Appendix C
Historical Records of Flood Damage

Appendix C Historical Records of Flood Damage

Flood damage data are available in each province for major flood events. These consist of information sent to OCD-NDRRMC in Camp Aguinaldo, Quezon City. In order to grasp the flood occurrence in the target river basins as well as flood damage due to tropical typhoons, historical records between 1990 and 2012 were collected from OCD-NDRRMC and summarized as follows:

Statistical Data on Typhoon Oriented Flooding in 1990 - 2012

No. of Occurrence	Casualties			Affected Population	Houses Damaged		Estimated Damage (PHP million)
	Dead	Injured	Missing		Totally	Partially	
221	18,035	20,914	6,093	109,243,360	1,860,992	5,529,468	294,783

Source: OCD-NDRRMC

The nationwide consolidated information in the table above shows that a total of 221 flood occurrences due mainly to typhoons and flood damage of PHP 295 billion (average of PHP 12.8 billion/year) were recorded in the logbook of OCD. A summary (annual records) is tabulated in Page C-2 and further detailed damage records with associated typhoon events and corresponding regions are tabulated in Page C-3 to C-10.

Based on the records of the regions in the table, the affected target river basins (among 19) were identified for respective flood events as enumerated in Pages C-11 to C-19.

Summary of Damage by Destructive Typhoons Year 1990 – 2012

Year	Causalities			Population Affected		Houses Damaged		Estimated Damage (PHP mil.)			
	Dead	Injured	Missing	Families	Persons	Totally	Partially	Agriculture	Infrastructure	Private	Total
1990	706	1,435	265	1,135,433	6,092,959	222,831	634,676	9,242	1,993	1,510	12,745
1991	5,414	1,258	1,330	3,544,176	1,815,989	23,956	159,076	5,905	1,911	215	8,031
1992	118	95	52	205,049	1,755,811	3,314	8,006	2,612	2,434	25	5,071
1993	827	1,921	248	1,404,446	7,363,591	172,361	452,635	13,255	6,252	531	20,037
1994	242	247	48	617,228	3,054,232	62,344	250,931	1,880	941	377	3,198
1995	1,356	4,532	580	1,561,334	7,683,526	294,147	839,934	11,276	3,618	282	15,175
1996	124	97	49	260,574	1,255,289	2,690	17,559	1,806	945	17	2,769
1997	95	44	8	480,173	2,399,435	2,348	21,071	553	450	44	1,046
1998	490	866	104	1,590,905	7,322,133	137,020	406,347	16,714	4,903	1,400	23,017
1999	103	63	16	382,620	1,793,742	2864	23,032	1,658	914	6	2,578
2000	345	386	106	1,450,773	7,284,946	24,295	196,465	4,980	2,120	378	7,478
2001	440	463	137	784,769	3,769,262	14,902	54,472	2,887	3,584	397	6,868
2002	169	72	33	538,600	3,546,469	1,055	4,159	481	339	10	830
2003	139	182	28	702,223	3,362,991	12,306	51,579	2,744	1,316	99	4,158
2004	1,232	1,250	586	1,409,907	6,966,136	72,668	261,860	9,007	4,134	122	13,262
2005	54	22	88	210,011	1,019,646	514	20,181	2,099	360	94	2,553
2006	1,165	3,253	903	2,397,012	11,253	375,605	863,334	10,854	9,373	0	20,227
2007	124	50	39	627,765	2,998,885	2,661	16,942	1,667	1,060	61	2,788
2008	673	925	138	1,417,208	7,009,725	131,796	503,046	12,553	7,493	62	20,109
2009	1,140	873	116	2,595,396	12,250,050	66,182	270,144	30,166	12,908	897	43,971
2010	136	133	85	543,311	2,596,587	103,334	182,082	11,767	625	0	12,392
2011	1,557	6, 312	244	2,088,909	9,884,577	38,380	149,570	18,364	8,427	404	27,195
2012	1,386	2,747	860	1,098,950	8,006,126	93,419	142,367	28,796	7,630	2,860	39,286
Total	**15,092**	**18,167**	**4,959**	**23,858,913**	**91,352,657**	**1,729,193**	**5,237,531**	**154,103**	**67,671**	**6,527**	**228,301**

Source: Study Team (enumerated based on the damage records of OCD-NDRRMC)

National Disaster Risk Reduction and Management Council
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DESTRUCTIVE TYPHOONS 1970 - 2012

DATES	DISASTERS / AREAS AFFECTED	CASUALTIES			AFFECTED		DAMAGED HOUSES		DAMAGED PROPERTIES (MILLIONS)			TOTAL COST OF DAMAGES	
		DEAD	INJ	MIS	FAMILIES	PERSONS	TOTAL	PART	AGRI	INFRA	PVT		
1990													
13-15 Jun.	TS Akang (X & XI)				42,193	227,269	306	2,684	101.940	96.945	1.245	P	200.130
17-23 Jun.	Bising (I, IV,VIII,X, XII,CAR,NCR)	64	17	8	16,440	81,355	40		16.869	43.186		P	60.055
27-28 Jul.	TS Emang (I & III)	8			6,697	32,974	3	594	5.096	12.022	7.700	P	24.818
15-20 Aug	Typhoon Gading I, IV, CAR and NCR	2								12.525	10.300	P	22.825
24-27 Aug	Typhoon Heling (I, IV, CAR and NCR)	36	43	3						20.500	24.117	P	44.617
28-30 Aug	Typhoon Iliang (I, IV, NCR and CAR)	50	53						600.000	400.097	502.100		1,502.197
5-8 Sept	Typhoon Loleng (1 and CAR)				5,591	27,955							
12-15 Sept	Typhoon Miding (I)	2	2	5	2,337	11,685							
15-17 Sep.	Ty Norming (I, III, IV & VI)	36	42	3	52,171	213,431	456	513	6.388	38.249		P	44.637
10-14 Nov.	Ruping (NCR, III, IV, V, VI, VII,												
	VIII, IX, X, XI & XII)	508	1,278	246	1,010,004	5,498,290	222,026	630,885	8,511.537	1,369.720	964.814	P	10,846.071
	TOTAL	**706**	**1,435**	**265**	**1,135,433**	**6,092,959**	**222,831**	**634,676**	**9,241.830**	**1,993.244**	**1,510.276**	**P**	**12,745.350**
1991													
11-13 Mar.	TS Auring (IV-A)	13	3	40	12,282	73,184	652	4,392	6.670	65.683		P	72.353
13-15 Jun.	Diding (V)	90	386	3	95,269	488,757	8,845	46,269	922.903	439.950		P	1,362.853
8-11 Jul.	Etang (Regions III & IV)	44	21	3	97,911	505,756	1,157	24,838	288.079	288.823	3.056	P	579.958
23-30 Oct	Trining (CAR, Regions I & II)	119	192	28	105,317	524,307	8,070	58,305	2,785.000	734.000	200.000	P	3,719.000
2-7 Nov.	TS Uring (Regions VI & VIII) and	5,101	292	1,256	43,397	223,985	5,232	25,272	1,124.322	277.571	11.605	P	1,413.498
	Ormoc City (Flooding) Tragedy												
14-20 Nov.	TS Yayang (Region IV)	47	364						778.259	104.768	0.050	P	883.077
	TOTAL	**5,414**	**1,258**	**1,330**	**354,176**	**1,815,989**	**23,956**	**159,076**	**5,905.233**	**1,910.795**	**214.711**	**P**	**8,030.739**
1992													
9-12 Jul.	Konsing (Regions II & III)	3		19	1,027	5,135	5	15	8.500	9.562	3.000	P	21.062
17-21 Jul.	TS Ditang (NCR, Regions I & II)	36	77	6	27,902	134,417	478	1,305	248.663	213.254	8.742	P	470.659
16-18 Aug.	TD Gloring (NCR, Regions III & IV)	22		4	148.049	725,956	1,428	3,072	912.934	434.199		P	1,347.133
26-31 Aug.	TS Isang (CAR, Regions I & II)	19	1	1	23,683	114,084	214	197	2.805	169.688		P	172.493
31 Aug-5 Sep	Lusing (CAR, Regions I & II)	10	1		31,787	171,603	393	145	264.771	632.538	5.435	P	902.744
18-23 Sep.	TS Maring (NCR, CAR, Regions I, II, III &												
	IV)	27	13	18	113,686	570,136	785	3,272	1,172.953	974.162	8.190	P	2,155.305
18-27 Oct.	Paring (NCR, Regions III & IV)	1	3	4	6,816	34,480	11		0.890	0.225		P	1.115
	TOTAL	**118**	**95**	**52**	**205,049**	**1,755,811**	**3,314**	**8,006**	**2,611.516**	**2,433.628**	**25.367**	**P**	**5,070.511**
1993													
23-27 Jun.	Goring (CAR, NCR, Regions I, II, III, IV, V)	75	121	13	153,949	812,830	35,069	79,695	994.694	1,735.000	45.000	P	2,774.694
7-9 Jul.	TS Huling (Regions IV, V & IX)	19	75		180	548			0.971	3.150		P	4.121
5-8 Aug.	Openg (Region III)		39		105	516	661	2,109			0.015		0.015
16-19 Aug.	TS Rubing (NCR, Regions I & III)	11	38	9	5,587	29,451	2,243	869	8.276	90.071		P	98.347
22-26 Aug.	TS Saling (Region VI - Capiz & Iloilo)	4	1		3,830	22,308	143	698	153.307	2.250	1.607	P	157.164
8-12 Sep.	Walding (Region II)		66	13	1,834	11,004	1,799	4,375	0.729	0.499	0.090	P	1.318
13-16 Sep.	Yeyeng (Regions I & III)		13		7,035	37,610			16.219	21.154		P	37.373
30 Sep-7 Oct.	Kadiang (NCR, CAR, Regions I, II, III & IV)	126	37	26	415,813	2,060,677	2,249	9,078	7,192.884	1,559.032	0.400	P	8,752.316

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		DEAD	INJ	MIS	FAMILIES	PERSONS	TOTAL	PART	AGRI	INFRA	PVT		
28 Oct-2 Nov.	Husing (CAR, Regions I, II, III & IV)	21	6	9	84,532	462,793	1,668	12,593	1,153.598	430.945	0.620	P	1,585.163
18-22 Nov.	TS Luring (Regions VI, VII & VIII)	18	59	26	18,020	185,727	3,938	982	20.000	7.800	0.080	P	27.880
3-7 Dec.	Monang (NCR, Regions II, IV & V)	273	607	90	264,912	1,361,267	60,357	160,164	1,380.000	929.000	155.000	P	2,464.000
6-12 Dec.	Naning (Regions IV, V & VIII)	93	579	10	98,799	463,925	30,013	54,918	545.000	567.000	281.000	P	1,393.000
14-17 Dec.	TD Oning												
24-29 Dec.	Puring (Regions VI, VII, VIII, X & XI)	187	280	52	349,850	1,914,935	34,221	127,154	1,789.000	906.000	47.000	P	2,742.000
	TOTAL	**827**	**1,921**	**248**	**1,404,446**	**7,363,591**	**172,361**	**452,635**	**13,254.678**	**6,251.901**	**530.812**	**P**	**20,037.391**
1994													
4-6 Apr.	TS Akang (Regions IV, V & VI)	45	26	17	9,909	49,159	522	3,039	47.514	32.050		P	79.564
31 Mar-9 Apr.	Bising (Regions VI, VII, VIII & X)	19	72	10	118,061	587,671	15,601	83,621	163.153	147.514	96.993	P	407.660
24-26 May.	TD Deling (Regions VII, XI & XII)	1			1,822	8,788	10	31	131.607	12.900	0.815	P	145.322
21-24 Jun.	TS Gading (NCR & Region III)	3			11,010	56,112							
7-10 Jul.	Iliang (Regions I, II & III)	11	21	6	32,700	166,564	2,174	11,589	26.172	126.395	2.736	P	155.303
10-11 Jul.	TS Loleng												
18-20 Jul.	TD Norming (Regions I & III)	12	9	1	127,647	616,860	101	204	0.120	4.360		P	4.480
25-29 Jul./31	TS Oyang/TD Pasing (ARMM, Regions I,												
Jul.-3 Aug.	III, IV, VI & XI)	48	9	2	60,129	336,069	505	689	81.307	49.422	3.055	P	133.784
4-7 Aug.	Ritang (CAR &Region I)	4			3,303	16,838	29	68	5.238	2.108		P	7.346
7-10 Sep.	TD Weling (Regions I & II)	10		1	15,605	70,597	28	60	117.809	66.036		P	183.845
18-23 Oct.	Katring (NCR, Regions II, III, IV & V)	45	24	6	59,097	287,737	14,596	44,472	946.677	213.629	272.877	P	1,433.183
18-24 Dec.	Garding (Regions IV, V, VI, VII, VIII & X)	44	86	5	177,945	857,837	28,778	107,158	360.674	286.867		P	647.541
	TOTAL	**242**	**247**	**48**	**617,228**	**3,054,232**	**62,344**	**250,931**	**1,880.271**	**941.281**	**376.476**	**P**	**3,198.028**
1995													
31 May-8 Jun.	TS Auring (Regions III & IV)	6		2	427	2,118	151	337		29.600		P	29.600
27-31 Jul.	TS Karing (CAR, Regions I, II & III)	2		2	12,734	58,186		251	38.083	100.083	27.900	P	166.066
25-31 Aug.	Gening (Regions I, II, III, IV & V)	3	3		39,357	195,885	72	824	68.679	92.476	9.187	P	170.342
2-5 Sep.	TS Helming (Region III)	8			24,043	104,416	713	458	4.764	3.180	0.350	P	8.294
14-17 Sep.	TS Ising (Regions I & III)	1			6,432	34,590			39.854		139.580	P	179.434
21-22 Sep.	Luding (Region I)	1	3		1,611	5,422	15	293					
27 Sep.-2 Oct	TS Mameng (NCR, Regions I, III, IV, V,												
	VI, VII, VIII & X)	116	49	126	241,430	1,240,668	13,234	21,852	1,676.076	1,286.848		P	2,962.924
26-30 Oct.	TS Pepang (Regions IV, VI, VII & VIII)	265	323	67	234,522	1,254,774	53,907	166,979	232.671	174.270	16.576	P	423.517
30 Oct-4 Nov.	Rosing (NCR, CAR, Regions I, II, III, IV,												
	V & VIII)	936	4,152	376	960,777	4,583,618	225,872	641,718	9,036.741	1,725.844	88.187	P	10,850.772
2-5 Dec.	TS Sendang	11		3	735	4,055	8			3.700		P	3.700
25-30 Dec.	TS Trining (Regions VII, VIII, XI & XIII)	7	2	4	39,266	199,794	175	7,222	178.726	202.035		P	380.761
	TOTAL	**1,356**	**4,532**	**580**	**1,561,334**	**7,683,526**	**294,147**	**839,934**	**11,275.594**	**3,618.036**	**281.780**	**P**	**15,175.410**
1996													
28 Feb-2 Mar.	TS Asiang (Regions VI & VIII)	2			1,411	8,221	14	51	0.037	7.520		P	7.557
5-9 Apr.	TS Biring (Regions V, VI & VIII)	3			315	1,000			34.616	6.010	0.075	P	40.701
11-17 May.	Konsing (Region V)									0.700		P	0.700

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		DEAD	INJ	MIS	FAMILIES	PERSONS	TOTAL	PART	AGRI	INFRA	PVT		
21-26 Jul.	Gloring (NCR, CAR, Regions I, II, III & IV)	72	50	24	143,853	686,250	714	6,790	1,397.650	722.604		P	2,120.254
27-31 Jul.	Huaning (NCR, CAR, Regions I, III & IV)	5	3	7	38,259	192,651	1	19		0.018		P	0.018
18-21 Aug.	TS Lusing (CAR, Regions I & II)	4	1		22,967	118,249	79	1,051	53.641	38.992		P	92.633
5-8 Sep.	Maring (Regin II)	6	22		1,614	9,297	887	727	0.010	10.775	13.055	P	23.840
10-11 Sep.	TD Ningning (CAR, Regions II & IV)				11	67	1	2	1.376	40.281		P	41.657
14-19 Oct.	Seniang (CAR, Regions I & II)	8	16	6	33,411	150,609	747	6,629	160.261	43.480		P	203.741
4-14 Nov.	TD Toyang (CAR, CARAGA, ARMM, Regions I, IV, V, VI, VII, VIII, IX, X & XI)	24	5	12	18,733	88,945	247	2,290	159.127	74.289	4.248	P	237.664
	TOTAL	**124**	**97**	**49**	**260,574**	**1,255,289**	**2,690**	**17,559**	**1,806.718**	**944.669**	**17.378**	**P**	**2,768.765**
1997													
26-29 May.	TS Bening (NCR, Regions I, III, IV & VI)	39	23	4	85,223	426,958	285	879	5.202	79.466	20.175	P	104.843
20-24 Jul.	Elang (Regin VI)	2	2		1,086	5,365	1	1	0.704	0.150		P	0.854
30 Jul-6 Aug.	TD Huling (Region III)				3,239	15,115	11	41		7.400		P	7.400
15-17 Aug.	Ibiang (CAR, Regions I, III, IV, VI, XI & XII)	36	11	2	304,327	1,521,125	272	6,379	280.594	172.478	23.460	P	476.532
21-29 Aug.	TD Miling (NCR & Region II)	4			37,250	186,266			4.875	1.120	0.412	P	6.407
16-23 Oct.	Narsing (CAR, Regions I & II)	14	8	2	49,048	244,606	1,779	13,771	261.162	188.955		P	450.117
	TOTAL	**95**	**44**	**8**	**480,173**	**2,399,435**	**2,348**	**21,071**	**552.537**	**449.569**	**44.047**	**P**	**1,046.153**
1998													
16-21 Sep.	Emang & Gading (NCR, CAR, Regions I, II, III & IV)	108	22	10	335,699	1,749,414	10,900	33,343	3,250.000	544.000		P	3,794.000
11-16 Oct.	Iliang (CAR, Rgions I, II, III, IV & V)	46	63	29	268,468	1,344,556	26,305	59,539	3,125.000	1,764.000	486.000	P	5,375.000
15-25 Oct.	Loleng (CAR, Regions I, II, III, IV, V, VI & VIII)	303	751	29	910,912	3,901,673	96,581	307,042	9,695.000	2,316.000	776.000	P	12,787.000
9-12 Dec.	Norming (Regions III, IV, V & VIII)	33	30	36	75,826	326,490	3,234	6,423	644.000	279.000	138.000	P	1,061.000
	TOTAL	**490**	**866**	**104**	**1,590,905**	**7,322,133**	**137,020**	**406,347**	**16,714.000**	**4,903.000**	**1,400.000**	**P**	**23,017.000**
1999													
1-6 Jun.	Etang (Regions II, III & V)	3	7	1	355	1,601	76	140					
4-6 Jun.	TD Gening (Region III-Zambales)				302	1,601	76	151	76.614	6.230	0.056	P	82.900
21-26 Jul.	TS Helming (NCR, CAR, Regions I, II & III)	1			11	55	3		2.511	21.030		P	23.541
28 Jul-1 Aug.	Ising (Regions III- all provinces & 4 cities)	45	2	2	263,324	1,245,917	31	163	984.673	305.590		P	1290.263
18-21 Aug.	TS Luding (CAR, Regions I, II & III)	10	23	1	7,089	35,222	34	373	29.432	128.404		P	157.836
10-15 Sep.	TS Neneng (Region III)	1	2		1,050	4,633	52	112					0.000
2-6 Oct.	Pepang (CAR, Regions I & II)	18	22	3	84,089	444,770	2,336	11,091	198.313	232.673	5.584	P	436.570
15-18 Oct.	TS Rening (Regions V & VIII)	1			3,290	5,791							0.000
7-9 Nov.	TS Sendang (Regions V, VI & VII)	24	7	9	23,110	54,152	256	11,002	366.089	220.320		P	586.409
	TOTAL	**103**	**63**	**16**	**382,620**	**1,793,742**	**2,864**	**23,032**	**1,657.632**	**914.247**	**5.640**	**P**	**2,577.519**
2000												**P**	
18-19 May.	TS Biring (NCR & Region III)	12	8		59,404	235,885	34	15	34.000	16.000		P	50.000
3-9 Jul.	Edeng (CAR, NCR, Regions I, III, IV & VI)	68	11	15	320,442	1,483,910	524	2,694	643.000	469.000	8.000	P	1,120.000

