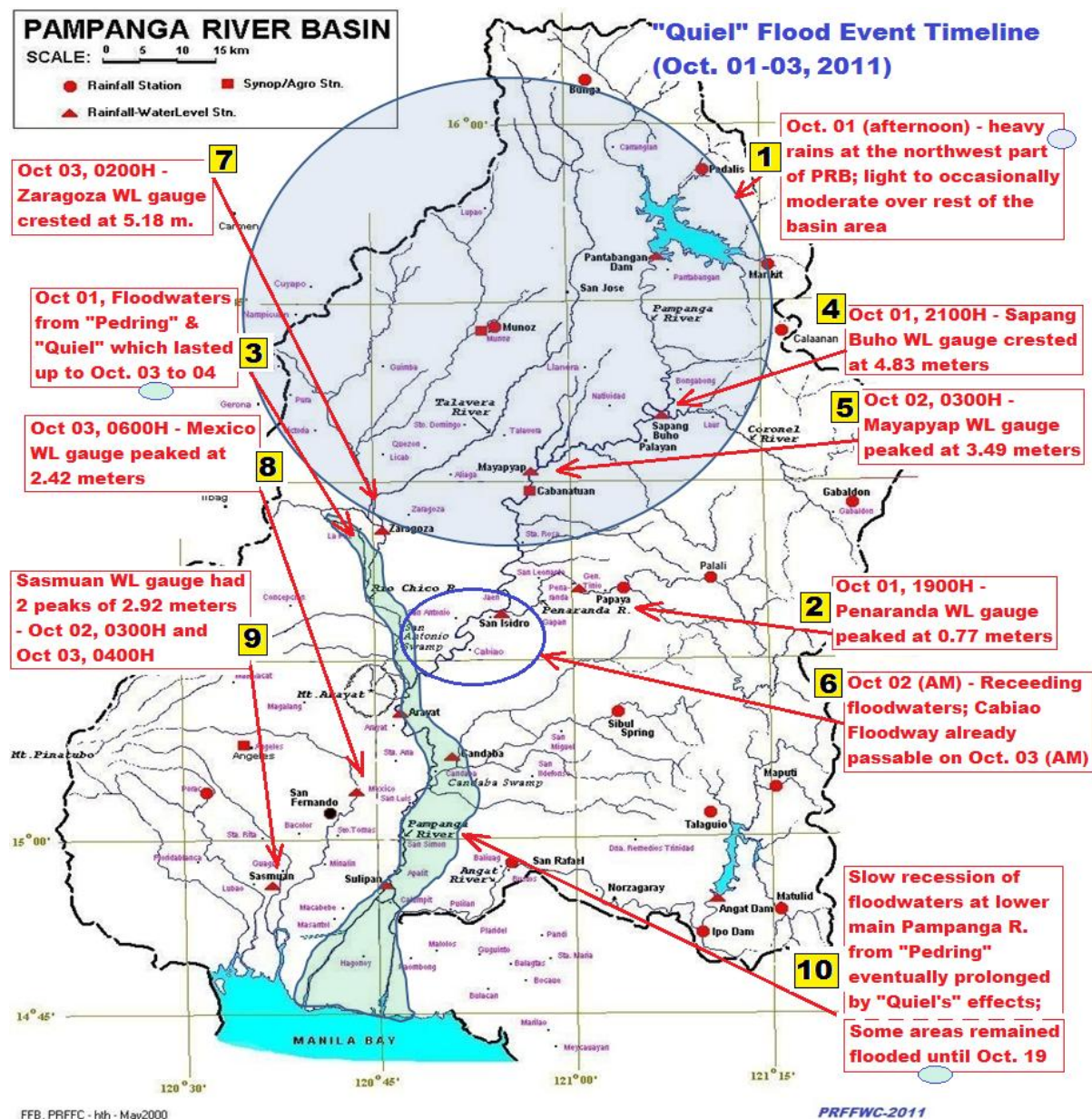


Figure 6.2 “Quiel” flood event timeline map from October 01 to 03, 2011.

7.0 Event Casualties and Damages (PRB / Region 3)⁷

Within the basin, the local Disaster Risk Reduction and Management Councils (DRRMCs) of the Province of Nueva Ecija (NE) and the Municipality of Calumpit in Bulacan (areas within the PRB)

⁷ NDRRMC Sitrep 25 and 25 re Effects of T. Pedring, dated October 10 and 11, 2011 (www.ndrrmc.gov.ph)

declared a State of Calamity following the flood event. There were 52 fatalities reported within Region 3 area mostly as a result of drowning. Breakdown of fatalities are as follows: 24 from Bulacan, 11 from NE, 8 in Pampanga, 8 in Zambales, and 1 for Bataan. A national total of 83 persons died as per NDRRMC report from the two events which affected a total of 42 cities and 312 municipalities in 35 provinces of 9 regions in the country including the National Capital Region (NCR).

Table 7.0 Breakdown of the population, towns / cities and barangays affected (in Region 3)

Province	Total Towns & / or Cities affected	Total Barangays affected	Number of Families affected	Number of persons affected
Aurora	8	80	11,782	57,146
Bataan	9	175	52,593	240,659
Bulacan	24	350	123,048	587,440
Nueva Ecija	27	444	108,172	513,320
Pampanga	22	364	104,324	492,763
Tarlac	12	150	27,728	111,868
Zambales	14	159	24,712	120,806
Total for Region	116	1,722	452,359	2,124,002
<i>Aurora, Bataan and Zambales are mainly outside the river basin. About 1/3 of Tarlac and 2/3 of Bulacan are within the PRB.</i>				

More than 450,000 families were affected within the Region, most of which are within the PRB.

Damaged houses for the Region totalled 22,393 of which 3,561 were totally damaged. Zambales had the most number of houses damaged within the region as a result of the winds from the 2 events.

Total damage to both infrastructure and agriculture for whole of Region 3 amounted to an annual disaster high of ₱ 11,392,473,079.36. Agricultural related damage of about ₱ 8 billion particularly to rice and corn crops which occupy a bulk of the aforementioned damage. The province of Nueva Ecija got the biggest share in terms of agricultural damage, rice and corn, amounting to some Philippine pesos ₱ 3,700,966,732.00.

Out of the 10 tropical disturbances that affected the country in 2011, T. “Pedring” ranked as number one in terms of total damages to property with an astounding amount of ₱ 15, 552, 586,957.49.

8.0 Areas Flooded within the PRB system during the Event

Flood information provided by various LGUs within the basin were gathered to produce an estimated list of areas (towns) affected during “Pedring” and “Quiel”.

Table 8.0 Areas flooded per Province within PRB with estimated range of flood depth

Towns	Number of Barangays affected as per reports	Estimated range of flood depths reported / observed (meters)	Situational Remarks
Province of Bulacan			
Angat	9		Mostly riverside areas
Baliuag	17		
Bustos	9	0.6	Mostly riverside areas
Calumpit	29	0.5 – 3.0	Almost whole town got flooded
Hagonoy	26	0.5 – 3.0	Overflow of Pampanga R. & tributaries
Malolos City	24	0.4 – 1.2	Some barangays are outside the basin

Norzagaray	2		Mostly riverside areas
Paombong	14	1.3	
Plaridel	4		Mostly riverside areas
Pulilan	17		
San Ildefonso	14	0.3 – 0.5	Mostly ponded rainwater
San Miguel	50	0.8 – 2.4	More than half of the area (bgys) were inundated - breaching of Bulu Dam
San Rafael	12	0.75 – 1.5	Overflow of Maasim R. & Candaba
Province of Pampanga			
Guagua	25	0.3 - 0.9	
Sasmuan	12	0.2 - 0.5	
Candaba	33	0.6 - 2.5	Almost whole town got flooded
Masantol	26	0.6 - 1.5	
San Luis	17	0.6 - 2.5	Mostly areas along the Pampanga R. / Candaba swamp
Sta. Ana	14	0.3 - 1.2	Mostly rice fields (ponded rainwater)
Apalit	12	0.6 - 1.5	Riverside areas (Pampanga R.)
Mexico	21	0.3 - 1.0	Mostly rice fields (ponded rainwater)
Mabalacat	6	0.6 - 1.0	
San Simon	14	1.0 - 2.5	Mostly areas along the Pampanga R. / Candaba swamp
Sta. Rita	2	0.3 - 0.6	
Sto. Tomas	7	0.3 - 1.0	
Floridablanca	15		
Bacolor	8	0.3 - 0.6	
Macabebe	25	0.3 – 1.2	
Arayat	21	0.3 – 1.6	
Magalang	1	0.6	
Minalin	15	0.3 – 0.7	
Lubao	21	0.3 – 0.6	
San Fernando	10	0.3 – 1.8	
Province of Nueva Ecija			
Bongabon	23	0.3 – 1.0	Riverside areas and fields (ponding)
Laur	4	0.3 – 1.8	River overflow (Coronel & Nabao)
Palayan City	5	0.3 – 1.0	Pampanga & Cabu Rivers
Gapan City	16	1.0 – 6.0	
Sta. Rosa	14	0.5 – 2.1	Overflow of Pampanga, Tabuating & Minatula Rivers
Gen. Tinio	3	4 – 4.5	Flash floods on Sept 26, mountainside areas
Peñaranda	4	3 - 4	From upstream areas (Gen. Tinio)
Zaragoza	6	1 – 1.2	Mostly rice field areas
Aliaga	5	1.5 – 2.4	
San Leonardo	15	1.5 – 3.0	Overflow of Pampanga R. & tributaries
Gen. Natividad	1	1.5	Rice field areas
Cabanatuan City		0.5 – 1.2	Overflow of Pampanga R. & tributaries
San Antonio	4	1.0	Ponded rainwater; overflow of Pampanga R.
Cabiao	4	0.4 – 2.5	Overflow of Pampanga R.
San Isidro			
Jaen	27	0.6 – 3.6	Overflow of Pampanga R.
Talavera			Overflow of Talavera R.
Gabaldon			Riverside areas due to heavy rains
Province of Tarlac (within PRB)			
La Paz	18	0.3 – 1.8	Overflow of Rio Chico & tributaries

Concepcion	7	0.6 – 1.5	
Capas			
Tarlac City (portions)			

Flood reports from various LGUs, agencies and from several surveys were used to produce a list of areas that were flooded during the event. Unfortunately, not all resource areas were able to provide information mainly because of the extent and depth of the effects of the flood within the basin causing most of these entities to execute evacuation responses rather than take info notes.