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		DEAD	INJ	MIS	FAMILIES	PERSONS	TOTAL	PART	AGRI	INFRA	PVT		
19-23 Aug.	Isang (Region II-Batanes)				3,338	11,690			6.000	1.000	1.000	P	8.000
2-7 Sep.	TS Maring (NCR-MM)	5			6,302	6,508	15						0.000
2-6 Sep.& 10-													0.000
12 Sep.	TS Ningning & Osang (CAR & Region II)	3	7	4	13,784	83,284	40	2,780	39.000	10.000		P	49.000
25 Oct-1 Nov.	Reming (NCR, CAR, Regions I, II, III, IV,												0.000
	V, VI & VIII)	114	319	47	486,400	2,455,942	16,910	125,790	2,862.000	963.000	119.000	P	3,944.000
31 Oct-5 Nov.	Seniang (NCR, CAR, Regions III, IV & V)	61		33	368,552	1,747,872	5,920	54,248	385.000	315.000	34.000	P	734.000
27 Nov-3 Dec	TS Toyang (CARAGA, Regions VI, VII,												0.000
	VIII & X)	43	26	5	28,055	164,105	584	8,453	265.000	204.000	216.000	P	685.000
6-8 Dec.	TD Ulpiang (Regions V, VI & CARAGA)	39	15	2	164,496	1,095,750	268	2,485	746.000	142.000		P	888.000
	TOTAL	**345**	**386**	**106**	**1,450,773**	**7,284,946**	**24,295**	**196,465**	**4,980.000**	**2,120.000**	**378.000**	**P**	**7,478.000**
2001												**P**	
18-20 Feb.	TD Auring (Regions VI & VIII)	9	45	3	27,800	139,967	3	50	23.000	22.000		P	45.000
2-5 Jul.	TY Feria (CAR, NCR, CARAGA, Regions												0.000
	I, II, III, IV, V, VI, VIII, IX & X)	188	241	44	415,436	1,902,413	12,774	39,147	1,249.000	1,854.000	383.000	P	3,486.000
16-19 Aug.	TD Jolina (Region III)				57,331	295,355	27	45	14.804			P	14.804
22-28 Sep.	TY Labuyo (CAR, Regions I & II)	2		1	10,677	45,013	4	2,192	32.619	38.831		P	71.450
6-10 Nov.	TY Nanang (NCR, CARAGA, CAR, Regs.												0.000
	IV, V, VII, VIII, IX & X)	236	169	88	262,612	1,331,682	1,973	12,763	1,564.034	1,667.991	13.942	P	3,245.967
4-7 Dec.	TS Quedan (Regions IV, VI, VII & VIII)	5	8	1	10,913	54,832	121	275	3.437	1.390		P	4.827
	TOTAL	**440**	**463**	**137**	**784,769**	**3,769,262**	**14,902**	**54,472**	**2,886.894**	**3,584.212**	**396.942**	**P**	**6,868.048**
2002												**P**	
20-23 Mar.	TD Caloy (Regions VI, VII, VIII &												
	CARAGA)	35	2	7	12,679	54,629	262	1,046	51.009	64.538	8.400	P	123.947
28 Jun-3 Jul.	TY Florita, Gloria, Inday & TS Hambalos												0.000
& 12-14 Jul	(NCR, CAR, Regions I, III, IV, VI, XI & XII)	85	45	5	483,595	3,278,341	404	2,059	344.331	176.849	0.710	P	521.890
18-23 Jul.	TD Juan (Regions IV & VI)	14	3		3,692	19,048	181	402	2.124	10.000		P	12.124
11-14 Aug.	TD Milenyo (Regions III, IV, V, VI, VII,												0.000
	VIII, NCR, X & CARAGA)	35	22	21	38,634	194,451	208	652	83.040	87.918	0.651	P	171.609
													0.000
	TOTAL	**169**	**72**	**33**	**538,600**	**3,546,469**	**1,055**	**4,159**	**480.504**	**339.305**	**9.761**	**P**	**829.570**
2003												**P**	
25-29 May.	TY Chedeng (Linfa) (Regions I, II,. V, VI,												
	CAR & NCR)	44	19	8	236,073	1,146,316	286	3,063	163.679	290.684	83.683	P	538.046
12-18 Jun.	TY Egay (Soudelor) (Regions I, II, V, VIII												
	& CAR)	12	2	2	9,967	45,400	94	157	50.123	67.758	13.029	P	130.910
15-19 Jul.	TS Gilas (Koni) (Regions IV & VIII)	4	1	4	24,183	116,601	191	840	28.768	38.490		P	67.258
19-21 Jul.	Super TY Harurot (Imbudo) (Regs. I, II,												
	III, IV, VI & CAR)	64	154	2	380,517	1,795,601	11,683	47,427	2,373.667	857.862	1.800	P	3,233.329
30-31 Jul.	TS Ineng (Rgions V, VIII & X)				650	3,748	12	52	1.414	6.286	0.286	P	7.986
4-5 Aug.	TS Kabayan (Region III)				31,630	155,147			35.497	1.486		P	36.983
20-24 Aug.	TY Niña (Krovanh) (Region I)			1	289	1,156	9		4.330			P	4.330

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DATES	DISASTERS / AREAS AFFECTED	CASUALTIES			AFFECTED		DAMAGED HOUSES		DAMAGED PROPERTIES (MILLIONS)			TOTAL COST OF DAMAGES	
		DEAD	INJ	MIS	FAMILIES	PERSONS	TOTAL	PART	AGRI	INFRA	PVT		
30 Aug-2 Sep.	TY Onyok (Dujuan) (Regions III & NCR)	1	1		6,535	34,288	1						
24-31 Oct.	TS Ursula (Region VI)	1			12,288	64,291	28	19	66.000	28.000		P	94.000
12-15 Nov.	TS Weng (Regions IV, V, VI, VII & VIII)	13	5	11	91	443	2	21	20.000	25.000		P	45.000
TOTAL		**139**	**182**	**28**	**702,223**	**3,362,991**	**12,306**	**51,579**	**2,743.478**	**1,315.566**	**98.798**	P	**4,157.842**
2004												P	
13-20 May.	TY Dindo (Nida) (Regions	35	23	6	76,715	355,214	10,574	56,223	97.688	214.686	10.840	P	323.214
5-9 Jun.	TS Frank	2		3	731	3,576			0.185	1.500		P	1.685
7-11 Jun.	TD Gener	7	7	3	1,499	7,490	246	1,263	19.500	30.000	26.100	P	75.600
25 Jun.-2 Jul.	TY Igme (Regions I, II, CAR, XII, ARMM,	55	47	20	166,540	805,723	4,821	33,310	1,375.255	1,067.979	3.980	P	2,447.214
	III, IV, V, VI)												0.000
15-17 Aug.	TD Lawin (Region VI)								2.861			P	2.861
20-24 Aug.	TS Marce (Regions I, II, III, IV-A, NCR &	65	10	1	445,107	2,150,363	436	3,811	1,828.179	563.213		P	2,391.392
	CAR)												
14-21 Nov.	TY Unding (Regions IV-B, V, VI)	71	160	69	144,553	759,045	36,011	91,803	Combined	Combined	Combined	P	Combined
22-26 Nov.	TD Violeta (Regions II, III & CAR)	31	187	17	21,151	99,461	369	900	"	"	"	P	"
28-30 Nov.	TD Winnie (Regions II, III, IV-A, V, NCR,	893	648	443	170,036	845,429	8,889	12,578	"	"	"	P	"
	CAR)												
30 Nov-3 Dec.	TY Yoyong	73	168	24	383,575	1,939,835	11,322	61,972	"	"	"	P	"
									5,683.058	**2,256.572**	**80.880**		8,020.510
TOTAL		**1,232**	**1,250**	**586**	**1,409,907**	**6,966,136**	**72,668**	**261,860**	**9,006.726**	**4,133.950**	**121.800**	P	**13,262.476**
2005													
15-18 Mar.	TS Auring (Roke) (Regions IV-B, V, VI & VIII	13		63	3,181	15,638	277	1,307	11.102	10.000		P	21.102
15-19 Jul.	TY Feria (Haitang) (Region II)								2.163	16.100	94.000	P	112.263
19-23 Sep.	TS Labuyo (Regions I, II, IV, V, VIII, CAR)	9	5	5	76,064	375,763	34	17,815	452.368	40.219		P	492.587
14-17 Sep.	LPA & ITCZ	15	11	4	7,136	29,592	10	157	48.180	87.785		P	135.965
16-20 Dec.	TD Quedan (Regions I, II, III, IV-A, IV-B,												0.000
	V, VI, VIII, IX, CAR & CARAGA)	17	6	16	123,630	598,653	193	902	1,584.936	205.500	0.305	P	1,790.741
TOTAL		**54**	**22**	**88**	**210,011**	**1,019,646**	**514**	**20,181**	**2,098.749**	**359.604**	**94.305**	P	**2,552.658**
2006													
9-15 May.	TY Caloy (Chanchu) (Regions I, IV-A,												
	IV-B, V, VI, VIII & NCR)	82	59	36	176,361	927,961	17,356	63,259	2,549.921	1,770.973		P	4,320.894
10-14 Jul.	TS Florita (Bilis) (Regions I, III, IV, V, VI,												0.000
	XI, NCR, CAR)	45	33	6	42,413	202,614	163	6,253	774.175	477.100		P	1,251.275
21-25 Jul.	TY Glenda (Kaemi) (Regions NCR, CAR,												0.000
	I, III & IV-A)	7		1	59,477	282,830	11		83.986	0.400		P	84.386
28 Jul-2 Aug.	TS Henry (Prapiroon) (Regions I, II & III)	12	1	6	286,668	825,819	23	55	122.594	101.155		P	223.749
5 - 9 Aug.	TS Inday (Bopha) (Region CAR)	2	5		31	190				13.900		P	13.900
25 - 29 Sep.	TY Milenyo (Xangsane) (Regions NCR,												0.000
	CAR, III, IV-A, IV-B, V, VI, VII & VIII)	213	660	48	841,207	4,139,195	118,081	385,096	3,968.842	2,637.995		P	6,606.837
27 - 30 Oct.	TY Paeng (Cimaron) (Regions I, II, III, V												0.000
	& CAR)	32	62	23	79,895	364,733	1,395	12,412	788.945	509.289		P	1,298.234
10 - 12 Oct.	TYQueenie (Chebi) (Regions II & III)	1	10		3,958	21,250	228	1,449					0.000

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		DEAD	INJ	MIS	FAMILIES	PERSONS	TOTAL	PART	AGRI	INFRA	PVT		
28 Nov-1Dec.	TY Reming (Durian) (Regions III, IV-A,												0.000
	IV-B & V)	734	2,360	762	707,966	3,536,342	228,436	359,601	1,936.201	3,512.379		P	5,448.580
	TY Seniang (Utor) (Regions IV-A, IV-B,												0.000
	V, VI, VII & VIII)	37	63	21	199,036	952,277	9,912	35,209	629.361	349.818		P	979.179
	TOTAL	**1,165**	**3,253**	**903**	**2,397,012**	**11,253,211**	**375,605**	**863,334**	**10,854.025**	**9,373.009**	**0.000**	**P**	**20,227.034**
2007													
July 11-13	Typhoon Bebeng (Reg VI, IX, XII & ARMM)	14	1	7	2,006	10,012	30	55					
August 5-10	TS Chedeng & Dodong (Reg I,III,IV,CAR,NCR	15	10	1	249,038	1,198,398	89	130	361.785	144.388		P	506.173
August 13-18	Typhoon Egay (Reg I, II, III, IV-A, IV-B,V	5	1		148,700	716,486	43	56	18.565	51.204		P	69.769
	NCR and CAR												0.000
Sept 27-30	Typhoon Hanna (Reg VI, XII, CAR & NCR)	14	5		5,007	18,223	140	885	0.521	32.616	0.005	P	33.142
Oct 1-7	Typhoon Ineng (Reg III,IV-A,IV-B,X, XII, CAR	1	1	14	3,750	20,252	477	1,917			0.451	P	0.451
Nov 3-7	TS Kabayan (Regions , II and CAR)	11	1		30,773	137,918	255	1,265	809.472	97.363		P	906.835
Nov 19- 28	TY Lando (Regions IV-B, V, VI, VII, VIII, X	14	11	6	13,315	59,535							0.000
	X and CARAGA						87	217	16.327	74.060	60.780	P	151.167
Nov 21-28	Ty Mina (Reg I, II, III, IV-A- IV-B, V, VIII & CAR	50	20	11	175,176	838,061	1,540	12,417	460.081	659.909		P	1,119.990
	TOTAL	**124**	**50**	**39**	**627,765**	**2,998,885**	**2,661**	**16,942**	**1,666.751**	**1,059.540**	**61.236**	**P**	**2,787.527**
2008													
May 14-20	Typhoon Cosme (Regl , II, III, VI, VII and CAR)	61	33	3	287,278	1,496,635	47,724	144,469	3,720.848	972.274		P	4,693.122
June 18-22	Typhoon Frank (Reg I, III,IV-A, IV-B, V,VI,VII,	557	826	87	958,515	4,776,778	82,735	345,475	7,481.319	5,856.343		P	13,337.662
	VIII,IX, X, XI and XII)												0.000
July 14-18	Tropical Storm Helen (Regions I and II)	2	2		12,028	54,318			40.975	21.252	62.220	P	124.447
July 24-28	Typhoon Igme (Regions I and CAR)	7	2	3	9,662	22,079	28	54	1.894			P	1.894
August 3-5	Tropical Storm Julian (Regions I and III)	3	1	11	13,878	66,130				135.525		P	135.525
August 17-21	Typhoon Karen (Regions I, III and CAR)	15	13	23	98,500	437,570	1,138	12,115	1,199.186	260.971		P	1,460.157
Sept 19-24	Typhoon Nina (Regions I, II, III,IV-B,VI, X & CAR)	16	30	7	31,188	128,507	170	933	106.103	246.430		P	352.533
Sept 29-Oct 2	Tropical Depression Quinta (Reg 111)	12	14	3	6,151	27,683			3.000			P	3.000
	TD Tonyo (Region XII)		4	1	8	25	1				0.200		0.200
	TOTAL	**673**	**925**	**138**	**1,417,208**	**7,009,725**	**131,796**	**503,046**	**12,553.325**	**7,492.795**	**62.420**	**P**	**20,108.540**
2009													
May 3	T D Crising (Region IV-A, V,VIII and X)	2		1	645	2,226	15		3.000	2.000		P	5.000
May 1-5	Typhoon Dante (Region V)	28	8	1	84,213	418,928	297	3,460	625.710	597.122	73.187	P	1,296.019
May 6-10	Typhoon Emong (Regions I, II, III and CAR)	64	53	13	84,280	400,954	23,482	32,753	980.213	70.595	341.461	P	1,392.269
Jun 10	Tropical Depression Gorio (Regions I and CAR)	1			9,740	42,720	11	2	6.166	0.003		P	6.169
June 23-26	Typhoon Feria (Regions III, IV-A, IV-B,V, VI,	17	12	4	30,566	150.491	1,340	11,354	69.244	149.050	13.779	P	232.073
	VII, VIII and NCR)												0.000
July 14-18	Tropical Storm Isang (Regions I,III,IV-A & NCR)	5		1	56,055	248,057	5	3	13.907	10.850	14.774	P	39.531
July 30-Aug 2	Tropical Storm Jolina (Regions I, II, III, IV-A,	13	10	2	54,318	226,823	125	320	114.087	187.054		P	301.141
	IV-B,VI,VI, VIII, X and XII)												0.000
Aug 7	Typhoon Kiko (Regions I, II, III,VI, XI, NCR	27	18	1	24,332	122,056	443	456	141.197	287.250	445.000	P	873.447
	and CAR)												0.000