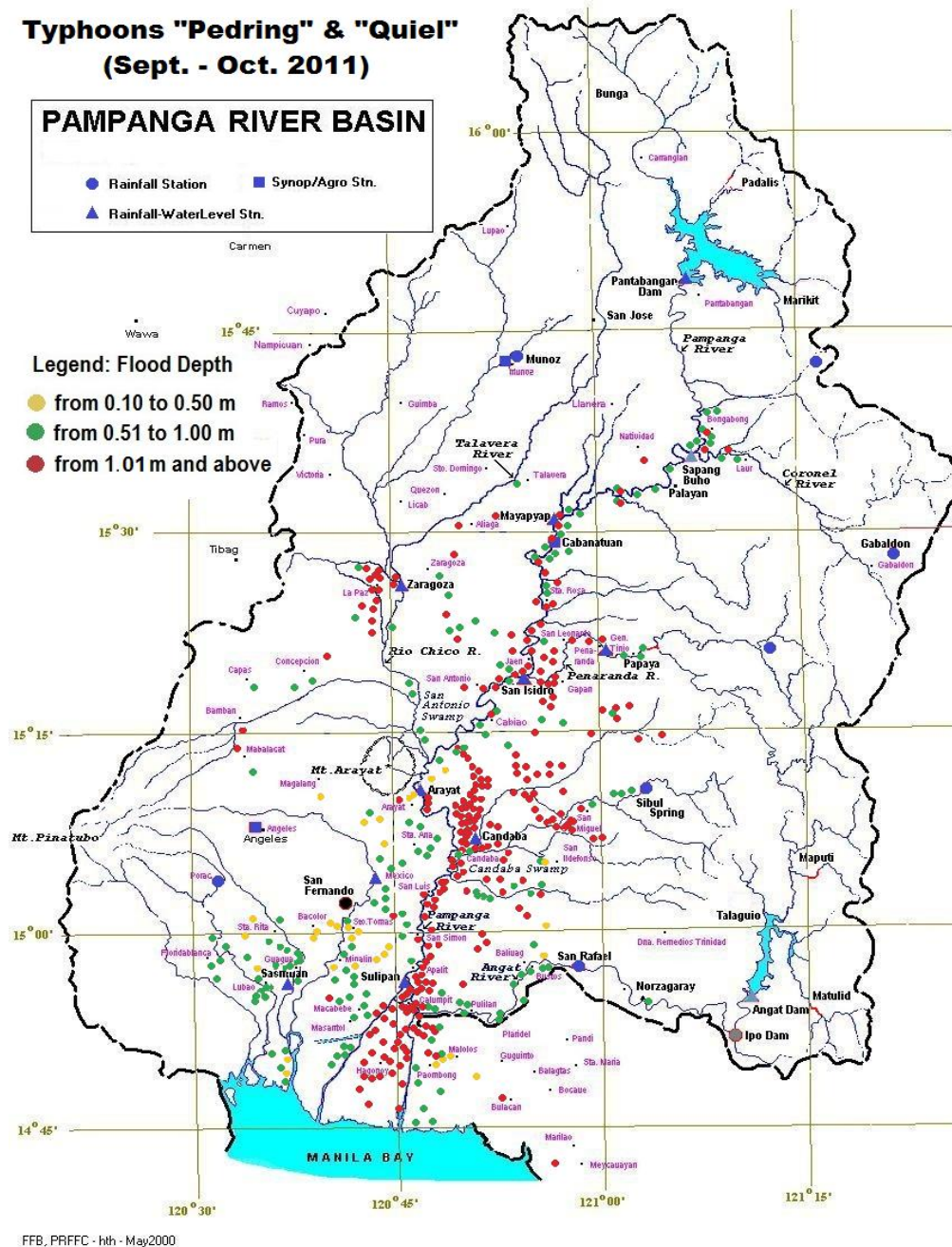



Figure 7.0 Estimated spot flood level (maximum) map during the event as per available reports from the various DRRMOs within the PRB.

9.0 Flood Forecasting & Warning Activities

Flood Advisory (FA) is hydrological information in general or in its simplest form. It is initialized anytime during flood watch period for awareness or preparedness of the flood prone areas within telemetered basins, when their rivers and streams are likely to be affected by high streamflow or flooding or flash flooding.⁸

During “Pedring” initial Flood Advisory (FA) information was issued at 1600H of September 26 (Figure 8.0). The information specifically warned on possible landslides and of river flooding including flash floods at areas close to mountain slopes and adjacent to the upper main Pampanga River. Further, included in the advisory is a list of waterways that are likely to be affected: the Rio Chico River, rivers within the allied basin of Guagua River, and the Candaba swamp area.



REPUBLIC OF THE PHILIPPINES
Department of Science and Technology
Philippine Atmospheric, Geophysical and
Astronomical Services Administration (PAGASA)
 PAGASA Science Garden, Agham Road, Diliman, Quezon City 1100
 Websites: www.pagasa.dost.gov.ph
 www.prffwc.webs.com

PAMPANGA RIVER FLOOD FORECASTING & WARNING CENTER
 Hydro-Meteorology Division/NCR-PRSD
 DOST compound, Bgy. Maimpis, San Fernando, Pampanga 2000

=====

GENERAL FLOOD ADVISORY NO. 1
PAMPANGA RIVER BASIN & ALLIED RIVERS

VALID FROM 4:00 PM, 26 SEPTEMBER 2011 TO 5:00 AM TOMORROW UNLESS THERE IS AN INTERVENING ADVISORY OR AN INITIAL BASIN FLOOD BULLETIN TO BE ISSUED.

BASIN RAINFALL AS OF 4:00 PM TODAY

PAST 24-HR OBSERVED RAINFALL (millimeters): 42
 FORECAST 12-HR RAINFALL (millimeters): BETWEEN 40 TO 60

WATERCOURSES LIKELY TO BE AFFECTED:

- UPPER MAIN PAMPANGA RIVER
- TRIBUTARY RIO CHICO
- CANDABA SWAMP AREA
- GUAGUA RIVER BASIN AREA - ABACAN, PORAC-GUMAIN, PASAC-GUAGUA, PASIG- POTRERO RIVERS

PUBLIC WARNING:

PEOPLE LIVING NEAR MOUNTAIN SLOPES AND IN LOW-LYING AREAS ADJACENT TO OR ALONG THE ABOVE-MENTIONED RIVERS AND THE LOCAL DISASTER RISK REDUCTION AND MANAGEMENT COUNCILS CONCERNED ARE ADVISED TO BE ALERT FOR POSSIBLE FLASHFLOODS OR RIVER FLOODING AND LANDSLIDES.

Prepared by:

PRFFWC – HTH / RPY / JRD / RFD

Figure 8.0 Initial Flood Information during the event.

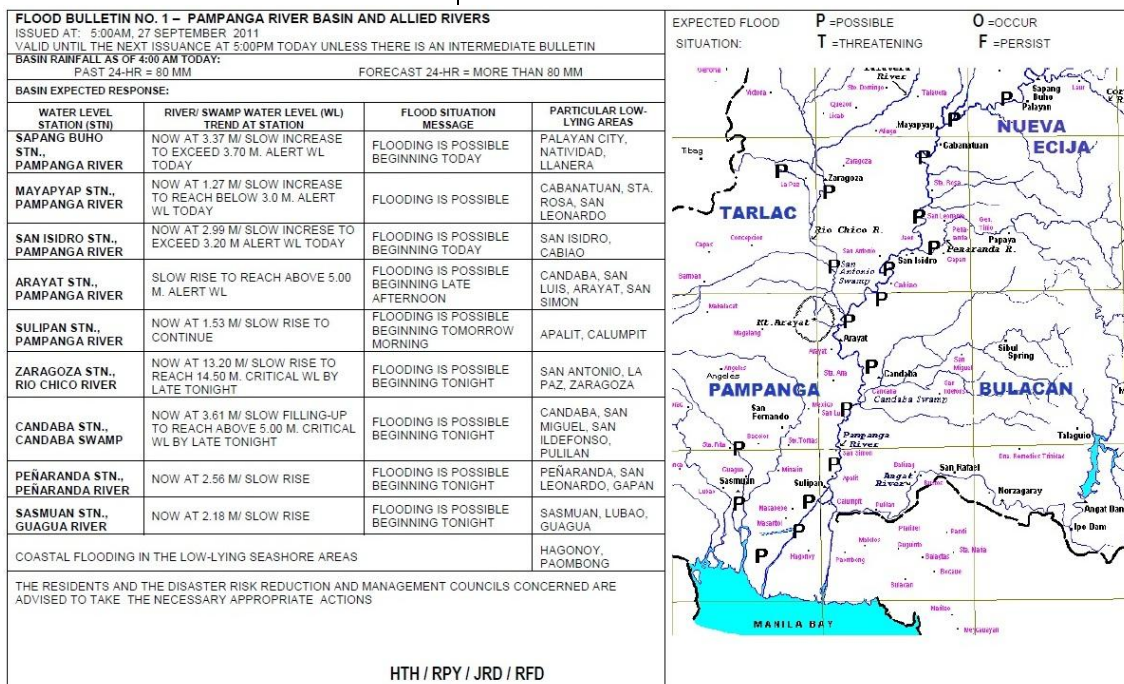


Figure 8.1 Flood Bulletin No. 1 issued at 0500H, 27 September 2012.