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		DEAD	INJ	MIS	FAMILIES	PERSONS	TOTAL	PART	AGRI	INFRA	PVT		
Sept 2-5	Typhoon Labuyo (Regions III, VI and VII)			1	18,960	95,700	5	6					0.000
Sept 8-9	T D Maring (Regions III, IV-A and IV-B)	13		2	87,202	388,373	3	20	236.688	68.204		P	304.892
Sept 12-13	T D Nando (Regions I, II, IV-A and CAR)	3	3	1	13,677	68,022	1	3					0.000
Sept 24-27	Tropical Storm Ondoy (Regions I, II, III, IV-A,	464	529	37	993,227	4,901,234	30,082	154,922	6,668.669	4,283.529		P	10,952.198
	IV-B, V, VI, IX, XII, ARMM, CAR and NCR)												0.000
Sept 30-Oct 10	Typhoon Pepeng (Regionsl, II, III, IV-A, IV-B,	465	207	47	954,087	4,478,284	6,253	48,120	20,494.689	6,799.333	2.700	P	27,296.722
	V, VI, CAR snd NCR)												0.000
Oct 16-22	Typhoon Ramil (Region I, II and CAR)				1,271	6,239	16	29					0.000
Oct 28- Nov 1	Typhoon Santi (Regions III, IV-A,IV-B,V & NCR	34	20	5	170,497	802,155	4,104	18,696	345.317	353.180	6.500	P	704.997
Nov 23-26	Typhoon Urduja (Regions X and CARAGA)	4	13		12,326	48,129			466.820	100.000		P	566.820
	TOTAL	**1,140**	**873**	**116**	**2,595,396**	**12,250,050**	**66,182**	**270,144**	**30,165.707**	**12,908.170**	**897.401**	**P**	**43,971.278**
2010													
24 - 27 March	Tropical Storm Agaton												
12-15 July	Typhoon Basyang (Regions III, IV-A, V and	102	91	46	114,905	585,383	73,286	65,908	239.410	138.566		P	377.976
	NCR)												
3 - 5 August	tropical Storm Doming												
19-20 July	Tropical Storm Caloy (Region III)	1			235	1,175							
7-9 Aug	Tropical Storm Ester (Regions III and NCR)	2		35	209	1,045							
27-28 August	Tropical Depression Florita												
29-31 August	Typhoon Glenda												
3-4 Sept	Tropical Depression Henry												
15-19 Sept	Typhoon Inday												
16-21 Oct	Typhoon Juan (Regions I, II, III, IV-A, NCR and	31	42	4	427,962	2,008,984	30,048	116,174	11,527.990	486.000		P	12,013.990
	CAR)												
	TOTAL	**136**	**133**	**85**	**543,311**	**2,596,587**	**103,334**	**182,082**	**11,767.400**	**624.566**	**0.000**	**P**	**12,391.966**
2011													
03–04 April	Tropical Depression Amang												
6-11 May	Tropical Storm Bebeng (Regions III, IV-A, IV-B,	35	11	2	83,632	431,837	64	10,134	1,085.696	1,167.537		P	2,253.233
	NCR, V, VII and VIII)												
20-28 May	Typhoon Chedeng (Regions NCR, II, V, IX, X, XII	4			91,767	446,907	83	48	8.823	5.488	4.622	P	18.933
	and ARMM)												
9-10 June	Tropical Storm Dodong (Regions I, II, III, IV-A	3	1	3	325	2,080	36	300			6.192	P	6.192
	and IV-B)												
14-20 June	Tropical Depression Egay (Regions III and NCR)	2	1		7,970	37,837	8	34				P	0.000
21-25 June	Tropical Storm Falcon (Regions I, II, III and NCR)	12	4	12	389,348	1,792,376	165	1,215	241.011	405.841		P	646.852
9-10 July	Tropical Depression Goring												
15-16 July	Tropical Depression Hanna												
17-Jul	Typhoon Ineng												
25-28 July	Tropical Storm Juaning g (Regions III, IV-A,IV-B,	77	53	8	255,129	1,285,906	11,196	21,710	1,590.947	2,850.851		P	4,441.798
	V, VII, VIII and NCR)												
28 July - 5 Aug	Tropical Storm Kabayan (Regions I, III, IV-A, VI	8	5	1	23,238	93,888	11	75	2.000		0.500	P	2.500
	and NCR)												
31 Jul -01 Aug	Tropical Depression Lando												

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		DEAD	INJ	MIS	FAMILIES	PERSONS	TOTAL	PART	AGRI	INFRA	PVT		
21-29 Aug	Typhoon Mina (Regions I, II, V, VI,CAR and NCR)	36	37	8	97,006	411,468	159	2,918	1,668.522	420.827		P	2,089.349
8 Sept	Tropical Storm Nonoy												
12-13, 17-18 Sept	Tropical Storm Onyok												
24-28 Sept	Typhoon Pedring (Regions I, II, III, IV-A, IV-B, V, VI, CAR and NCR)	85	91	21	667,602	3,105,355	7,491	47,022	13,457.770	2,094.817		P	15,552.587
29 Sept- 02 Oct	Typhoon Quiel (Regions I, II, III and CAR)	17	32	7	323,303	1,489,535	5,553	28,493		115.076		P	115.076
10-14 Oct	Tropical Storm Ramon (Regions IV-B, VI, VII, VIII, X, XII and CARAGA)	10	6	1	17,971	88,506	29	62				P	0.000
16-18 Dec	Tropical Storm Sendong (Regions VI, VII, IX, X, XI and CARAGA)	1,268	6,071	181	131,618	698,882	13,585	37,559	309.101	1,366.346	392.919	P	2,068.366
	TOTAL	1,557	6,312	244	2,088,909	9,884,577	38,380	149,570	18,363.870	8,426.783	404.233	P	27,194.886
2012													
31 May - 05 June	Tropical Storm Ambo	3	7	5									
14 - 18 June	Typhoon Butchoy	1			71	310							
20 June	Tropical Storm Carina												
25 - 29 June	Tropical Storm Dindo (Regions I and X)				4,836	22,714		13		15.500		P	15.500
16 - 17 July	Tropical Storm Enteng												
20 - 21 July	Tropical Depression Ferdie (Region IV-A)	6		3	1,381	5,118			0.582	5.400		P	5.982
28 - 31 July	Tropical Depression Gener (Regions I,II,III,IV-A, IV-B,V, VI,VII,IX,X,XI,XII, CAR and NCR)	54	35	3	211,967	948,696	1,424	7,945	424.386	301.341	2.604	P	728.331
11 - 16 Aug	Tropical Depression Helen (Regions I, II,III, IV-B and CAR)	10	17		40,836	181,527	15	29	125.130			P	125.130
19 - 28 Aug	Typhoon Igme (Regions I, IV-A, IX and X)	9		2	1,298	5,790	1	44	4.088			P	4.088
11 - 15 Sept	Tropical Depression Karen (Regions III, VIII and NCR)	1			3,232	13,033					0.025	P	0.025
20 - 29 Sept	Typhoon Lawin (Regions IV-B and XI)	3		1	8,131	33,898	146	105					
01 - 06 Oct	Tropical Storm Marce (Regions III and IV-B)	1		3	66	322							
08 - 16 Oct	Tropical Storm Nina											P	0.000
22 - 26 Oct	Tropical Depression Ofel (Regions III, IV-A, IV-B, V, VI, VII, VIII, IX, XII, CAR and CARAGA)	27	19	6	36,353	173,427	236	2,558	96.360	113.020		P	209.380
02 - 09 Dec	Typhoon Pablo (Regions I, IV-B, VI, VII, VIII, IX, X, XI, XII, ARMM, CARAGA)	1,248	2,666	834	711,682	6,243,998	89,666	127,151	27,998.266	6,647.038	2,857.523	P	37,502.827
25 - 27 Dec	Tropical Depression Quinta (Regions IV-A, IV-B, VI, VIII and CARAGA	23	3	3	79,097	377,293	1,931	4,522	146.856	548.129		P	694.985
	TOTAL	1,386	2,747	860	1,098,950	8,006,126	93,419	142,367	28,795.668	7,630.428	2,860.152	P	39,286.248

Historical Record of Flood Damage in Target 19 River Basins

Year	From	To	Area/Location	Typhoon or Monsson associated	Main cause/ Type of flood	Damage			1 Cagayan (CAR and Region 2)	2 Agno (Regions 1, 2, 3, CAR)	3 Pampanga (Region 3)	4 Pasig-Laguna de Bay (NCR and Region 4A)	5 Bicol (Region 5)	6 Abulog (Region 2)	7 Abra (Region 1 and CAR)	8 Panay (Region 6)	9 Jalaur (Region 6)	10 Ilog-Hilabangan (Regions 6 and 7)	11 Agusan (Regions 11 and 13)	12 Tagoloan (Region 10)	13 Cagayan de Oro (Region 10)	14 Agus-Lake Lanao (ARMM and Region 10)	15 Davao (Regions 10 and 11)	16 Tagum-Libuganon (Regions 11 and 13)	17 Mindanano (Cotabato) (ARMM and Region 12)	18 Buayan-Malungon (Regions 11 and 12)	19 Mandulog (Region 10)	Data Source
						Killed	Total affected people	Estimated damage (US$mil.)																				
1990	13-Jun	15-Jun	X and XI	Akang		No Data	227,269	P200.130											o	o	o	o	o	o		o	o	NDRRMC
	17-Jun	23-Jun	I, IV, VIII, X, XII, CAR	Bising		64	81,355	P60,055	o	o		o			o					o	o	o	o		o		o	
			NCR																									
	27-Jul	28-Jul	I, III	Emang		8	32,974	P24.818		o	o				o													
	15-Aug	20-Aug	I, IV, CAR, NCR	Gading		2	No Data	P22,825	o	o		o			o													
	24-Aug	27-Aug	I, IV, CAR, NCR	Heling		36	No Data	P44,617	o	o		o			o													
	28-Aug	30-Aug	I, IV, CAR, NCR	Iliang		50	No Data	P1,502,197	o	o		o			o													
	5-Sep	8-Sep	I, CAR	Loleng		No Data	27,955	No Data		o					o													
	12-Sep	15-Sep	I	Miding		2	11,685	No Data		o					o													
	15-Sep	17-Sep	I, III, IV, VI	Norming		36	213,431	P44.637		o	o	o			o	o	o	o										
	10-Aug	14-Aug	NCR, III, IV, V, VI, VII,	Ruping		508	5,498,290	P10,846,071		o	o	o	o			o	o	o		o	o	o	o	o	o	o	o	
			VIII, IX, X, XI, XII																									
									4	9	3	6	1	0	8	2	2	2	2	3	3	3	3	2	2	2	3	
1991	11-Mar	13-Mar	IV-A	Auring		13	73,184	P72,353				o																
	13-Jun	15-Jun	V	Diding		90	488,757	P1,362,853					o															
	8-Jul	11-Jul	III, IV	Etang		44	505,756	P579,958		o	o	o																
	23-Oct	30-Oct	CAR, I, II	Trining		119	524,307	P3,719,000	o	o				o	o													
	2-Nov	7-Nov	VI, VIII, Ormoc (tragedy	Uring		5101	223,985	P1,413,498								o	o	o										
	14-Nov	20-Nov	IV	Yayang		47	No Data	P883,077				o																
									1	2	1	3	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	
1992	9-Jul	12-Jul	II, III	Konsing		3	5,135	P21,062	o	o	o			o														
	17-Jul	21-Jul	NCR, I, II	Ditang		36	134,417	P470,659	o	o		o		o	o													
	16-Aug	18-Aug	NCR, III, IV	Gloring		22	725,956	P1,347,133		o	o	o																
	26-Aug	31-Aug	CAR, I, II	Isang		19	114,084	P172,493	o	o				o	o													
	31-Aug	5-Sep	CAR, I, II	Lusing		10	171,603	P902,744	o	o				o	o													
	18-Sep	23-Sep	NCR, CAR, I, II, III, IV	Maring		27	570,136	P2,155,305	o	o	o	o		o	o													
	18-Oct	27-Oct	NCR, III, IV	Paring		1	34,480	P1,115		o	o	o																
									5	7	4	4	0	5	4	0	0	0	0	0	0	0	0	0	0	0	0	

Historical Record of Flood Damage in Target 19 River Basins

Year	From	To	Area/Location	Typhoon or Monsson associated	Main cause/ Type of flood	Damage			1 Cagayan (CAR and Region 2)	2 Agno (Regions 1, 2, 3, CAR)	3 Pampanga (Region 3)	4 Pasig-Laguna de Bay (NCR and Region 4A)	5 Bicol (Region 5)	6 Abulog (Region 2)	7 Abra (Region 1 and CAR)	8 Panay (Region 6)	9 Jalaur (Region 6)	10 Ilog-Hilabangan (Regions 6 and 7)	11 Agusan (Regions 11 and 13)	12 Tagoloan (Region 10)	13 Cagayan de Oro (Region 10)	14 Agus-Lake Lanao (ARMM and Region 10)	15 Davao (Regions 10 and 11)	16 Tagum-Libuganon (Regions 11 and 13)	17 Mindanano (Cotabato) (ARMM and Region 12)	18 Buayan-Malungon (Regions 11 and 12)	19 Mandulog (Region 10)	Data Source
						Killed	Total affected people	Estimated damage (US$mil.)																				
1993	23-Jun	27-Jun	CAR, NCR, I, II, III, IV, V	Goring		75	812,830	P2,774,694	o	o	o	o	o	o	o													NDRRMC
	7-Jul	9-Jul	IV, V, IX	Huling		19	548	P4,121				o	o															
	5-Aug	8-Aug	III	Openg		No Data	516	P0.015		o	o																	
	16-Aug	19-Aug	NCR, I, III	Rubing		11	29,451	P98,347		o	o	o			o													
	22-Aug	26-Aug	VI (Capiz and Iloilo)	Saling		4	22,308	P157,164								o	o	o										
	8-Sep	12-Sep	II	Walding		No Data	11,004	P1,318	o	o				o														
	13-Sep	16-Sep	I, III	Yeyeng		No Data	37,610	P37,373		o	o				o													
	30-Sep	7-Oct	NCR, CAR, I, II, III, IV	Kadiang		126	2,060,677	P8,752,316	o	o	o	o		o	o													
	28-Oct	2-Nov	CAR, I, II, III, IV	Husing		21	462,793	P1,585,163	o	o	o	o		o	o													
	18-Nov	22-Nov	VI, VII, VIII	Luring		18	185,727	P27880								o	o	o										
	3-Dec	7-Dec	NCR, II, IV, V	Monang		273	1,361,267	P2,464,000	o	o		o	o	o														
	6-Dec	12-Dec	IV, V, VIII	Naning		93	463,925	P1,393,000				o	o															
	14-Dec	17-Dec	No Data	Oning		No Data	No Data	No Data																				
	24-Dec	29-Dec	VI, VII, VIII, X, XI	Puring		187	1,914,935	P2,742,000								o	o	o	o	o	o	o	o	o	o			
									5	8	6	7	4	5	5	3	3	3	1	1	1	1	1	1	0	1	1	
1994	31-Mar	9-Apr	VI, VII, VIII, X	Bising		19	587,671	P407,660								o	o	o		o	o	o	o				o	
	4-Apr	6-Apr	IV, V, VI	Akang		45	49,159	P79,564				o	o			o	o	o										
	24-May	26-May	VII, XI, XII	Deling		1	8,788	P145,322										o	o				o	o	o	o		
	21-Jun	24-Jun	NCR, III	Gading		3	56,112	No Data		o	o	o																
	7-Jul	10-Jul	I, II, III	Iliang		11	166,564	P155,303	o	o	o			o	o													
	10-Jul	11-Jul	No Data	Loleng		No Data	No Data	No Data																				
	18-Jul	20-Jul	I, III	Norming		12	616,860	P4,480		o	o				o													
	25-Jul	29-Jul	For both Oyang/Pasing	Oyang																								
	31-Jul	3-Aug	ARMM, I, III, IV, VI, XI	Pasing		48	336,069	P133,784		o	o	o			o	o	o	o	o			o	o	o	o	o		
	4-Aug	7-Aug	CAR, I	Ritang		4	16,838	P7,346	o	o					o													
	7-Sep	10-Sep	I, II	Weling		10	70,597	P183,845	o	o				o	o													
	18-Oct	23-Oct	NCR, II, III, IV, V	Katring		45	287,737	P1, 433,183	o	o	o	o	o	o														
	18-Dec	24-Dec	IV, V, VI, VII, VIII, X	Garding		44	857,837	P647,541				o	o			o	o	o		o	o	o	o				o	
									4	7	5	5	3	3	5	4	4	5	2	2	2	3	4	2	2	2	2	0

Historical Record of Flood Damage in Target 19 River Basins

Year	From	To	Area/Location	Typhoon or Monsson associated	Main cause/ Type of flood	Damage			1 Cagayan (CAR and Region 2)	2 Agno (Regions 1, 2, 3, CAR)	3 Pampanga (Region 3)	4 Pasig-Laguna de Bay (NCR and Region 4A)	5 Bicol (Region 5)	6 Abulog (Region 2)	7 Abra (Region 1 and CAR)	8 Panay (Region 6)	9 Jalaur (Region 6)	10 Ilog-Hilabangan (Regions 6 and 7)	11 Agusan (Regions 11 and 13)	12 Tagoloan (Region 10)	13 Cagayan de Oro (Region 10)	14 Agus-Lake Lanao (ARMM and Region 10)	15 Davao (Regions 10 and 11)	16 Tagum-Libuganon (Regions 11 and 13)	17 Mindanano (Cotabato) (ARMM and Region 12)	18 Buayan-Malungon (Regions 11 and 12)	19 Mandulog (Region 10)	Data Source
						Killed	Total affected people	Estimated damage (US$mil.)																				
1995	31-May	8-Jun	III, IV	Auring		6	2,118	P29,600		o	o	o																
	27-Jul	31-Jul	CAR, I, II, III	Karing		2	58,186	P166,066	o	o	o			o	o													
	25-Aug	31-Aug	I, II, III, IV, V	Gening		3	195,885	P170,342	o	o	o	o	o	o	o													
	2-Sep	5-Sep	III	Helming		8	104,416	P8,294		o	o																	
	14-Sep	17-Sep	I, III	Ising		1	34,590	P179,434		o	o				o													
	21-Sep	22-Sep	I	Luding		1	5,422	No Data		o					o													
	27-Sep	2-Oct	NCRI, III, IV, V, VI, VII, VIII, X	Mameng		116	1,240,668	P2,962,924		o	o	o	o		o	o	o	o		o	o	o	o				o	
	26-Oct	30-Oct	IV, VI, VII, VIII	Pepang		265	1,254,774	P423,517				o				o	o	o										
	30-Oct	4-Nov	NCR, CAR, I, II, III, IV, V, VIII	Rosing		936	4,583,618	P10,850,772	o	o	o	o	o	o	o													
	2-Dec	5-Dec	No Data	Sendang		11	4,055	P3,700																				
	25-Dec	30-Dec	VII, VIII, XI, XIII	Trining		7	199,794	P380.761										o	o				o	o		o		
									3	8	7	5	3	3	6	2	2	3	1	1	1	1	2	1	0	1	1	
1996	28-Feb	2-Mar	VI, VIII	Asiang		2	8,221	P7,557								o	o											
	5-Apr	9-Apr	V, VI, VIII	Biring		3	1,000	P40,701					o			o	o	o										
	11-May	17-May	V	Konsing		No Data	No Data	P0.700					o															
	21-Jul	26-Jul	NCR, CAR, I, II, III, IV	Gloring		72	686,250	P2,120,254	o	o	o	o		o	o													
	27-Jul	31-Jul	NCR, CAR, I, III, IV	Huaning		5	192,651	P0.018	o	o	o	o			o													
	18-Aug	21-Aug	CAR, I, II	Lusing		4	118,249	P92,633	o	o				o	o													
	5-Sep	8-Sep	II	Maring		6	9,297	P23,840	o	o				o														
	10-Sep	11-Sep	CAR, II, IV	Ningning		No Data	67	P41,657	o	o		o		o	o													
	14-Oct	19-Oct	CAR, I, II	Seniang		8	150,609	P203,741	o	o				o	o													
	4-Nov	14-Nov	CAR, CARAGA, ARMM I, IV, V, VI, VII, VIII, IX, X, XI	Toyang		24	88,945	P237,664	o	o		o	o		o	o	o	o	o	o	o	o	o	o	o	o	o	
									7	7	2	4	3	5	6	3	3	2	1	1	1	1	1	1	1	1	1	
1997	26-May	29-May	NCR, I, III, IV, VI	Bening		39	426,958	P104,843		o	o	o			o	o	o	o										
	20-Jul	24-Jul	VI	Elang		2	5,365	P0.854								o	o	o										
	30-Jul	6-Aug	III	Huling		No Data	15,115	P7,400		o	o																	
	15-Aug	17-Aug	CAR, I, III, IV, VI, XI, XII	Ibiang		36	1,521,125	P476,532	o	o	o	o			o	o	o	o	o				o	o	o	o		
	21-Aug	29-Aug	NCR, II	Miling		4	186,266	P6,407	o	o		o		o														
	16-Oct	23-Oct	CAR, I, II	Narsing		14	244,606	P450,117	o	o				o	o													
									3	5	3	3	0	2	3	3	3	3	1	0	0	0	1	1	1	1	0	

Historical Record of Flood Damage in Target 19 River Basins

Year	From	To	Area/Location	Typhoon or Monsson associated	Main cause/ Type of flood	Damage			1 Cagayan (CAR and Region 2)	2 Agno (Regions 1, 2, 3, CAR)	3 Pampanga (Region 3)	4 Pasig-Laguna de Bay (NCR and Region 4A)	5 Bicol (Region 5)	6 Abulog (Region 2)	7 Abra (Region 1 and CAR)	8 Panay (Region 6)	9 Jalaur (Region 6)	10 Ilog-Hilabangan (Regions 6 and 7)	11 Agusan (Regions 11 and 13)	12 Tagoloan (Region 10)	13 Cagayan de Oro (Region 10)	14 Agus-Lake Lanao (ARMM and Region 10)	15 Davao (Regions 10 and 11)	16 Tagum-Libuganon (Regions 11 and 13)	17 Mindanano (Cotabato) (ARMM and Region 12)	18 Buayan-Malungon (Regions 11 and 12)	19 Mandulog (Region 10)	Data Source
						Killed	Total affected people	Estimated damage (US$mil.)																			
1998	16-Sep	21-Sep	NCR, CAR I, II, III, IV	Emang, Gading		108	1,749,414	P3,794,000	o	o	o	o		o	o												
	11-Oct	16-Oct	CAR, I, II, III, IV, V	Iliang		46	1,344,556	P5,375,000	o	o	o	o	o	o	o												
	15-Oct	25-Oct	CAR, I, II, III, IV, V, VI, VIII	Loleng		303	3,901,673	P12,787,000	o	o	o	o	o	o	o	o	o	o									
	9-Dec	12-Dec	III, IV, V, VIII	Norming		33	326,490	P1,061,000		o	o	o	o														
									3	4	4	4	3	3	3	1	1	1	0	0	0	0	0	0	0	0	
1999	1-Jun	6-Jun	II, III, V	Etang		3	1,601	No Data	o	o	o		o	o													
	4-Jun	6-Jun	III, Zambales	Gening		No Data	1,601	P82,900		o	o																
	21-Jul	26-Jul	NCR, CAR, I, II, III	Helming		1	55	P23,541	o	o	o	o		o	o												
	28-Jul	1-Aug	III - All provinces and 4 cities	Ising		45	1,245,917	P1,290,263		o	o																
	18-Aug	21-Aug	CAR, I, II, III	Luding		10	35,222	P157,836	o	o	o			o	o												
	10-Sep	15-Sep	III	Neneng		1	4,633	0,000		o	o																
	2-Oct	6-Oct	CAR, I, II	Pepang		18	444,770	P436,570	o	o				o	o												
	15-Oct	18-Oct	V, VIII	Rening		1	5,791	0,000					o														
	7-Nov	9-Nov	V, VI, VII	Sendang		24	54,152	P586,409					o			o	o	o									
									4	7	6	1	3	4	3	1	1	1	0	0	0	0	0	0	0	0	
2000	18-May	19-May	NCR, III	Biring		12	235,885	P50,000		o	o	o															
	3-Jul	9-Jul	CAR, NCR, I, III, IV,VI	Edeng		68	1,483,910	P1,120,000	o	o	o	o			o	o	o	o									
	19-Aug	23-Aug	II Batanes	Isang		No Data	11,690	P8,000	o	o				o													
	2-Sep	7-Sep	NCR, MM	Maring		5	6,508	P0,000				o															
	2-Sep	6-Sep	CAR,, II	Ningning		3	83,284	P49,000	o	o				o	o												
	10-Sep	12-Sep		and Osang																							
	25-Oct	1-Nov	NCR, CAR, I, II, III, IV, V, VI, VIII	Reming		114	486,400	P3,944,000	o	o	o	o	o	o	o	o	o	o									
	31-Oct	5-Nov	NCR, CAR, III, IV, V	Seniang		61	1,747,872	P734,000	o	o	o	o	o		o												
	27-Nov	3-Dec	CARAGA, VI, VII, VIII, X	Toyang		43	164,105	P685,000								o	o	o	o	o	o	o	o	o		o	
	6-Dec	8-Dec	V, VI, CARAGA	Ulpiang		39	1,095,750	P888,000					o			o	o	o	o					o			
									5	6	4	5	2	3	4	4	4	4	2	1	1	1	1	2	0	0	1	

Historical Record of Flood Damage in Target 19 River Basins

Year	From	To	Area/Location	Typhoon or Monsson associated	Main cause/ Type of flood	Damage			1 Cagayan (CAR and Region 2)	2 Agno (Regions 1, 2, 3, CAR)	3 Pampanga (Region 3)	4 Pasig-Laguna de Bay (NCR and Region 4A)	5 Bicol (Region 5)	6 Abulog (Region 2)	7 Abra (Region 1 and CAR)	8 Panay (Region 6)	9 Jalaur (Region 6)	10 Ilog-Hilabangan (Regions 6 and 7)	11 Agusan (Regions 11 and 13)	12 Tagoloan (Region 10)	13 Cagayan de Oro (Region 10)	14 Agus-Lake Lanao (ARMM and Region 10)	15 Davao (Regions 10 and 11)	16 Tagum-Libuganon (Regions 11 and 13)	17 Mindanano (Cotabato) (ARMM and Region 12)	18 Buayan-Malungon (Regions 11 and 12)	19 Mandulog (Region 10)	Data Source
						Killed	Total affected people	Estimated damage (US$mil.)																				
2001	18-Feb	20-Feb	VI, VIII	Auring		9	139,967	P45,000								o	o	o									
	2-Jul	5-Jul	CAR, NCR, CARAGA, I	Feria		188	1,902,413	P3,486,000	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o			o	
			II, III, IV, V, VI, VIII IX, X																									
	16-Aug	19-Aug	III	Jolina		No Data	295,355	P14,804		o	o																	
	22-Sep	28-Sep	CAR, I, II	Labuyo		2	45,013	P71,450	o	o				o	o													
	6-Nov	10-Nov	NCR, CARAGA, CAR, IV	Nanang		236	1,331,682	P3,245,967	o	o		o	o		o			o	o	o	o	o	o	o			o	
			V, VII, VIII, IX, X																									
	4-Dec	7-Dec	IV, VI, VII, VIII	Quedan		5	54,832	P4,827				o				o	o	o										
									3	4	2	3	2	2	3	3	3	4	2	2	2	2	2	2	0	0	2	
2002	20-Mar	23-Mar	VI, VII, VIII, CARAGA	Caloy		35	54,629	P123.947								o	o	o	o					o				
	28-Jun	3-Jul	NCR, CAR, I, III, IV, VI,	Florira, Gloria,		85	3,278,341	P521,890	o	o	o	o			o	o	o	o	o				o	o	o	o		
	12-Jul	14-Jul	XI, XII	Inday, Hambalos																								
	18-Jul	23-Jul	IV, VI	Juan		14	19,048	P12,124				o				o	o	o										
	11-Aug	14-Aug	III, IV, V, VI, VII, VIII,	Milenyo		35	194,451	P171,609		o	o	o	o			o	o	o	o	o	o	o	o	o			o	
			NCR, X, CARAGA																									
									1	2	2	3	1	0	1	4	4	4	3	1	1	1	2	3	1	1	1	
2003	25-May	29-May	I, II, V, VI, CAR, NCR	Chedeng		44	1,146,316	P538,046	o	o		o	o	o	o	o	o	o										
	12-Jun	18-Jun	I, II, V, VIII, CAR	Egay		12	45,400	P130,910	o	o			o	o	o													
	15-Jul	19-Jul	IV, VIII	Gilas		4	116,601	P67,258				o																
	19-Jul	21-Jul	I, II, III, IV, VI, CAR	Haruruot		64	1,795,601	P3,233,329	o	o	o	o	o	o	o	o	o	o										
	30-Jul	31-Jul	V, VIII, X	Ineng		No Data	3,748	P7,986					o							o	o	o	o				o	
	4-Aug	5-Aug	III	Kabayan		No Data	155,147	P36,983		o	o																	
	20-Aug	24-Aug	I	Niña		No Data	1,156	P4,330		o					o													
	30-Aug	2-Sep	III, NCR	Onyok		1	34,288	No Data		o	o	o																
	24-Oct	31-Oct	VI	Ursula		1	64,291	P94,000								o	o	o										
	12-Nov	15-Nov	IV, V, VI, VII, VIII	Weng		13	443	P45,000				o	o			o	o	o										
									3	6	3	5	5	3	4	4	4	4	0	1	1	1	1	0	0	0	1	

Historical Record of Flood Damage in Target 19 River Basins

Year	From	To	Area/Location	Typhoon or Monsson associated	Main cause/ Type of flood	Damage			1 Cagayan (CAR and Region 2)	2 Agno (Regions 1, 2, 3, CAR)	3 Pampanga (Region 3)	4 Pasig-Laguna de Bay (NCR and Region 4A)	5 Bicol (Region 5)	6 Abulog (Region 2)	7 Abra (Region 1 and CAR)	8 Panay (Region 6)	9 Jalaur (Region 6)	10 Ilog-Hilabangan (Regions 6 and 7)	11 Agusan (Regions 11 and 13)	12 Tagoloan (Region 10)	13 Cagayan de Oro (Region 10)	14 Agus-Lake Lanao (ARMM and Region 10)	15 Davao (Regions 10 and 11)	16 Tagum-Libuganon (Regions 11 and 13)	17 Mindanano (Cotabato) (ARMM and Region 12)	18 Buayan-Malungon (Regions 11 and 12)	19 Mandulog (Region 10)	Data Source
						Killed	Total affected people	Estimated damage (US$mil.)																				
2004	13-May	20-May	No Data	Dindo		35	355,214	P323,214																				
	5-Jun	9-Jun	No Data	Frank		2	3,576	P1,685																				
	7-Jun	11-Jun	No Data	Gener		7	7,490	P75,600																				
	25-Jun	2-Jul	I, II, III, IV, V, VI, XII CAR, ARMM	Igme		55	805,723	P2,447,214	o	o	o	o	o	o	o	o	o	o				o			o	o		
	15-Aug	17-Aug	VI	Lawin		No Data	No Data	P2,861								o	o	o										
	20-Aug	24-Aug	I, II, III, IV-A, NCR, CAR	Marce		65	2,150,363	P2,391,392	o	o	o	o		o	o													
	14-Nov	21-Nov	IV-B, V, VI	Unding		71	759,045	P8,020,510					o			o	o	o										
	22-Nov	26-Nov	II, III, CAR	Violeta		31	99,461	Combined	o	o	o			o	o													
	28-Nov	30-Nov	II, III, IV-A, V, NCR, CA	Winnie		893	845,429	nding, Violeta,	o	o	o	o	o	o	o													
	30-Nov	3-Dec	No Data	Yoyong		73	1,939,835	innie, Yoyong																				
									4	4	4	3	3	4	4	3	3	3	0	0	0	1	0	0	1	1	0	
2005	15-Mar	18-Mar	IV-B, V, VI, VIII	Auring		13	15,638	P21,102					o			o	o	o										
	15-Jul	19-Jul	II	Feria		No Data	No Data	P112,263	o	o				o														
	14-Sep	17-Sep	No Data	LPA and ITCZ		15	29,592	P135,965																				
	19-Sep	23-Sep	I, II, IV, V, VIII, CAR	Labuyo		9	375,763	P492,587	o	o		o	o	o	o													
	16-Dec	20-Dec	I, II, III, IV-A, IV-B, V, VI, VIII, IX, CAR, CARAGA	Quedan		17	598,653	P1,790,741	o	o	o	o	o	o	o	o	o	o	o						o			
									3	3	1	2	3	3	2	2	2	2	1	0	0	0	1	0	0	0		
2006	9-May	15-May	I, IV-A, IV-B, V, VI, VIII NCR	Caloy		82	927,961	P4,320,894	o	o		o	o		o	o	o	o										
	10-Jul	14-Jul	I, III, IV, V, VI, XI, NCR, CAR	Florita		45	202,614	P1,251,275	o	o	o	o	o		o	o	o	o	o				o	o		o		
	21-Jul	25-Jul	NCR, CAR, I, III, IV-A	Glenda		7	282,830	P84,386	o	o	o	o			o													
	28-Jul	2-Aug	I, II, III	Henry		12	825,819	P223,749	o	o	o			o	o													
	5-Aug	9-Aug	CAR	Inday		2	190	P13,900	o	o					o													
	25-Sep	29-Sep	NCR, CAR, III, IV-A, IV-B, V, VI, VII, VIII	Milenyo		213	4,139,195	P6,606,837	o	o	o	o	o		o	o	o	o										
	10-Oct	12-Oct	II, III	Queenie		1	21,250	P0,000	o	o	o			o														
	27-Oct	30-Oct	I, II, III, V, CAR	Paeng		32	364,733	P1,298,234	o	o	o		o	o	o													
	28-Nov	1-Dec	III, IV-A, IV-B, V	Reming		734	3,536,342	P5,448,580		o	o	o	o															
	No Data	No Data	IV-A, IV-B, V, VI, VII, VIII	Seniang		37	952,277	P979,179				o	o			o	o	o										
									8	9	7	6	6	3	7	4	4	4	1	0	0	0	1	1	0	1	0	