⁸ Provision of Hydro (Flood) Information Protocol (as of July 2011) by H.M. Borja, AWSC, HMD

Flood Bulletin (FB) number 1 was issued on the following day, 0500H of September 27. Flood situational message in the bulletin suggested possible flooding within the day in almost all the upstream forecasting points and flood possibilities at downstream areas later that day. Flood Bulletins (FB) are more specific flood information issued whether or not it is being preceded by a basin general flood advisory (depending on the situation) during flood watch monitoring. It can be initialized anytime and issued regularly by FFWCs thereafter until being finalized when floodwaters have generally subsided or no significant increases in the present situation is expected further. FB is more near specific as to river level changes, in terms of its rising and falling trends including the possible areas (towns/cities) to be affected. FB is issued by PRFFWC at 5am and 5pm daily during flood watch operations unless when situations warrants that an intermediate FB needs to be issued at any time between those two issuance stages to cover for unfavorable situations within the basin.

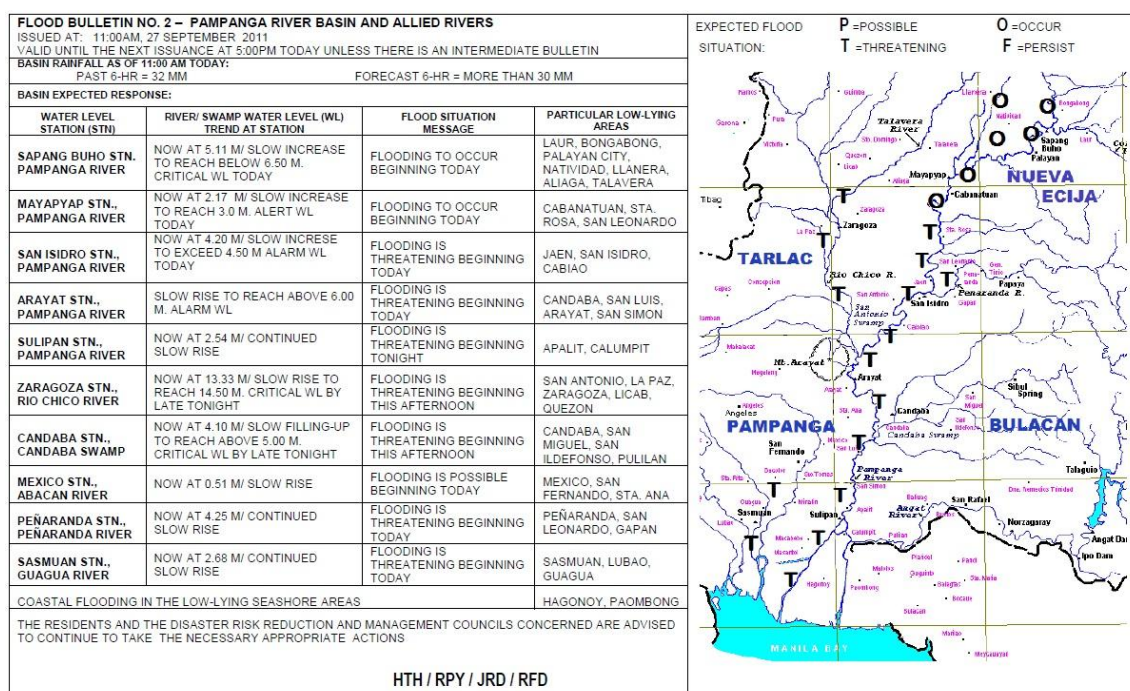


Figure 8.2 Intermediate Flood Bulletin No. 2 issued at 1100H, 27 September 2012.

With moderate to rapid increases in water levels at most of the monitoring stations at the upstream sections of the basin were observed, an intermediate FB (FB no. 2) was issued unexpectedly at 1100H of September 27 (Figure 8.2). The issuance was immediately warranted inasmuch as WL per monitored section at the upper basin had significantly increased during the last 4 hours. Middle sections had also reacted with continuous slow to gradual WL increases.

All subsequent FBs afterwards were issued at 5am and 5pm covering the period from September 27 to October 04, inclusively for events “Pedring” and “Quiel” except for FB no. 9 (1100H of Sept. 30), which was again an intermediate FB. The issuance was made to cover the expected passage of “Quiel” close to the PRB.

Total flood information issued was 19 (1 FA and 18 FBs) for the two events with the final FB being issued at 1600H of October 04 (Figure 8.3). Further, other than being forwarded directly to DRRM offices at national level and within the basin, all issued flood information are uploaded at the

center’s website and / or either e-mailed directly to various local DRRM entities, individuals, etc; also shared in various social networks – “facebook” and “twitter”.