Historical Record of Flood Damage in Target 19 River Basins

Year	From	To	Area/Location	Typhoon or Monsson associated	Main cause/ Type of flood	Damage			1 Cagayan (CAR and Region 2)	2 Agno (Regions 1, 2, 3, CAR)	3 Pampanga (Region 3)	4 Pasig-Laguna de Bay (NCR and Region 4A)	5 Bicol (Region 5)	6 Abulog (Region 2)	7 Abra (Region 1 and CAR)	8 Panay (Region 6)	9 Jalaur (Region 6)	10 Ilog-Hilabangan (Regions 6 and 7)	11 Agusan (Regions 11 and 13)	12 Tagoloan (Region 10)	13 Cagayan de Oro (Region 10)	14 Agus-Lake Lanao (ARMM and Region 10)	15 Davao (Regions 10 and 11)	16 Tagum-Libuganon (Regions 11 and 13)	17 Mindanano (Cotabato) (ARMM and Region 12)	18 Buayan-Malungon (Regions 11 and 12)	19 Mandulog (Region 10)	Data Source
						Killed	Total affected people	Estimated damage (US$mil.)																				
2007	11-Jul	13-Jul	VI, IX, XII, ARMM	Bebeng		14	10,012	No Data								o	o	o				o			o	o		
	5-Aug	10-Aug	I, III, IV, CAR, NCR	Chedeng, Dodong		15	1,198,398	P506,173	o	o	o	o			o													
	13-Aug	18-Aug	I, II, III, IV-A, IV-B, V, NCR, CAR	Egay		5	716,486	P69,769	o	o	o	o	o	o	o													
	27-Sep	30-Sep	VI, XII, CAR, NCR	Hanna		14	18,223	P33,142	o	o		o			o	o	o	o							o	o		
	1-Oct	7-Oct	III, IV-A, IV-B, X, XII, CAR	Ineng		1	20,252	P0.451	o	o	o	o			o					o	o	o	o		o	o	o	
	3-Nov	7-Nov	II, CAR	Kabayan		11	137,918	P906,835	o	o				o	o													
	19-Nov	28-Nov	IV-B, V, VI, VII, VIII, X, CARAGA	Lando		14	59,535	P151,167					o			o	o	o	o	o	o	o	o	o			o	
	21-Nov	28-Nov	I, II, III, IV-A, IV-B, V, VIII, CAR	Mina		50	838,061	P1,119,990	o	o	o	o	o	o	o													
									6	6	4	5	3	3	6	3	3	3	1	2	2	3	2	1	3	3	2	
2008	14-May	20-May	I, II, III, VI, VII, CAR	Cosme		61	1,496,635	P4,693,122	o	o	o			o	o	o	o	o										
	18-Jun	22-Jun	I, III, IV-A, IV-B, V, VI, VII, VIII, IX, X, XI, XII	Frank		557	4,776,778	P13,337,662		o	o	o	o		o	o	o	o	o	o	o	o	o	o	o	o	o	
	14-Jul	18-Jul	I, II	Helen		2	54,318	P124,447	o	o				o	o													
	24-Jul	28-Jul	I, CAR	Igme		7	22,079	P1,894	o	o					o													
	3-Aug	5-Aug	I, III	Julian		3	66,130	P135,525		o	o				o													
	17-Aug	21-Aug	I, III, CAR	Karen		15	437,570	P1,460,157	o	o	o				o													
	19-Sep	24-Sep	I, II, III, IV-B, VI, X, CAR	Nina		16	128,507	P352,533	o	o	o	o		o	o	o	o	o		o	o	o	o				o	
	29-Sep	2-Oct	III	Quinta		12	27,683	P3,000		o	o																	
	No Data	No Data	VII	Tonyo		No Data	25	P0.200										o										
									5	8	6	2	1	3	7	3	3	4	1	2	2	2	2	1	1	1	2	
2009	3-May	3-May	IV-A, V, VIII, X	Crising		2	2,226	P5,000				o	o							o	o	o	o				o	
	1-May	5-May	V	Dante		28	418,928	P1,296,019					o															
	6-May	10-May	I, II, III, CAR	Emong		64	400,954	P1,392,269	o	o	o			o	o													
	10-Jun	10-Jun	I, CAR	Gorio		1	42,720	P6,169	o	o					o													
	23-Jun	26-Jun	III, IV-A, IV-B, V, VI, VII, VIII, NCR	Feria		17	150,491	P232,073		o	o	o	o			o	o	o										
	14-Jul	18-Jul	I, III, IV-A, NCR	Isang		5	248,057	P39,531		o	o	o			o													
	30-Jul	2-Aug	I, II, III, IV-A, IV-B, VI, VIII, X, XII	Jolina		13	226,823	P301.141	o	o	o	o			o	o	o	o		o	o	o	o		o	o	o	
	7-Aug	7-Aug	I, II, III, VI, XI, NCR, CAR	Kiko		27	122,056	P873,447	o	o	o	o		o	o	o	o	o	o				o	o		o		
	2-Sep	5-Sep	III, VI, VII	Labuyo		No Data	95,700	No Data		o	o					o	o	o										
	8-Sep	9-Sep	III, IV-A, IV-B	Maring		13	388,373	P304,892		o	o	o																
	12-Sep	13-Sep	I, II, IV-A, CAR	Nando		3	68,022	No Data	o	o		o		o	o													
	24-Sep	27-Sep	I, II, III, IV-A, IV-B, V, IX XII, ARMM, CAR, NCR	Ondoy		464	4,901,234	P10,952,198	o	o	o	o	o	o	o	o	o	o					o		o	o		
	30-Sep	10-Oct	I, II, III, IV-A, IV-B, V, CAR, NCR	Pepeng		465	4,478,284	P27,296,722	o	o	o	o	o	o	o	o	o	o										
	16-Oct	22-Oct	I, II, CAR	Ramil		No Data	6,239	No Data	o	o				o	o													
	28-Oct	1-Nov	III, IV-A, IV-B, V, NCR	Santi		34	802,155	P704,997		o	o	o	o															
	23-Nov	26-Nov	X, CARAGA	Urduja		4	48,129	P566,820											o	o	o	o	o	o			o	
									8	13	10	10	6	6	9	6	6	6	2	3	3	4	4	2	2	3	3	

Historical Record of Flood Damage in Target 19 River Basins

Year	From	To	Area/Location	Typhoon or Monsson associated	Main cause/ Type of flood	Damage			1 Cagayan (CAR and Region 2)	2 Agno (Regions 1, 2, 3, CAR)	3 Pampanga (Region 3)	4 Pasig-Laguna de Bay (NCR and Region 4A)	5 Bicol (Region 5)	6 Abulog (Region 2)	7 Abra (Region 1 and CAR)	8 Panay (Region 6)	9 Jalaur (Region 6)	10 Ilog-Hilabangan (Regions 6 and 7)	11 Agusan (Regions 11 and 13)	12 Tagoloan (Region 10)	13 Cagayan de Oro (Region 10)	14 Agus-Lake Lanao (ARMM and Region 10)	15 Davao (Regions 10 and 11)	16 Tagum-Libuganon (Regions 11 and 13)	17 Mindanano (Cotabato) (ARMM and Region 12)	18 Buayan-Malungon (Regions 11 and 12)	19 Mandulog (Region 10)	Data Source
						Killed	Total affected people	Estimated damage (US$mil.)																				
2010	24-Mar	27-Mar	No Data	Agaton		No Data	No Data	No Data																				
	12-Jul	15-Jul	III, IV-A, V, NCR	Basyang		102	585,383	P377,976		o	o	o	o															
	3-Aug	5-Aug	No Data	Doming		No Data	No Data	No Data																				
	19-Jul	20-Jul	III	Caloy		1	1,175	No Data		o	o																	
	7-Aug	9-Aug	III, NCR	Ester		2	1,045	No Data		o	o	o																
	27-Aug	28-Aug	No Data	Florita		No Data	No Data	No Data																				
	29-Aug	31-Aug	No Data	Glenda		No Data	No Data	No Data																				
	3-Sep	4-Sep	No Data	Henry		No Data	No Data	No Data																				
	15-Sep	19-Sep	No Data	Inday		No Data	No Data	No Data																				
	16-Oct	21-Oct	I, II, III, IV-A, NCR, CAR	Juan		31	2,008,984	P12,013,990	o	o	o	o		o	o													
									1	4	4	3	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	
2011	3-Apr	4-Apr	No Data	Amang		No Data	No Data	No Data																				
	6-May	11-May	III, IV-A, IV-B, NCR, V,, VII, VIII	Bebeng		35	431,837	P2,253,233		o	o	o	o						o									
	20-May	28-May	NCR, II, V, IX, X, XII ARMM	Chedeng		4	446,907	P18,933	o	o		o	o	o						o	o	o	o		o	o	o	
	9-Jun	10-Jun	I, II, III, IV-A, IV-B	Dodong		3	2,080	P6,192	o	o	o	o		o	o													
	14-Jun	20-Jun	III, NCR	Egay		2	37,837	P0.000		o	o	o																
	21-Jun	25-Jun	I, II, III, NCR	Falcon		12	1,792,376	P646,852	o	o	o	o		o	o													
	9-Jul	10-Jul	No Data	Goring		No Data	No Data	No Data																				
	15-Jul	16-Jul	No Data	Hanna		No Data	No Data	No Data																				
	17-Jul	17-Jul	No Data	Ineng		No Data	No Data	No Data																				
	25-Jul	28-Jul	III, IV-A, IV-B, V, VII, VIII, NCR	Juaning		77	1,285,906	P4,441,798		o	o	o	o						o									
	28-Jul	5-Aug	I, III, IV-A, VI, NCR	Kabayan		8	93,888	P2500	o	o	o	o			o	o	o	o										
	31-Jul	1-Aug	No Data	Lando		No Data	No Data	No Data																				
	21-Aug	29-Aug	I, II, V, VI, CAR, NCR	Mina		36	411,468	P2,089,349	o	o		o	o	o	o	o	o	o										
	8-Sep	8-Sep	No Data	Nonoy		No Data	No Data	No Data																				
	12-Sep	13-Sep	No Data	Onyok		No Data	No Data	No Data																				
	17-Sep	18-Sep	No Data	Onyok		No Data	No Data	No Data																				
	24-Sep	28-Sep	I, II, III, IV-A, IV-B, V, CAR, NCR	Pedring		85	3,105,355	P15,552,587	o	o	o	o	o	o	o	o	o	o										
	29-Sep	2-Oct	I, II, III, CAR	Quiel		17	1,489,535	P115,076	o	o	o			o	o													
	10-Oct	14-Oct	IV-B,VI, VII, VIII, X, XII, CARAGA	Ramon		10	88,506	No Data								o	o	o	o	o	o	o	o	o	o	o	o	
	16-Dec	18-Dec	VI, VII, IX, X, XI, CARAGA	Sendong		1,268	1,168,726	P1,706,344								o	o	o	o	o	o	o	o	o		o	o	
									7	10	8	9	5	6	6	5	5	7	2	3	3	3	3	2	2	3	3	0

Historical Record of Flood Damage in Target 19 River Basins

Year	From	To	Area/Location	Typhoon or Monsson associated	Main cause/ Type of flood	Damage			1 Cagayan (CAR and Region 2)	2 Agno (Regions 1, 2, 3, CAR)	3 Pampanga (Region 3)	4 Pasig-Laguna de Bay (NCR and Region 4A)	5 Bicol (Region 5)	6 Abulog (Region 2)	7 Abra (Region 1 and CAR)	8 Panay (Region 6)	9 Jalaur (Region 6)	10 Ilog-Hilabangan (Regions 6 and 7)	11 Agusan (Regions 11 and 13)	12 Tagoloan (Region 10)	13 Cagayan de Oro (Region 10)	14 Agus-Lake Lanao (ARMM and Region 10)	15 Davao (Regions 10 and 11)	16 Tagum-Libuganon (Regions 11 and 13)	17 Mindanano (Cotabato) (ARMM and Region 12)	18 Buayan-Malungon (Regions 11 and 12)	19 Mandulog (Region 10)	Data Source
						Killed	Total affected people	Estimated damage (US$mil.)																			
2012	31-May	5-Jun	No Data	Ambo		3	No Data	No Data																			
	14-Jun	18-Jun	No Data	Butchoy		1	310	No Data																			
	20-Jun	20-Jun	No Data	Carina		No Data	No Data	No Data																			
	25-Jun	29-Jun	I, X	Dindo		No Data	22,714	P15,500,000		o					o					o	o	o	o			o	
	16-Jul	17-Jul	No Data	Enteng		No Data	No Data	No Data																			
	20-Jul	21-Jul	IV-A	Ferdie		6	5,118	P5,982,000				o															
	28-Jul	31-Jul	I, II, III, IV-A, IV-B, V, V	Gener		54	948,696	728,331,305.02	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	
			VII, IX, X, XI, XII, CAR,																								
			NCR																								
	11-Aug	16-Aug	I, II, III, IV-B, CAR	Helen		10	181,527	125,129,796,87	o	o	o			o	o												
	19-Aug	28-Aug	I, IV-A, IX,, X	Igme		9	5,790	P4,087,533.91		o		o								o	o	o	o				o
	11-Sep	15-Sep	III, VIII, NCR	Karen		1	13,033	P25,000		o	o	o															
	20-Sep	29-Sep	IV-B, XI	Lawin		3	33,898	No Data											o				o	o		o	
	1-Oct	6-Oct	III, IV-B	Marce		1	322	No Data		o	o																
	8-Oct	16-Oct	No Data	Nina		No Data	No Data	No Data																			
	22-Oct	26-Oct	III, IV-A, IV-B, V, VI, VI	Ofel		27	173,427	P209,380,000		o	o	o	o		o	o	o	o	o					o	o	o	
			VIII, IX, XII, CARAGA,																								
			CAR																								
									2	7	5	5	2	2	4	2	2	2	3	3	3	3	4	3	2	3	3	

Appendix D

Current Status of EFCOS as of September 2013

Appendix D Current Status of EFCOS

D1. Inspection of EFCOS and discussions with MMDA's Staff

In order to confirm the current status of Effective Flood Control System (EFCOS) and to discuss with the staff of MMDA in charge of operation, the Study Team visited the Rosario Master Control Station on June 18, 2013 during second field works. The this Appendix summarizes the results of inspection and discussions.

D2. Covered Area of EFCOS (Effective Flood Control System)

The covered area of EFCOS is the whole Pasig –Marikina River basin of 634 km^2. In addition, it includes Tullahan River basin as target river basin, which is monitored by DOST-ASTI. The Tullahan River originates at the La Mesa Dam and flows down in the Quezon City and finally empties at Navotas in north of Metro Manila. The target warning areas are as follows:

(1) The water level records are disseminated to 16 municipalities and one city.
(2) Wireless telephone is commonly used as a mean of information and communication in each municipality
(3) Evacuation warnings are issued by the Local Government Units (LGUs) based on the records of EFCOS. Exchanging the Memorandum of Agreement (MOA) between MMDA and LGUs (Barangays concerned) regarding dissemination of water level records among the residents is currently in progress.
(4) Discharge warning is issued along the Mangahan Floodway (through warning posts).
(5) The water level records are disseminated to OCD and LGUs through Flood Control Information Center (FCEC) of MMDA from Rosario Master Control Station by wireless telephone.

D3. Current Status of Monitoring Facilities

(1) Current status of monitoring facilities is summarized as follows:

Current Status of monitoring Facilities of EFCOS

Item	Nos. of stations	Note
Rainfall G/S	4/7	
Water level G/S	8/11	The sensor at lake side of Rosario Hydraulic Structure is out of order.
Warning Stations for discharge from Rosario Hydraulic Structure	7/10	

Note: B/A, A: Total number of stations, B: Operational stations

Source: MMDA

(2) Because the relay station for multiplex radio at Antipolo is now out of order (due to lightning occurred in 2006), the data is transmitted through OCD to PAGASA. In August 2012, PAAGSA has restored the connection with OCD by existing 18 GHz multiplex radio devices with national budget (originally these devices were used for connection between NIA and OCD). The data server for EFCOS has been also renewed at that time. By means of such restoration, checking monitored data of EFCO became to be enabled at PAGASA WFFC.

(3) In connection with the failure at Antipolo, MMDA has changed the network of data transmission route directly transmitting to Rosario Master Control Station instead of passing though PAGASA Science Garden from Fort Santiago, San Juan and Pandacan Gauging Stations. However, the rainfall data at Science Garden still cannot not be transmitted at present due to unknown reason.

(4) The broken-down 7.5 GHz micro multiplex radio devices and antenna were removed.
(5) Although the rainfall G/S at Nangka was damaged on 2009, the devices at Napindan G/S has been transferred and restored.
(6) In order to improve EFCOS, MMDA has applied to JICA's Technical Cooperation Project. However, the request was disapproved.
(7) There are four rain gauge stations and 37 water level stations by DOST-ASTI (ASTI-EFCOS) in the Pasig-Marikina and Tullahan River basins. The data is detected by WiMax and stored in server for checking real time. However, dedicated terminal is not provided. Therefore, the data is retrieved by accessing from personal computer to the server by the MMDA staff in charge. The records are indicated every 10 minutes interval. In accordance with the check of the data series, it was verified that more than half of the data were missing in the period. Water level fluctuated from 5 to 7 m within only 10 to 20 minutes although no significant record was recorded. The system seems to be rather unreliable and it needs substantial checking. It is presumed that the system might be still under developing level not in operational level in DOST-ASTI. Regarding the abnormal values of the water level records, MMDA cannot identify the reason now. Sharing of responsibilities to improve the system is not clear in order to upgrade to operation al level.

D4. Operation Rules of Rosario Weir and Napindan Hydraulic Control Structure

The operation rules of gate structures at Rosario Weir was prepared in 1993 and it was updated with rehabilitation works of EFCOS in 2001. Further, it was revised through discussions with LGUs in 2011. However, the river cross section data is still using those measured in 2001, it

shall be changed with the latest ones. The operation rules of Napindan Hydraulic Control Structure were prepared in 2006.

D5. Operation Rules of EFCOS

The operation rules was prepared in 1993 and updated with rehabilitation works of EFCOS in 2001. The flood warning water levels at water level gauging stations were revised at that time. And now it is required to further review. The system developed by KOICA is not installed in EFOCS Office. Therefore, the flood warning water levels are not practically applied yet.

D6. Information Dissemination to Other Related Agencies

The records of EFCOS are shared among OCD, PAGASA, DOST-ASTI, DPWH (MFCDP), and LGUs. The route of dissemination is as follows:

- EFCOS Office ⇒ FCIC (Flood Control Information Center, MMDA) ⇒ LGUs

Normally, the monitored records are transmitted from MMDA to LGUs and actual flood conditions in the target areas are fed back from LGUs to MMDA.

D7. Existing Data Management System

MMDA makes annual reports compiling and analyzing the extreme events. Monitored records of rainfall, water levels and operation of gates are compiled in the report. The versions of Year 1997 and 2001 were confirmed at the Rosario Master Control Station. Rainfall and water level records are archived in Excel manually. MMDA recognizes importance that such archived data should be disclosed in internet web-site for information sharing.

D8. Current Status of Flood Runoff Model

There is a flood runoff model prepared in 2001 by means of MIKE11. However, since the renewal cost for continuation of license contract was so high (about P.500,000/year), renewal could not be properly conducted. Therefore, the model is not used for actual flood operation at present.

D9. Relationship with the Project NOMAH

Although the Project NOAH is conducting flood forecasting in the Marikina River basins, its accuracy is relatively low. During the flood event in August 2012, the record showed several meter higher than the actual. If the records is disseminated to the people in the LGUs who are residing in the downstream vulnerable areas, a panic would strike them. Further, in order to appropriately utilize the monitored data of EFCOS, exchange of MOA between MMDA and DOST-ASTI is highly recommended.

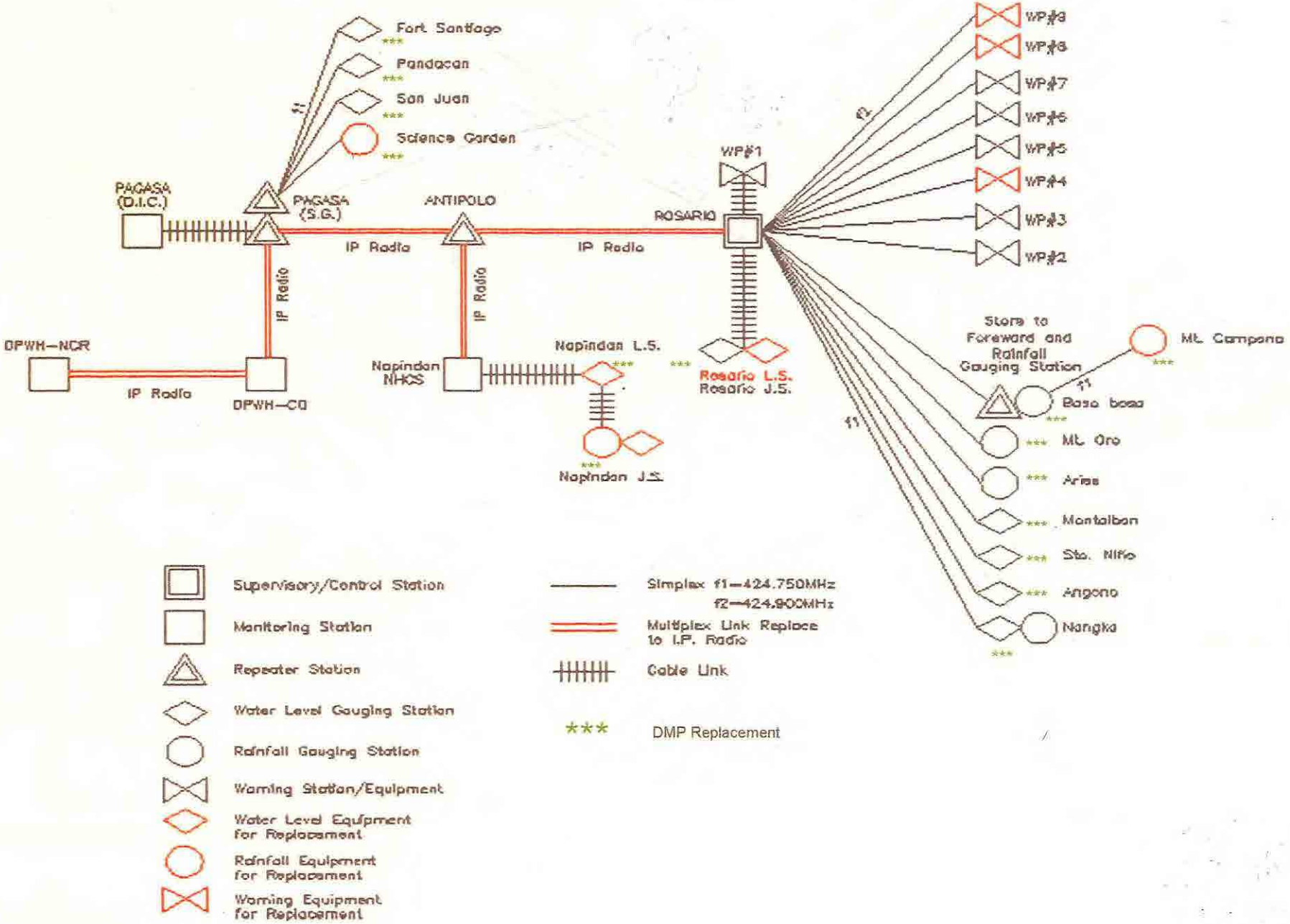
D10. Other Associated Activities

One water level and 22 rain gauges have been installed under the “Resilience Project” in the Pasig-Marikina river basin. As of September 2013, the data cannot be confirmed on monitors in WFFC due to incomplete program for format conversion. It is reported that the warning system was installed by Marikina City Government (The details are not verified yet by PAGASA).

D11. Proposed Rehabilitation of EFCOS

A rehabilitation plan prepared by MMDA is shown in next page:

PROPOSED REHABLITATION OF EFCOS PROJECT



Appendix E

Ongoing Project Sheet

No.	Title of Project
	Projects directly managed by HMD's Initiative
01	Establishment of FFWS Centers in 13 Major River Basins ("River Center Project")
02	Enhancing Risk Analysis Capacities for Flood, Tropical Cyclone, Severe Wind, and Earthquake for Greater Metro Manila Area (GMMA-RAP)
03	Strengthening of Flood Forecasting and Warning System in the Bicol River Basin ("Bicol Project")
04	Strengthening of Flood Forecasting and Warning System of Magat Dam and Downstream Communities ("NORAD Project")
05	Building Community Resilience and Strengthening Local Government Capacities for Recovery and Disaster Risk Management ("Resilience Project")
06	UNDP Ready for GMMA Project
07	Applying Remote Sensing Technology in River Basin Management in the Philippines
08	Supporting Investments in Water-related Disaster Management
09	Ecotown Demonstration Framework on Vulnerability and Adaptation Assessment (V & A) of Vulnerable Areas to Climate Change
10	Integrating Disaster Risk Reduction and Climate Change Adaptation (DRR/ CCA) in Local Development Planning and Decision-making Process
11	Enabling the Cities of Cagayan de Oro and Iligan to Cope with Climate Change ("Project Climate Twin Phoenix")
12	Establishment of a Pilot Automatic Warning System (AWS) in Cagayan de Oro River
13	Resilience Capacity Building for Cities and Municipalities to Reduce Disaster Risks from Climate Change and Natural Hazards, Phase 1 ("ReBUILD Project")
14	Counter Plan for Extra-ordinary Flood
15	Data Collection Survey on Situation of Nationwide Flood Forecasting and Warning System
16	Operationalization of KOICA2 Project
17	Disaster Preparedness and Response Project

1.	Title of Project	: Establishment of FFWS Centers in 13 Major River Basins ("**River Center Project"**)
2.	Name of Donor Agency	: Government of the Philippines (GOP)
3.	Target Area/River Basin	: Non-telemetered Major River Basins
4.	Project Period	: 2013-2014
5.	Budget	: PHP 65.0 M
6.	Contact Person in PAGASA	: Mr. Roy A. Badilla and Mr. Edgar dela Cruz (HMD)

7.1 Objectives

To establish a flood forecasting and warning center with telemetered hydrological network in each of the 13 major river basins of the Philippines. These centers will cater to the flood forecasting and warning activities in their respective river basins.

7.2 Salient Features

(1) Design and Construction of a Flood Forecasting and Warning Center

(2) Installation of a telemetered hydrological network

(3) Recruitment of highly competitive and dependable personnel

7.3 List of River Basins and Location of Corresponding River Centers, as of September 2013

River Basin/Location	Status and Location
(1) Mindanao/Cotabato River Basin Cotabato City, Maguindanao	Option 1. Lat: 7^0 09' 39" Long: 124^0 12' 58" Option 2. Lat: 7^0 10' 11" Long: 124^0 12' 05"
(2) Agusan River Basin, Municipality of Prosperidad	Lat: 8° 33' 01.3"N, Long: 125° 56' 33.0 .
(3) Abra River Basin, Sinait Agromet Station, Ilocos Sur	Lat: 17^0 33' 49" Long: 120^0 22' 18"
(4) Abulug River Basin, to be integrated/co-located with the Cagayan River Basin Flood Forecasting and Warning Center, Tuguegarao City	Lat: 17^0 38' 52" N Long: 121^0 45' 32" E
(5) Tagum-Libuganon River Basin, Tagum City, Davao del Norte	Lat: 7° 27' 07" Long: 125° 46' 46"
(6) Ilog-Hilabangan River Basin, Municipality of Kabangkalan	Lat: 10° 00' 15.4" N Long: 122° 48' 18.4" E
(7) Panay River Basin, to be integrated/co-located with the Roxas Synoptic Station	Lat: 11^0 35' 26" N Long: 122^0 45' 39" E
(8) Togoloan River Basin, to be integrated/co-located with the El Salvador Synoptic Station	Lat: 8° 32' 09" Long: 124° 33' 29"
(9) Agus River Basin, Iligan City	No Data (No Location Survey)
(10) Davao River Basin, Davao Synoptic Station, Davao del Sur	Lat: 7° 07' 39" Long: 125° 39' 18"
(11) Cagayan de Oro River Basin, El Salvador Synoptic Station, Cagayan de Oro, Misamis Oriental	Lat: 8° 32' 09" Long: 124° 33' 29"
(12) Jalaur River Basin, to be integrated/co-located with the Iloilo Radar Station	Lat: $10^0$46' 20.08" N Long: $122^0$34' 45.08" E
(13) Buayan-Malungon River Basin, Gen. Santos Synoptic Station, Sarangani	Lat: 6° 03' 26" Long: 125° 06' 12"

8. Current Status (As of September 2013)

(1) Finalized the TOR for bidding purposes.

(2) Dispatched HMD civil engineers to the proposed river center locations for the finalization of the buildings' structural design and estimate (Mindanao Area).

(3) Conducted negotiations for the location of river centers (Luzon and Visayas Areas).

(4) Pre-procurement finished for the three FFW Centers (Tagum-Libuganon, Buayan-Malugon, and Mindanao River Basins)

9. Other Notable Issues

(1) Mindanao is the priority area.

(2) ASTI-DOST in coordination with PAGASA-DOST is currently installing ARGs and WLGs in the flood prone areas of the Philippines.

(3) Other private organizations (e.g., Aboitiz, NGOs) are also installing or have installed AWS/ARG in different municipalities of the Philippines.

(4) Bureau of Soil and Water Management (BSWM) is currently installing AWS in different municipalities of the Philippines.

10. Data Source

Individual travel orders/reports, building plans from the Engineering and Technical Services Division (ETSD)

1.	Title of Project	: Enhancing Risk Analysis Capacities for Flood, Tropical Cyclone, Severe Wind, and Earthquake for Greater Metro Manila Area (GMMA-RAP)
2.	Name of Donor Agency	: Australian Agency for International Development (AusAID)
3.	Target Area/River Basin	: Greater Metro Manila Area (GMMA)
4.	Project Period	: 2010-2013
5.	Budget	: AUD 1.0 M
6.	Contact Person in PAGASA	: Mr. Roy A. Badilla and Ms. Adelaida C. Duran (HMD)

7.1 Objectives:

(1) Capacity enhancement for PAGASA and MGB personnel in flood risk modeling

(2) Production of flood hazard maps with different return period

(3) Production of flood risks maps with different return period.

7.2 Salient Features:

(1) Acquisition of a high resolution digital elevation model (DEM) derived from LiDAR

(2) Construction of exposure database for Metro Manila

(3) Construction of vulnerability curves for different building types in Metro Manila

(5) Flood hazard maps with different return period.

(6) Flood risk maps with different return period.

8. Current Status (As of September 2013)

(1) Finalized the flood hazard maps for Pasig-Marikina River Basin with different annual exceedance probabilities (AEP) .

(2) Finalized the flood risk maps for Pasig-Marikina River Basin with different annual exceedance probabilities (AEP)

(3) NAMRIA finalized the layout of flood hazard and risk maps with different AEP for production/publication in September 2013.

(4) Facilitated the HLURB and MMDA knowledge-sharing workshops for GMMA LGUs

(5) Presented results to various government agencies and academic institutions

(6) Presented final maps to local chief executives (September-October 2013). Other LGUs to follow.

9. Other Notable Issues

No Data

10. Data Source

Inception Report, Part B - Flood "Development of Vulnerability Curves of Key Building Types in the Greater Metro Manila Area, Philippines," February 2012, AusAID Agreement No. 57382.

1.	Title of Project	: Strengthening of Flood Forecasting and Warning System in the Bicol River Basin **("Bicol Project")**
2.	Name of Donor Agency	: Government of Japan (through the Embassy of Japan: Non-project type of grant)
3.	Target Area/River Basin	: Bicol River Basin
4.	Project Period	: 2010-2013 (to be extended to 2016)
5.	Budget	: JPY1,500 millon for all PAGASA and DPWH projects.
6.	Contact Person in PAGASA	: Mr. Mario I. Dungca and Mr. Jose Perin (HMD)

7. Objectives/Salient Features

(1) The Project is a response to the following conditions and issues on FFWS: inadequate network, insufficient available data for FFWS, and poor observation facilities capacity for FFWS such as lack of monitoring stations and non-functional equipment (sensor, transmission, etc.)

(2) The objective of the Project is to restore and improve the functions of the existing FFWS as the first step toward the ultimate goal of "Protection of Human Life through the Establishment of Effective FFWS" through the following:

a. Planning of optimum station layout for upgrading establishment of FFWS

b. Establishment of appropriate warning level for upgraded stations

c. Impoving reliability of network system for FFWS

d. Construction of facilities to enable reliable and timely observation

In summary, the upgrading of the FFWS in order to provide timely and accurate flood forecasts and warnings will be conducted through rehabilitation of telemetering system, rainfall and water level monitoring equipment, the computer system, and supply of spare parts and O & M equipment. It aims to minimize flood-related disasters in the Bicol River basin.

(3) Technical approaches employed in Project implementation consist of: a) restoration and improvement of FFWS functions such as the identification of appropriate monitoring station sites, establishment of warning level at suitable sites; and telecommunication design (VHF radio links between gauging station and repeater station, microwave links between Pili Sub-centre and Legaspi and monitoring station, network links between Pili Sub-centre DIC) and Quezon City; b) construction and installation supervision including safety management, quality management, time management, and risk management.

8. Current Status (As of September 2013)

(1) Project Preparatory Reports have been submitted by the Crown Agents of Foreign Affairs and Embassy of Japan for tendering.

(2) Permits/approval for bank protection works have been acquired from the Bureau of Design (BOD), DPWH.

(3) Negotiations for installation of the new sites with Region 5 including the District, Municipal Mayors, and Barangay on the new location of the station were mostly completed.

(4) Additional permit to purchase Radio for (Agdanganan and Pili) stations was secured.

(5) Tower height clearance with the Civil Aviation Authority of the Philippines (CAAP) at Pili and Legazpi stations was resolved. Height clearance was already issued. Heigh clearance was likewise issued to Salvacion and Agdangan. Waiting for clearance of Malabog Tower.

(6) Tender documents as well as detailed tendering procedure were approved by Crown Agents and MOFA in August 2013 with condition of final approval on the third country procurement scheme.

(7) Pre-bid conference will be held in the middle of September 2013 and construction works will be commenced in January 2014.

(8) Certificate of Non-Coverage for the Project was already issued by the Regional Office of Environmental Management Bureau.

9. Other Notable Issues

Pursuant to MOFA's instruction, any hardware and software of the existing Pampanga and Agno FFWS could be replaced or modified with new hardware and/or software to accommodate the new equipment for Bicol FFWS.

10. Data Source

(1) PAGASA Annual Repot 2011

(2) Project Proposal entitled "Undertaking a Preparatory Study and Supervision for the Project for Strengthening FFWS in the Bicol River Basin"

1.	Title of Project	: Strengthening of Flood Forecasting and Warning System of Magat Dam and Downstream Communities **("NORAD Project")**
2.	Name of Donor Agency	: Norwegian Agency for Development Cooperation (NORAD)
3.	Target Area/River Basin	: Upstream of Magat Dam and Cagayan River Basin
4.	Project Period	: April 2012 - May 2014
5.	Budget	: NOK 10,700.00
6.	Contact Person in PAGASA	: Ms. Margaret P. Bautista

7. Objectives/Salient Features

(1) To restore and enhance the communication system of the Flood Forecasting and Warning System (FFWS) between National Irrigation Authority (NIA) - Magat and PAGASA

(2) To upgrade the existing network of rainfall and water level stations

(3) To improve the operation of Magat Dam through the provision of inflow and flood forecasts with enough lead time using ground observations

(4) To establish a decision support system for the operation of Magat Dam

(5) To enhance the public information drive within the flood prone areas

8. Current Status (As of September2013)

(1) The Norwegian Water Resources and Energy Directorate (NVE) is in the process of completing the Technical Specifications and Bidding Documents of the Project.

(2) Meetings were conducted on 11 and 13 June 2013 with the Norwegian Embassy and NVE regarding the technical specifications of the Bid Document.

(3) NVE requested PAGASA to form a new TWG for the Project to include NIA as member, being one of the stakeholders of the Project.

9. Other Notable Issues

NVE favors the holding of International Bidding.