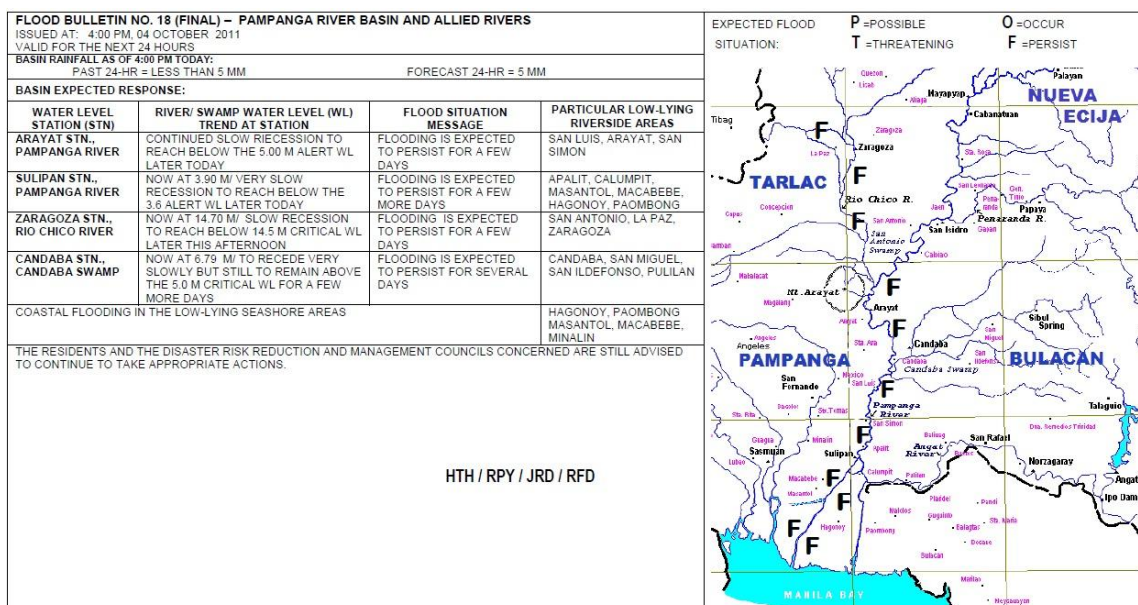


Figure 8.3 Final FB, number 18 (above) issued 1600H of October 04, still maintaining floods to remain or persist (symbol “F”) at several areas along the main river. Floods at these areas may remain for several days due to area characteristics, ponding of floodwaters due to relatively low elevation, and due to an over-saturated and still soaked land cover.

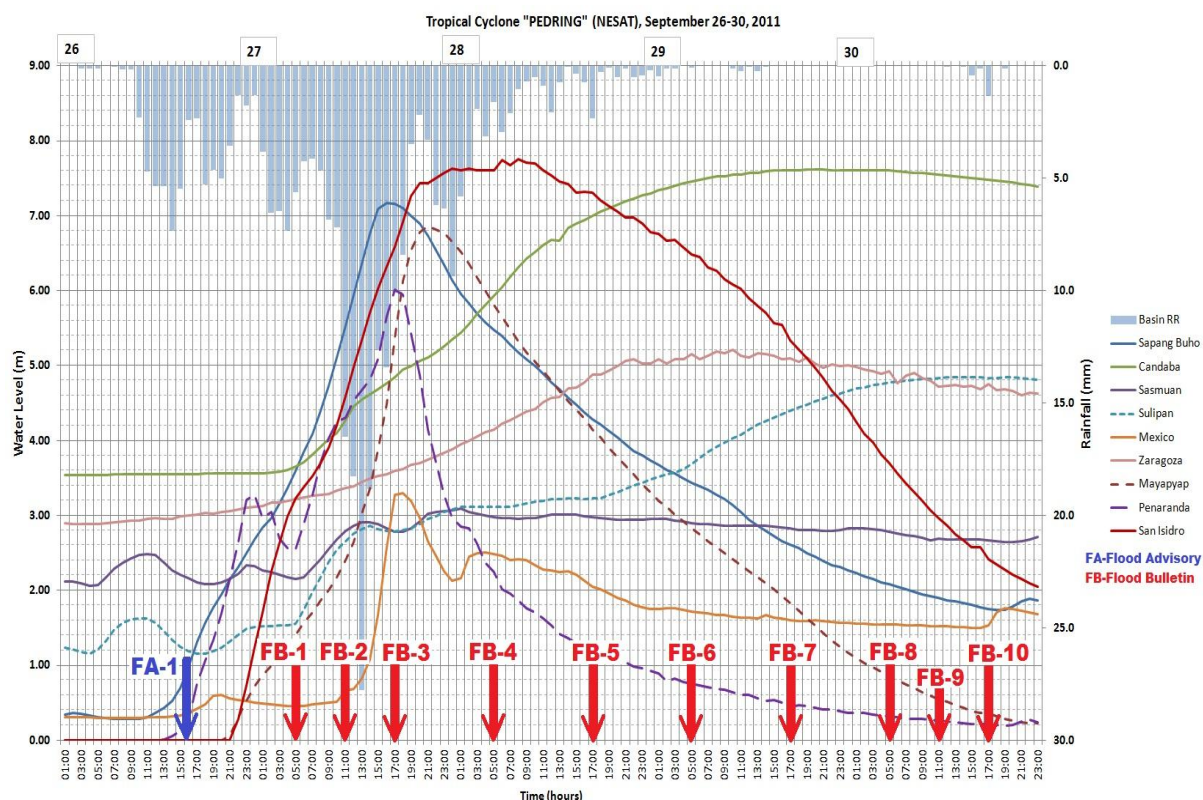


Figure 9.0 Event basin hyetograph and hydrographs (above) for the period September 26 to 30 with the corresponding time issuance of FA and FBs relative to the basin’s hydrological flood event.