10. Data Source

(1) Inception Report (May 2012)

(2) Formal communication among the Norwegian Water Resources, Energy Directorate (NVE), and PAGASA

(3) Memorandum of Agreement (MOA) between the Department of Science and Technology (DOST) and NORAD

1.	Title of Project	: Building Community Resilience and Strengthening Local Government Capacities for Recovery and Disaster Risk Management ("**Resilience Project**")
2.	Name of Donor Agency	: United Nations Development Programme/Canadian International Development Agency (UNDP/CIDA)
3.	Target Area/River Basin	: Pasig-Marikina-Tullahan
4.	Project Period	: 2010-2013
5.	Budget	: $940,000
6.	Contact Person in PAGASA	: Mr. Socrates F. Paat, Jr. and Ms. Sheila S.Schneider

7. Objectives/Salient Features:

(1) Strengthening of LGU capacities in Disaster Risk Reduction and Management towards building community resilience to disasters and reducing vulnerability to natural hazards

(2) Establishment of Flood Early Warning System in the Pasig-Marikina and Tullahan River Basins

(3) Integration of EFCOS, KOICA, DOST-ASTI, and new gauging stations as official flood EWS for Metro Manila

(4) Support strategic roles of LGUs (Marikina-Pasig-Cainta) in creating DRM-sensitive policies and plans, ensuring people's participation, accountability, and partnership with various stakeholders

(5) Main Components:

a. Activities that bring about an enabling policy environment on gender-responsive DRM

b. Activities that enhance capacities on DRM and improve coordination among and between claimholders and duty bearers

8. Current Status (As of September 2013)

(1) Formal Project Exit Conference conducted on 12 April 2013

(2) Gauging stations installed - 90% completed (Target completion: end of April 2013)

(3) Formal MOA signing among stakeholders in March 2013

(4) Completed installation of gauging stations (1WL, 22 rain gauges, 2 Data Centers) last week of May 2013

(5) Site inspection conducted: First week of June 2013

(6) System not operational as of August. Contractor is doing remedial works to date.

9. Other Notable Issues

(1) Delayed completion of installation of gauging stations due to miscellaneous reasons (delayed awarding of contract to winning bidder, NTC permit, changes in site locations)

(2) Data transmission affected by illegal radio operators based in Rizal Province.

10. Data Source

PowerPoint presentation of Rita Petralba, Project Leader; Project documents; Actual involvement with Project activities

1.	Title of Project	: UNDP Ready for GMMA Project	
2.	Name of Donor Agency	: UNDP/ AusAID	
3.	Target Area/River Basin	: Laguna, Rizal, Cavite, and Bulacan Provinces	
4.	Project Period	: 2010-2014	- CBFEWS Component : 2012-2014 Laguna & Rizal - Flood Hazard Mapping Componer : 2010-2013 Cavite & Bulacan - Validation & Assessment Compon : 2013-2014 Rizal & Bulacan
5.	Budget	: No Data	
6.	Contact Person in PAGASA	: Ms. Rosalie S. Pagulayan and Mr. Oscar D. Cruz	

7. Objectives/Salient Features

(1) Decrease the vulnerability of the Greater Metro Manila Area to natural hazards and increase its resilience, by strengthening the institutional capacities of the local government units, concerned national government agencies, academic institutions, and civil society organizations to manage disaster and climate change risks

(2) CBFEWS (Community - Based Flood Early Warning System) component: install automatic rainfall and water level gauges with wireless capability, intelligence and stand alone operation, independent power supply from solar and back-up batteries; establish Data Operation Station at the respective PDRRMOs and at PAGASA WFFC that will receive the data, store them in a database, and display real-time information from all the remote stations

(3) Conduct hydrosurvey for the basic forecasting points

(4) Estimate project cost for equipment (ARG, WL and Disaster Operation Center): PhP 8,738,000.00

(5) Assess disaster/climate risk vulnerabilities of GMMA

(6) Implement priority disaster/climate risk mitigation actions for GMMA

(7) Enhance competencies of GMMA local government units and key partners on integrating DRM/CRM into local development planning and regulatory processes

(8) Demonstrate DRM/CRM mainstreaming in local land use/development plan(s) and regulatory processes of selected GMMA local government units (LGUs)

(9) Establish DRM/CRM Knowledge Management System/ Community of Practice

8. Current Status (As of September 2013)

(1) Conducted consultation meeting with the concerned LGUs of Cavite, Laguna, Rizal, and Bulacan.

(2) Conducted site survey for the location of rain fall and water level gauges. Site finalization is now underway so as not to duplicate with the FEWS being initiated by some LGUs within the project sites.

(3) Completed fieldwork for certain municipalities of Laguna, Cavite, Bulacan, Rizal with available 1:10,000K basemaps

(4) Ongoing finalization of flood hazard maps for certain municipalities of Laguna, Cavite, Bulacan, and Rizal

(5) Ongoing finalization of the Terms of Reference and the budgetary requirements for all the project areas. There are sites where the number of RR and WL equipment have been reduced.

(6) Completed the conduct of hydrosurvey for the Province of Laguna

(7) Finished hazard mapping of Bulacan, Cavite and Laguna; target for 4th quarter is Rizal.

(8) Estimated project cost for equipment (ARG, WL, Disaster Operation Center and the Radio Transmitter): PhP 10,088,800.00.

(9) Hydrosurvey is being undertaken for the Province of Bulacan.

(10) September 17-20, 2013: Schedule of separate consultation meeting for each project site area.

9. Other Notable Issues

Sustainability and maintenance of the installed equipment shall be borne by the LGUs. PAGASA shall provide the technical assistance to ensure the continuous operation of the equipment and the whole FEWS.

10. Data Source

UNDP Project Documents; participation in consultation meetings, fieldwork, and consultations

1.	Title of Project	: Applying Remote Sensing Technology in River Basin Management in the Philippines
2.	Name of Donor Agency	: Asian Development Bank / Japan Aerospace Exploration Agency (ADB / JAXA)
3.	Target Area/River Basin	: Cagayan River Basin
4.	Project Period	: 2013
5.	Budget	: $2.6398 M for 3 Countries including Vietnam and Bangladesh
6.	Contact Person in PAGASA	: Mr. Socrates F. Paat and Ms. Nivagene Nievares

7. Objectives/Salient Features

(1) The Asian Development Bank (ADB), in collaboration with Japan Aerospace Exploration Agency (JAXA), is formulating a regional capacity development technical assistance (TA) to support countries in Asia and Pacific, apply space based technologies (SBT), and information communication technology (ICT) for improved river basin management. Country level interest has been explored through ADB's existing sector partnership with the member countries, and the Philippines has been identified as Pilot Country for the following reasons:

a) The Philippines remains one of the most water-related disaster prone countries from 1988 to 2008, where the number of people who perished from water-related disaster is the fifth largest among the developing member countries.

b) Mitigating natural disaster is stressed in the Country's Operations' Business Plan (COBP).

c) The Philippines has strong ownership in developing structural and non-structural measures to mitigate water-related disasters.

(2) Satellite-based rainfall data called Global Satellite Mapping for Precipitation (GSMaP) will be utilized to interpolate the ground-based rainfall observation and apply the calibrated data to improve the quality of flood forecasting and/or prediction.

(3) Below are activities involved:

(a) Development of methodology and system to calibrate satellite-based rainfall data in the Cagayan River basin with new rain gauge installation

(b) Development of system interface to the calibrated satellite-based rainfall data to existing flood models for Cagayan River Basin.

(c) Capacity development program to operate the developed methodology and systems

(d) Development of policy guidelines to apply remote sensing for flood risk management with socio-economic cost-benefit analysis

8. Current Status (As of September 2013)

(1) Submitted to ADB: Basic Specifications for Rainfall Gauging stations to be established (Dec 2012)

(2) Submitted to ADB: Quotations from three (3) suppliers for project component described above (December 2012)

(3) Dispatch of Japanese consultants to PAGASA Main Office and Cagayan Regional Center (17 to 20 April 2013) to finalize Specifications and Terms of Reference for rain gauges to be installed and network architecture.

(4) Resubmission of quotations for installation of new rain gauges (end of June 2013)

(5) Planning for Training Workshop in Tuguegarao (tentatively on September 2013)

(6) Resolution of certain issues on network architecture

(7) Resubmission of quotations after resolving the above items.

(8) Fixing date of two workshops: 4 October 2013 in Tuguegarao and 7-11 October 2013 in Manila

(9) Coordination with lot owners for proposed rain gauge sites

9. Other Notable Issues

Some issues on network architecture needed to be resolved.

(1) The existing system is a "closed" system hence new system cannot be directly connected.

(2) Integrating (old and new system) data for simplified transmission to PAGASA Headquarters via SMS

10. Data Source:

Powerpoint presentation of Toshikatsu Imai; IDEA Consultant; Project documents; Inception Report; Reports from Consultants

1.	Title of Project	: Supporting Investments in Water-related Disaster Management
2.	Name of Donor Agency	: ADB/ ICHARM
3.	Target Area/River Basin	: Pampanga and Cagayan River Basins
4.	Project Period	: 28 June 2012 to 28 February 2013
5.	Budget	: Data not Available
6.	Contact Person in PAGASA	: Ms. Sheila S. Schneider, Mr.Roy A. Badilla, and Mr.Edgar dela Cruz

7. Objectives/Salient Features

(1) Support PAGASA in applying IFAS in the Pampanga and Cagayan River basins. In the Pampanga River basin, IFAS will be applied to identify the causes of historical floods in the basin by incorporating satellite-based and ground-observed data. In the Cagayan River basin, IFAS will be applied. mainly to identify the causes of historical floods in the middle reaches including Tuguegarao City by incorporating satellite-based rainfall data in the south eastern upstream and ground-observed hydrological data in the south western upstream.

(2) To organize training programs for developing the capacity of PAGASA staff. These training programs will be conducted for personnel of PAGASA Headquarters and regional offices, including San Fernando and Tuguegarao, to optimize the Agency's human and technical resources and experience in: a) identifying causes of historical floods by incorporating satellite-based and ground observation data, b) understanding the mechanism of floods in the Cagayan and Pampanga River basins, and c) utilizing IFAS in practical work as supplementary information for the existing flood monitoring system. Staff of selected government

8. Current Status (As of September 2013)

(1) Date of the Seminar at the ADB was February 4, 2013..

(2) The Final Report was submitted.

9. Project Results

(1) IFAS trainings were given to PAGASA staff as well as local agencies and LGUs considering the use and purpose of IFAS for them.

(2) Strengths of IFAS were identified as supplemental information for the existing flood monitoring system.

(3) Weaknesses of IFAS including the need for calibration of the IFAS parameters with the observed ground data were identified.

10. Other Notable Issues

(1) For better flood and drought risk management, there is a strong need to develop the standards for dam operation including: i) dam inflow forecasting and dam operation training (including PAGASA); (ii) rearrangement of dam operation rules; iii) reallocation of dam capacity; and iv) long-term forecast and optimum dam operation to mitigate extreme floods and droughts which are likely to be exacerbated by climate change, for which the WMO shows its interest.

(2) PAGASA has a mandate to install FFWS in 18 major river basins in the Philippines. FFWS has forecasting model. Until the plan is completed, flood forecasting models which utilize satellite-observed rainfall data can be strong tools for supplementary forecasting information in poorly-gauged river basins.

(3) The highest prioritized river basin is the Cagayan de Oro River Basin in which JICA's supported project, "Flood Risk Management for Cagayan de Oro" has started.

(4) The results of the training program showed that the application of the RRI (rainfall-runoff inundation) model to the Pampanga River basin will contribute to the enhancement of the Pampanga River Flood Forecasting and Warning Center's flood information and warning services. The International Committee on Hydrology (ICH) would like to enhance follow-up activities like . this training program on inundation analysis.

11. Data Source:

Draft Final Report on "Supporting Investments in Water-related Disaster Management" and interviews with concerned PAGASA staff

1.	Title of Project	: Ecotown Demonstration Framework on Vulnerability and Adaptation Assessment (V & A) of Vulnerable Areas to Climate Change
2.	Name of Donor Agency	: Global Green Growth Institute (GGGI): Korea / Climate Change Commission (CCC)
3.	Target Area/River Basin	: Siargao Island and Palawan
4.	Project Period	: 2012-2013
5.	Budget	: Data not Available
6.	Contact Person in PAGASA	: Mr. Oscar D. Cruz and Ms. Leonida Santos

7. Objectives/Salient Features

(1) Build the adaptive capacities of women and men in their communities

(2) Increase the resilience of vulnerable sectors and natural ecosystems to climate change

(3) Optimize mitigation opportunities towards gender-responsive and rights-based sustainable development

8. Current Status (As of September 2013)

(1) Flood Hazard Mapping for Siargao Island completed

(2) Flood Hazard Mapping for San Vicente, Palawan, completed

(3) Integration Workshop in EDSA Shangrila (17-18 April 2013) conducted

(4) Validation Workshop in Puerto Princesa, Palawan, completed

(5) Project completed as of July 2013

(6) Hazard maps and terminal reports submitted

(7) Waiting for additional information regarding the expansion of the Project

9. Other Notable Issues

No Data

10. Data Source

http://gggi.org/wp-content/uploads/2013/01/S2b_Philippines-Green-Growth-Initiative-Eco-town-framework.pdf

1.	Title of Project	: Integrating Disaster Risk Reduction and Climate Change Adaptation (DRR/ CCA) in Local Development Planning and Decision-making Process
2.	Name of Donor Agency	: United Nations Development Program/Australian Agency for International Development (UNDP/AusAID) and New Zealand Assistance Programme/National Economic Development Authority(NZAP/NEDA)
3.	Target Area/River Basin	: All 13 Regions and 82 Provinces
4.	Project Period	: 2012-2013
5.	Budget	: Aus$ 2.5 Million
6.	Contact Person in PAGASA	: Mr. Oscar D. Cruz

7. Objectives/Salient Features

(1) Address the capacity gaps of institutions and individuals in relation to DRR/CCA.

(2) Enhance local awareness and understanding of climate change and its effect on natural hazards.

(3) Develop tools to enable the formulation of land use and development plans for hazards considering climate change.

(4) Demonstrate practical integrated DRR/CCA approaches at the community level.

(5) Improve the national enabling plan through national and local DRR/CCA plans and multistakeholder coordinating mechanisms.

8. Current Status (As of September 2013)

(1) The responsible agency in the Philippine side is NEDA.

(2) PAGASA provided the result of climate change projection and flood hazard maps to NEDA.

(3) PAGASA made a presentation about climate change projection and flood hazard maps in the Workshop.

(4) NEDA will conduct economic projection analysis considering climate change projection.

(5) At present, the Project awaits its commencement scheduled for the third quarter of 2013.

9. Other Notable Issues

No Data

10. Data Source

Interview with PAGASA staff; Annual Project Report 2009

1.	Title of Project	: Enabling the Cities of Cagayan de Oro and Iligan to Cope with Climate Change **("Project Climate Twin Phoenix")**
2.	Name of Donor Agency	: United Nations Development Programme/Austraian Agency for International Development (UNDP/AusAID)
3.	Target Area/River Basin	: Cagayan de Oro and Mandulog River Basins
4.	Project Period	: 1 March 2012 to 31 December 2014
5.	Budget	: UNDP/BCPR: US$100,000; AusAID AUS$1,500,000
6.	Contact Person in PAGASA	: Ms. Nivagene C. Nievares and Ms. Adelaida Castillo-Duran

7. Objectives/Salient Features

(1) Climate/disaster risk vulnerabilities of Cagayan de Oro (CDO) and Iligan cities, including all the municipalities around the CDO and Mandulog River Basins assessed.

(2) Priority climate/disaster mitigation action for priority cities and municipalities around the Cagayan de Oro and Mandulog River Basins implemented.

(3) Awareness of the general populace on C/DRM and competencies of key local actors in target cities and municipalities around the CDO and Mandulog River Basins on mainstreaming climate change adaptation and disaster risk management into local planning and regulatory processes enhanced.

(4) C/DRM mainstreaming demonstrated in local land use/development plan(s) and regulatory processes in CDO and Iligan cities and other municipalities around the CDO and Mandulog River Basins.

(5) Socio-economic resilience of the poor and most vulnerable in CDO and Iligan Cities enhanced.

(6) Local Knowledge management system for communities around the CDO and Mandulog River Basins established.

8. Current Status (As of September 2013)

(1) For Early Warning System Component: the network has been approved; further, waiting for budget approval

(2) For Flood Modeling Component: validation of modelng results ongoing

9. Other Notable Issues

No Data

10. Data Source

UNDP (Country: Philippines) Project Document; participation in Project activities such as meetings and field visits

1.	Title of Project	: Establishment of a Pilot Automatic Warning System (AWS) in Cagayan de Oro River Basin
2.	Name of Donor Agency	: National Disaster Management Institute / Ministry of Public Administration and Security* (NDMI/ MOPAS), Korea
3.	Target Area/River Basin	: Cagayan de Oro River Basin
4.	Project Period	: 2013
5.	Budget	: Data not Available
6.	Contact Person in PAGASA	: Mr. Socrates F. Paat, Jr. and Ms. Nivagine Nievares

7. Objective:

Mitigation of flooding in Cagayan de Oro City particularly in areas affected during Typhoons Sendong and Pablo.

Salient Features:

(1) Establishment of automatic rainfall alert system (ARAS) in the flood-prone areas of Cagayan de Oro City

(2) Installation of Flash Flood Alert System (FFAS) in PAGASA to be used as flood forecasting tool

8. Current Status (As of September 2013)

(1) Ongoing detailed design in NDMI Headquarters for the final network.

(2) Conducted Site survey on April 16-18, 2013, for locations of two ARAS and additional rainfall and water level stations

(3) Conducted coordination meetings with concerned agencies: Cagayan de Oro City Disaster Risk Reduction and Management Council (CDRRMC), local government units in the upstream, regional government office of Department of Science and Technology (DOST-Region 10).

(4) Inspected the automatic gauging stations installed by the Advanced Science and Technology Institute (ASTI) within the CDO river basin during the 3-day field visit

(5) Discussed Project during Typhoon Committee DRR Meeting in Seoul, Korea (last week of May 2013); Dispatch of Korean experts is July 2013.

(6) Conducted second site survey with NDMI consultant/contractor on 23 to 25 July 2013.

(7) Final sites for proposed network established was decided through field work.

9. Other Notable Issues

(1) Integration of the proposed system with the existing ASTI equipment under the NOAH Project.

(2) Installation of the FFAS in the planned River Center in the PAGASA-El Salvador Compound.