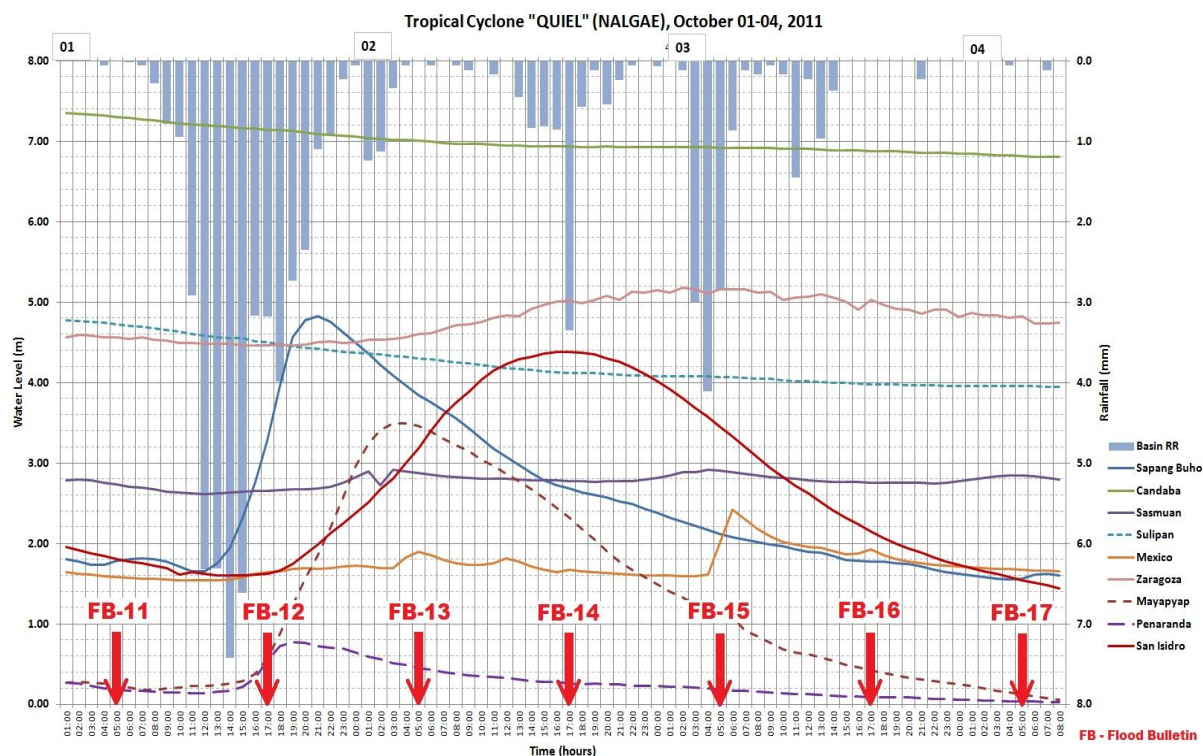


Figure 9.1 Event basin hyetograph and hydrographs (above) for the period October 01 to 04 with the corresponding time issuance of FBs relative to the basin's hydrological flood event.

10.0 Event Highlights (in Pictures)





(Above) Villa Luz subdivision area in Bgy. Mabini, Cabanatuan City was more than a meter flooded during "Pedring". (Right) The water level gauge at Mayapyap station peaked at 6.86 meters during the event.



Flood mark of about 45 cms. High left by "Pedring" on a wooden cabinet inside the PAGASA Cabanatuan synoptic station.



Flood debris mark, more than a meter high, left on a wall somewhere along km. 101 along Maharlika hi-way in San Leonardo, Nueva Ecija.



Zaida Lajom of Bgy. Gomez, Sta. Rosa (N.E.) points to the flood mark, about 0.6 meter high, inside her residence.



A meter high of flood debris along a barangay road in Bgy. Lawang Cupang, San Antonio (N.E.)



The old water level gauge at Sapang Buho WL station (Palayan City, N.E.) still covered by flood debris after “Pedring’s” flood event.



Cabiao flowway road at Bgy. San Vicente, Cabiao (N.E.) during Pampanga River’s spill-over at the area. The said road was not passable for about 4-days during the event period.



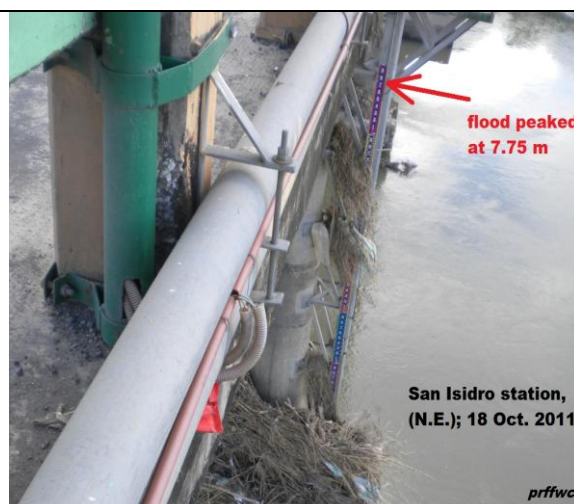
MSWD office in the town of Jaen (N.E.) was underwater by about 0.5 meters as pointed out by Ms. Pablo, MSWDO, of the said town.



The barangay road and its surrounding area in Barangay San Vicente, Jaen (N.E.) was flooded for more than 4 days during “Pedring”.



Flood was more than a meter high at Bgy. San Anton, San Leonardo (N.E.) as pointed out by Ms. Perlita Tinio, a long-time resident of the area.



Floodwaters reached 7.75 meters as per telemetered data for San Isidro station. Dried grasses are still clinging to the river gauge after more than 2 weeks since peaking at that level.



Maximum flood level of about 1 meter at Bgy. San Roque in La Paz, Tarlac during the event.

La Paz Public Market (Sept. 2011)



A view of La Paz market area at the height of flooding in the area due to "Pedring".



The La Paz to Tarlac City road was impassable to almost all types of vehicle between the period Sept. 29 to 30.

La Paz - Zaragoza Road



La Paz to Zaragoza hi-way was likewise not passable between the period Sept. 29 to 30 due to overflowing of Rio Chico river.



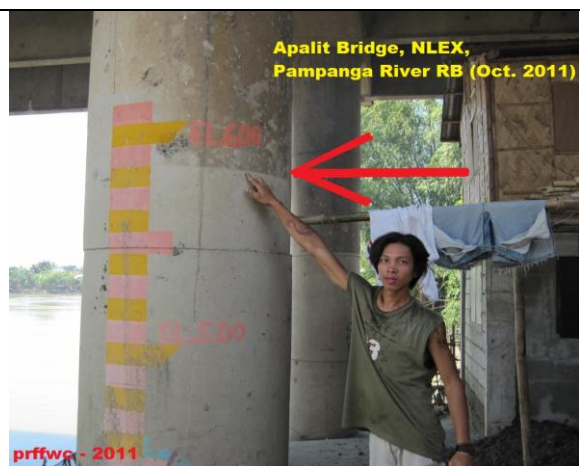
Maximum flood level at Bgy. Candating in Arayat (Pampanga) as pointed out by residents in the area. Floodwaters started inundating the area as early as noontime of Sept. 27.



A barangay official of Bgy. San Agustin in Candaba (Pampanga) points to the maximum flood level attained during event "Pedring", almost 3 meters high from road level.



The old telemetering station along Rio Chico River in Zaragoza (N.E.) with reference flood level at the station.



Flood marks on the DPWH gauge (reading of about 5.80m) at the Apalit Bridge's pier (NLEX), situated at the right bank of Pampanga River.



About a meter high of floodwaters overflowed the left bank of Pampanga River in Bgy. San Juan in Apalit going towards the viaduct area.



Flooding situation in Bgy. San Jose, San Simon (Pampanga) at the height of the flood event caused by "Pedring".



The flooded San Luis Public Market (Poblacion) area during the event. Maximum inundation level reached 1.5 meters at some areas.



A resident of Bgy. Sta. Monica in San Luis (Pampanga) points to the maximum flood height (1.3 m from road level) in their area.

**Bgy. Sta. Cruz, San Luis,
Pampanga (Sept. 2011)**



San Luis LGU

Barangay Sta Cruz in San Luis (Pampanga) had some areas inundated by more than 2 meters of floodwaters .

**Bgy. Sto. Tomas, San Luis,
Pampanga (Sept. 2011)**



San Luis LGU

Bgy. Sto. Tomas was one of the worst flood-affected area in the town of San Luis (Pampanga). Some areas in the barangay were about 3 meters deep.

**Sapang Maragul (San Juan Nepomuceno Area along
Pritil), 28 Sept 2011, 0721H
Guagua, Pampanga**



MPDO-Guagua

The town of Guagua in the Pasac-Guagua river basin system was not spared during “Pedring” as shown in the picture above.



**McArthur Hi-way, Sto. Cristo, Guagua,
Pampanga (28 Sept. 2011, 1330H
MPDO, Guagua**

Flooded portions of McArthur Hi-way in Bgy. Sto. Cristo in the town of Guagua during passage of “Pedring”.



**Bgy. Bardias, San Miguel,
Bulacan (Oct. 2011)**

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Flood depths attained at Bgy. Bardias in San Miguel (Bulacan). Flooding in the area was mainly a result of the breaching of Bulu Dam.



**Bgy. Hall - King Kabayo,
San Miguel, Bulacan
(Oct. 2011)**

prffwc - 2011

Likewise, Bgy. King Kabayo in the town of San Miguel (Bulacan) was inundated as a result of the breaching of Bulu Dam.



Floodwaters of up to 2 meters (from road level) inundated Bgy. Bulusan in Calumpit (Bulacan). The town of Calumpit was flooded for more than 2 weeks during the event.



Pulilan to Calumpit road stretch at Bgy. Pungo, Calumpit was inundated by some 0.5 meters of floodwaters coming from the spill-over of the lower Candaba swamp area (viaduct section).



Flood marks as seen on a fire truck parked in front of Hagonoy town hall and pointed out by Mr. Rodolfo Santos, MDRRMO officer of the said town.



More than 1 meter of floodwaters were experienced at Bgy. San Isidro in Hagonoy, as seen from the flood marks on the wall along the barangay road.



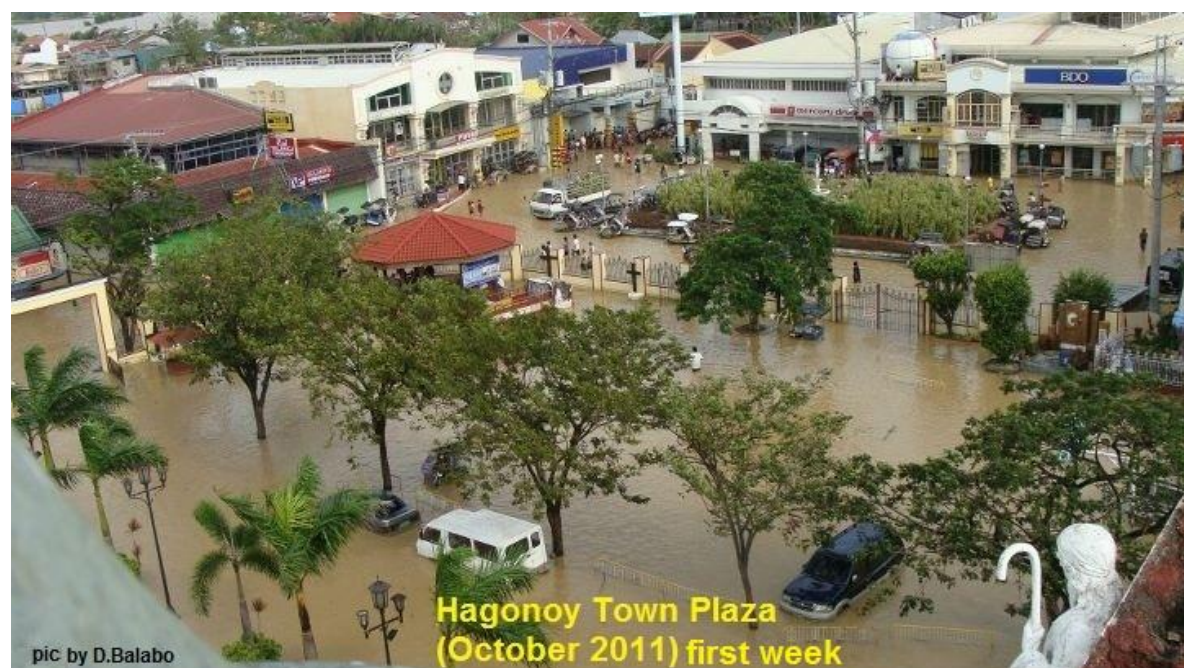
A resident of Bgy. San Agustin in Hagonoy points to the estimated flood height attained during the “Pedring” flood event.



A photo of flooding in Bgy. San Juan (Hagonoy) taken before noontime of Sept. 29, 2011. Floodwaters were still on a rising stage at that time.



(Above) An aerial view of the Calumpit District Hospital (in the middle) isolated with floodwaters during the “Pedring” flood event. The aerial view also shows the extent of the flooding in the background, which is the lower Candaba swamp area. (Below) A rooftop view of the Hagonoy town plaza still inundated from the floodwaters brought about by Typhoon “Pedring”.



11.0 Event Comparison

The flood brought about by Typhoon “Pedring” is considered as one major event for the PRB. Several river stages attained during the event were the highest observed so far during the last 20 years of operational flood forecasting and warning for the said basin. Peak river stages (in meters) during event “Pedring” compared with peak stages attained from other major flood events are shown in the table below.

Table 9.0 Peak stage attained at each WL station as per various flood events for PRB.

Water Level stations	T. Pedring (Sept - Oct 2011)	T.S. Falcon – SW (June 2011)	T. Pepeng (Oct 2009)	T.S. Ondoy (Sept 2009)	T. Marce - SW (Aug 2004)	T.D. Winnie – T. Yoyong (Nov – Dec 2004)	T. Loleng (Oct. 1998)	T. Kadiang (Sept – Oct 1993)
Sapang Buho	7.17	3.47	6.29	3.38	5.45	7.60 (est.)	7.15 (est.)	6.30 (S.G.)
Mayapyap	6.86	2.57	5.46	1.72	5.06	7.18	6.50 (est.)	6.18 (S.G.)
Zaragoza	15.40	14.88	15.68	14.143	15.39	13.63	15.76	15.9 (S.G.)
Peñaranda	6.01	2.56	2.79	3.93				
San Isidro	7.75	4.08	6.46	3.89	6.70	7.16 (est.)	7.38	7.65 (S.G.)
Arayat	10.6 (est.)	8.37	9.66	8.35	10.03	9.42 (est.)	9.47	9.81 (S.G.)
Candaba	7.62	6.24	7.02	6.40	7.38	6.96	6.62	7.6 (S.G.)
Mexico	3.30	2.72	4.03	2.81				
Sasmuan	3.09	3.22	2.73	3.03	2.06 (est.)			
Sulipan	4.85	2.80	4.03	3.29	4.39	3.97	4.87	4.91 (S.G.)

Note: est. – estimated value based on flood marks; S.G. (staff gauge) – flood marks on gauge. Values in red are highest for the station and blue as 2nd highest. Peñaranda and Mexico stations started operations in 2009 only. Sasmuan station was not functioning during the Dec 2004, Oct 1998 and Oct 1993 events.

References:

Reports:

PRFFWC Post-Flood Report 2011-1: Enhanced Southwest Monsoon due to Tropical Storm “Falcon” (Meari), (June 24 to 27, 2011); PRFFWC, PAGASA, DOST. 2011

PRFFWC Post-Flood Report 2009-1 (Nov. 30, 2009) Pampanga River Basin Flood Events: Tropical Storm “Ondoy”, Sept. 25 to 27, 2009; and Typhoon “Pepeng”, October 6 to 15, 2009; PRFFWC, HMD, PAGASA, DOST. November 2009

PRFFWC Post-Flood Report. Pampanga River Basin: Flood of August 2004 (Southwest Monsoon as enhanced by Typhoon Marce). PRFFWC, PAGASA. October 2004

Post-Flood Investigation Report: Pampanga River Basin Floods due to Tropical Depression Winnie and Typhoon Yoyong (November 28 to December 04, 2004), PRFFWC, PAGASA. February 2005

Resource Entities:

1. National Disaster Risk Reduction & Management Council (www.ndrrmc.gov.ph)
2. Office of Civil Defense Reg. 3 / Regional Disaster Risk Reduction & Management Council 3
3. Pampanga Provincial Disaster Risk Reduction & Management Office
4. Bulacan Provincial Disaster Risk Reduction & Management Office
5. Nueva Ecija Provincial Disaster Risk Reduction & Management Office
6. Tarlac Provincial Disaster Risk Reduction & Management Office
7. Guagua Municipal Disaster Risk Reduction & Management Office
8. San Luis Municipal Disaster Risk Reduction & Management Office
9. Hagonoy Municipal Disaster Risk Reduction & Management Office
10. Flood Forecasting & Warning Section (FFWS), HMD, PAGASA

Resource Persons:

1. Henry Cajucom, MPDO, Bongabon, N.E.
2. Engr. Jonathan M. Liwag, Municipal Engineer, Laur, N.E.
3. Romeo Basco, Bgy. Captain of Bgy. Concepcion, Cabiao, N.E.
4. Zaida Lajom, resident of Bgy. Gomez, Sta. Rosa, N.E.
5. Perlita Tinio, resident of Bgy. San Anton, San Leonardo, N.E.
6. Andy Macapagal, resident of Bgy. San Vicente, Cabiao, N.E.
7. Ruben C. Espejo, Municipal Administrator, Sta. Rosa, N.E.
8. “Duds” Romero, CDRRMO-Palayan City
9. Engr. Josephine Legaspi, PDRRMO officer, PDRRMO-N.E.
10. Paperlyn U. Pablo, MSWDO, Jaen, N.E.
11. Billy Sicam, resident of Bgy. San Roque, La Paz, Tarlac
12. Engr. Marito G. Nicolas, Municipal Engineer, La Paz, Tarlac
13. Nemensio T. Benozza, MPDO, Macabebe, Pampanga
14. Engr. Allan Odchigue, MPDO/MDAO, Municipality of Apalit, Pampanga
15. Cesar Jornadal, resident of Bgy. San Mateo, Arayat, Pampanga
16. Benny Trinidad, resident of Bgy. Candating, Arayat, Pampanga

17. Elueterio Sagum, Barangay Official of Bgy. San Agustin, Candaba, Pampanga
18. Lenny Manalo, Municipal Employee of Candaba, Pampanga
19. Thelma Macapagal, Bgy. Captain of Bgy. Paralaya, Candaba, Pampanga
20. Antonio Gamboa, resident of Bgy. Sta. Monica, San Luis, Pampanga
21. Venancio “Asiong” S. Macapagal, Mayor of San Luis, Pampanga
22. Louie V. Rodriguez, MDAO, San Rafael, Bulacan
23. Bryan Cyro Velasco, PDRRMO-Bulacan
24. Raul Agustin, PDRRMO-Bulacan
25. Lambert Sylvestre, PDRRMO-Bulacan
26. Liz L. Mungcal, Executive Officer, PDRRMO-Bulacan
27. Rodolfo Santos, MDAO, Hagonoy, Bulacan
28. Michael Pagua, Municipal Employee, San Miguel, Bulacan
29. Rosalinda Dijon, resident of Bgy. Lambakin, San Miguel, Bulacan
30. Gloria Flores, resident of Purok 6, Bgy. San Juan, Hagonoy, Bulacan
31. Jojo Tomas, Municipal Administrator, Calumpit, Bulacan
32. Liway Rivera, Weather Observer, Cabanatuan Synoptic station
33. Bong Masagca, Executive Director, PDRN
34. Ann Ria Barreira, PDRN
35. Thutz Santiago, Employee, NEDA Region 3
36. Lerry Hernandez, Employee, DILG Region 3
37. Leonida Santos, PAGASA employee, Sto. Rosario, Paombong
38. Russell Rigor, Principal Hydrologist, Angat Dam FFWSDO, NPC



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