(3) Cancellation of Madulog River basin component due to security issues

10. Data Source:

Project Documents; actual involvement in field work

* Presently named Ministry of Security and Public Administration (MOSPA)

1.	Title of Project	: Resilience Capacity Building for Cities and Municipalities to Reduce Disaster Risks from Climate Change and Natural Hazards, Phase 1 ("ReBUILD Project")
2.	Name of Donor Agency	: UNDP/ NZAP
3.	Target Area/River Basin	: Cagayan and Jalaur River Basin
4.	Project Period	: Three (3) years: October 2012 to June 2015
5.	Budget	: US$ 1.22 M
6.	Contact Person in PAGASA	: Ms. Adelaida C. Duran

7. Objectives/Salient Features

(1) The Project aims to assess the disaster vulnerabilities of the cities and municipalities surrounding the Cagayan and Jalaur River Basin to geological, meteorological, and meteorologically-induced hazards due to climate change. The results will provide the basis for priority mitigation actions like community based and managed early warning systems and integrated contigency planning and mobilization.

(2) The Project aims to enhance the competencies of the concerned LGUs on mainstreaming climate/disaster risk management into local landuse and development planning and regulatory processes.

(3) The Project outcomes and outputs include:

(a) Climate change/disaster risk vulnerabilities of Cagayan and Jalaur River Basins assessed

(b) Priority climate change adaptation and disaster risk mitigation measures for priority cities and municipalities around the Cagayan and Jalaur River Basins developed

(c) Climate change/Disaster risk management mainstreamed into the target areas' planning and regulatory processes

(d) Socio-economic resilience of the poor and most vulnerable in target areas developed

(e) Local knowledge management (KM) systems established in selected target areas

8. Current Status (As of September 2013)

(1) Held a Training for Trainers in Tagaytay last April 2013

(2) Held a Training on GIS from 29 April to 3 May 2013

(3) Launched Project in Tuguegarao and Iloilo on 4 July and 8 July 2013, respectively.

(4) Submitted the network for Cagayan and Ilo-ilo with costing

9. Other Notable Issues

10. Data Source: Inception Workshop Presentation, 14 March 2013

1.	Title of Project	: Counter Plan for Extra-ordinary Flood
2.	Name of Donor Agency	: United Nations Economic and Social Commission for Asia and the Pacific/World Meteorological Organization/Typhoon Committee/Korean Institute of Science and Technology (UNESCAP/WMO/TC/KICT)
3.	Target Area/River Basin	: Pampanga River Basin
4.	Project Period	: 2013-2014
5.	Budget	: Data not Available
6.	Contact Person in PAGASA	: Ms. Nivagene C. Nievares

7. Objectives/Salient Features

(1) As a pilot country for the Development of Comprehensive Counterplan for Extraordinary Flood in AOP6 Project of Typhoon Committee

(2) Conduct an investigation of the extreme flood events in the Philippines and selection of the pilot area for the Project

8. Current Status (As of September 2013)

The scheduled additional investigation and collection of flood information in the second week of May 2013 did not push through. No alternative date has been set.

The Project is pending due to some issues in the Korean Institute of Science and Technology (KIST)

9. Other Notable Issues

No Data

10. Data Source

Project documents; participation in meetings and other Project activities

1.	Title of Project	: Data Collection Survey on Situation of Nationwide Flood Forecasting and Warning System
2.	Name of Donor Agency	: JICA
3.	Target Area/River Basin	: All major river basins including Madulog River Basin
4.	Project Period	: 2013
5.	Budget	: Y70.0 mil.
6.	Contact Person in PAGASA	: Ms. Rosalie S. Pagulayan and Ms. Rhonalyn Vergara

7. Objectives/Salient Features

To collect and study basic information on FFWS in the Philippines in terms of the issues of equipment, organization, or institutional arrangements/capacity

8. Current Status (As of September 2013)

(1) A workshop was conducted last April 11, 2013 in Tuguegarao, Cagayan, to further identify crucial issues, direction of improvement, and enhancement of the present status of Flood Forecasting and Warning System.

(2) Also in the Workshop, assessment of other river basins (e.g., Davao River) was conducted in terms of the feasibility of putting up an FFWC in the area.

(3) PAGASA undertook some initiatives like the conduct of verification of sites for the location of RR and WL equipmnet. The equipment will be fabricated and installed by ASTI. Preparation for the costing for the construction of river centers (structural, plumbing, electrical, others) is underway. The bidding for construction is scheduled for July, with Davao as priority area.

(4) Coordination with concerned agency is being undertaken, particularly for Mindanao River basin, for the location of the weather and flood forecasting center (synoptic/weather station and river center will be housed in one building). CAAP has the jurisdiction over the land being requested by PAGASA for the building. Likewise, priority areas are as follows: Davao, Buayan-Malungon,

(5) Bidding for the building construction is scheduled within this month.

9. Other Notable Issues

No Data

10. Data Source

Seminar handout/proceedings, 2013; Member Report, Typhoon Committee, 2012

Interim Report, June 2013

1.	Title of Project	: Operationalization of KOICA2 Project
2.	Name of Donor Agency	: Korean International Cooperation Agency (KOICA)
3.	Target Area/River Basin	: Pasig-Marikina River Basin
4.	Project Period	: 2013
5.	Budget	: Data not Available
6.	Contact Person in PAGASA	: Mr. Maximo F. Peralta and Ms. Shiela S. Schneider

7. Objectives/Salient Features

(1) To be able to operationalize the installed monitoring equipment (KOICA Project) within the Pasig Marikina River Basin

(2) To come up with an integrated monitoring network of existing and newly-installed FEWS for the Greater Metro Manila Area

(3) To be able to have an operational model as a basis of warning for the Pasig-Marikina Watershed

8. Current Status (As of September 2013)

(1) Installed equipments were ten water level stations, ten rain gauge stations, 20 warning posts, and six disaster risk reduction offices as well as three relay stations

(2) All of the equipment and instrumentations are operational and working except in four warning posts and one rainfall station. Three of the warning posts were submerged by floodwaters during the Habagat episode in August 2012. These were the San Mateo2, San Juan, and Nangka Stations. Nangka warning post was being restored during the first quarter of 2013. The other equipments were not replaced due to the unavailability of spare parts. Hence, a request has been made to KOICA (Project Donor).

(3) Completed the installation of other equipments such as LCD display, setup box, and display control unit at the DRRM offices such as Antipolo and Marikina to come up with a fully operational warning system in Pasig-Marikina River Basin.

(4) Hydrologist from PAGASA conducted hydrographic survey last October 2012 to tie up the gauge datum of the newly installed KOICA water level station with the existing water level station of EFCOS based from the Mean Low Low Water (MLLW) with a value equivalent to 10.46 m in all stations. The water level sensor height as well as the warning assessment level were also established.

(5) Updated the three public warning messages along with three different siren sounds applied in public address system, were recorded, and set up in all the warning posts. The basis of the said warnings is from the assessment levels of individual locations approximate water level sensors along the Pasig Marikina River basin.

(6) Participated in the flood drill conducted by the Resilience Project.

(7) Last July 28 to August 3, 2013, a fact-finding committee was dispached by KOICA to understand the local environment of the status of the flooded equipment, conduct site survey in preparation for the installation of equipment, and negotiate a schedule for post management as well as the modificationn of the data base.

9. Other Notable Issues

(1) Continuous collaboration with the LGU's within the Pasig - Marikina River with regards to the improvement of the warning within the basin. Protocols of the LGU's in the early warning system are being harmonized since these will be important inputs for the operationalization of the KOICA 2 Project.

(2) During the pre-operation of the system, PAGASA encountered problems that need to be addressed to fully operationalize the system. These are as follows :

(a) PAGASA should come up with an operation plan for the regular and periodic maintenance of the system and to allocate funding for the said maintenance.

(b) The integration of the MMDA EFCOS to the KOICA system did not materialize because of the unavailability of the readable MMDA-EFCOS data.

(c) The relocation/elevation of the warning post which was submerged due to floodwaters are needed before the replacement of the damaged equipment.

(3) (a) The rehabilitation of the damaged equipment will commence in the second week of September and target to finish by Novembe

(b) Reconfigure the Flood Forecasting System to incorporate the newly installed ARG and one WLG (under Resilience Project) and EFCOS data (under MMDA). This is to improve the output of the flood model includin in the system.

10. Data Source

Discussions in meetings, project site visits, and other fora

1.	Title of Project	: Disaster Preparedness and Response Project
2.	Name of Donor Agency	: United Nations/World Food Program (UN/ WFP)
3.	Target Area/River Basin	: Benguet (CAR), Cagayan (Region 2), Laguna (Region IV-A) and Sorsogon (Region V)
4.	Project Period	: 2013
5.	Budget	: Data not Available
6.	Contact Person in PAGASA	: Ms. Rosalie S. Pagulayan

7. Objectives/Salient Features

(1) The main objective of the Project is to complement current local government efforts in strengthening their disaster preparedness and response capacity.

(2) Project components: (a) Strengthening local capacity and building resilience through community-based projects, (b) Building capacity through trainings tailored to local needs, and (c) Strengthening the government's logistics capacity for disaster response.

(3) Project sites are the four disaster-prone provinces in Luzon: Laguna (Region IV-A), Sorsogon (Region 5), Benguet (CAR), and Cagayan (Region 2).

(4) Initiatives for Benguet Province (Municipalities of Atok and Tublay) were more of agro-forestry and application of vetiver grass technology as a preventive measure for soil erosion. The WFP also partnered with the local nongovernmental organization (NGO), Philippines Business for Social Progress (PBSP), for the provision of training on vetiver grass technology, hazard mapping, and barangay-level contingency planning.

(5) Projects of Cagayan Province: Enrile- strengthening the preparedness and response capacities of Disaster Risk Reduction and Management Offices through hardware support (hand-held radios, emergency generator, life vests, and engine boat); Aparri - being a coastal community, and a perennially flooded area, a rising sea level adaptation project through vetiver grass technology; and Amulung - construction of , emergency food and seed storage facility

(6) Projects of Sorsogon Province: Juban - the WFP with complementary contributions from the LGU and DSWD constructed an Emergency Operations Center that will serve as a hub for all disaster response activities and rehabilitation of the three frequently-utilized evacuation centers; Irosin - capacity building project initiated for the barangays. WFP partnered with PBSP in the conduct of the IEC.

(7) In all the WFP programs, there is always a counterpart contribution from the LGUs so as to instill a sense of ownership on their part. DSWD was also included for the cash-for-work scheme.

8. Current Status (As of September 2013)

(1) Province of Laguna: Strengthening local capacity and building resilience through community-based projects for the municipalities of Mabitac, Pila, Rizal, and Famy; Pila - rehabilitation of the Bulusukan River implemented throught he joint financial assistance of WFP and Mabitac LGU, with DSWD and DENR also contributing to the project cost that amounted to PhP 2,761,860.00. Planting of vetiver grass river banks and river dredging were done through the cash-for-work program scheme. Mabitac - Solid Waste Management Project and Strengthening of MDRMC Office with technical assistance in capacity building by the PBSP.

(2) One of the components of the WFP project is entitled “Adapting a Communication Protocol to Monitor Rainfall Using Automatic Weather Stations (AWS) in Four (4) Towns in Laguna Province namely Famy, Mabitac, Pila, and Rizal.” The WFP purchased ten units of Davis Instruments Automatic Weather Stations and established a partnership with UPLB for the installation of AWS in the aforementioned municipalities. The Research Team of UPLB developed and enhanced some important features of the AWS such as database management, wireless communications, internet connectivity, and program for triggering the siren, and warning light module of the AWS. They partnered with the UPLB for the installation of these AWS in Project sites.

(3) Installation was already done in the municipality of Mabitac. IEC and flood drill were conducted last 27 February 2013 to test the audibility of the warning siren of the AWS. Installation for other municipalities are underway. IEC and flood drill for the other municipalities will be scheduled after completion of AWS installation.

(4) Lecture on FF and other early warning systems provided on May 20, 2013 for WFP staff involved in DDRM activities and initiatives. A concern is the integration of WFP installed equipment with PAGASA to harmonize initiatives with the latter. Plan to install additional equipment, water level gauges. PAGASA can provide technical assistance to sustain utilization of these water level

(5) The following activities were undertaken:
(a) Flood drill and IEC in Brgy. Aplaya, Municipality of Pila, Laguna on October 8, 2013.
(b) IEC for the DRRMO of Municipality of Famy, Laguna on October 9, 2013.

(6) Salient observations during the drill at Pila: (a) the location of the installed AWS was already at the river mouth, which could defeat the purpose of giving an advanced warning for the flood-prone areas in Pila. (b) the threshold values of rainfall (alert, alarm and critical) that will trigger the alarm system of the AWS was adapted from the rainfall warning system being issued by PAGASA for Metro Manila. This caused some confusion on the part of the community. In the IEC part, all these matters were given emphasis. (c) Although there were portion of the areas where the warning siren was not heard, this matter will be addressed by the Public Address System of the barangay.

(7) Two (2) AWS was installed at the Municipality of Famy: Brgy. Cataypuanan and Brgy. Minayutan. One concern of the LGUs is how to covert the intensity of rainfall to something that can be understood by the local or common people.

9. Other Notable Issues

Integration of the WFP installed AWS with the PAGASA network of monitoring equipment

10. Data Source

WFP Disaster Preparedness and Response - Capacity Building

Attachment for the new update: Summary Report

Appendix F

Current Status of Project NOAH

Appendix F Current Status of the Project NOAH

F.1 Component of Project NOAH

The Nationwide Operational Assessment of Hazards Project (Project NOAH)[1] has eight components as follows:

- Distribution of hydrometeorological devices in hard-hit areas in the Philippines (Hydromet): installation of 600 automated rain gauges and 400 water level monitoring station by December 2013;
- Disaster Risk Exposure Assessment for Mitigation – Light Detection and Ranging (DREAM-LIDAR) Project: generation of accurate flood inundation and hazard maps by December 2013;
- Enhancing Geohazards Mapping through LIDAR: identification of areas prone to landslides by December 2014;
- Coastal Hazards and Storm Surge Assessment and Mitigation (CHASSAM): establishment of wave surge, wave refraction, and coastal circulation models by December 2014;
- Flood Information Network (FloodNET) Project: formulation of flood early warning systems by December 2013;
- Local Development of Doppler Radar Systems (LaDDeRS): development of local capacity to design, fabricate, and operate sub-systems of Doppler radars;
- Landslide Sensors Development Project: development of early monitoring and warning system for landslides; and
- Weather Hazard Information Project (WHIP): distribution of proper weather hazard information through television, web portal, IEC.

The components related to PAGASA are the Hydromet Project, DREAM-LIDAR Project, CHASSAM, FloodNET Project, LaDDeRS, and WHIP Project.

F.2 Target Area of Project NOAH

The target areas of Project NOAH are the 18 river basins consisting of the following: Pasig-Marikina, Cagayan de Oro, Iligan, Agno, Pampanga, Bicol, Cagayan, Agusan, Panay, Magaswang Tubig, Jalaur, Ilog-Hilabangan, Agus, Davao, Mindanao, Tagum-Libuganon, Tagaloan and Buayan-Malungun river basins.[2] Works in other river basins of the Philippines will be conducted after the completion of efforts in the above 18 river basins.

F.3 Current Status

The Study Team surveyed the current situation of Project NOAH through interviews and meetings held on 20 March 2013 with ASTI, and on 25 March and 7 May 2013 with UP.

(1) Hydromet Project

The Hydromet Project is being conducted by the Advanced Science and Technology Institute (ASTI) of DOST. A total of 600 automated rain gauges (ARG) and 400 water level

[1] Data source: http://www.gov.ph/about-project-noah/
[2] Data source: http://noah.dost.gov.ph/#about

monitoring stations (WLMS) will be installed by December 2013 for the Hydromet Project. There are 101 ARG, 82 AWS and 66 WLMS that have been already installed as of 17 January 2013[3]. The total number of installed gauges is 249, comprising only 25% of the target. The challenge being faced by ASTI is the completion of the remaining 75% by December 2013 deadline.

The data loggers of the gauges were designed by ASTI and were manufactured by a local electronic company.

(2) DREAM-LIDAR Project

The DREAM-LIDAR Project is being managed by the University of the Philippines (UP) with assistance from the environmental agency of the United Kingdom. Project funding is provided by the national government.

The objectives of the Project include:

a. Detailed flood hazard map based on several scenarios of return periods at 5, 10, 25, 50 and 100 years;
b. Flood advisory using the observed data of the gauges installed by ASTI; and
c. Real time flood inundation maps.

The target river basins of the LIDAR survey and hazard mapping are shown in Table F.1. According to the Project Team, the light detection and ranging (LIDAR) equipment were procured from a Canadian company. The Project Team is conducting high resolution elevation surveys with the use of LIDAR equipment. River cross section surveys are contracted to local survey firms. The coverage areas of the LIDAR survey are shown in Figure F.1.

Survey and progress reports are directly submitted to DOST. Although river basin survey reports are made, LIDAR reports are still unavailable. About 20% of the total survey work has been done as of May 2013.

The hazard maps by DREAM-LIDAR Project are shown in Figure F.2.

(3) FloodNET

The FloodNET Project is being implemented by UP. According to the Project Team, flood forecasting models were established using HEC-HMS and HEC-RAS. The input rainfall data used for modeling are rainfall radar data. The observed data by radar is obtained every 11 minutes, and stored in the ASTI data server. The Team operated the flood forecasting model of the Pasig-Marikina River basin during the rainy season of 2012. The model contributed to early flood warnings for the evacuation of residents along the Pasig-Marikina River during the August 2012 monsoon flood.

As of March 2013, the Team is trying to use four hour rainfall forecasting under the Climate X Project to extend the forecasting capacity of its flood forecasting models. The Team also is trying to establish real time hazard maps as an integration of the results of the FloodNET and DREAM-LIDAR projects. Candidates for inundation analysis modeling are FLO-2D,

[3] Data source: the list of ASTI stations which was collected from PAGASA

HEC-RAS, HEC-HMS, LISFLOOD, and ISIS.

(4) WHIP

The WHIP Project is being undertaken by ASTI. According to the Project Team, they established data servers in ASTI and backup servers in Makati and Cebu for the opening of its web portal site. Currently, the capacity of the web server is seven viewers per second, which will be upgraded to 200 viewers per second in the future.

A MOA was made with Philippine Cable TV. The TV station will provide a disaster and weather channel without charge, considering the Company's social responsibility.

Through EIC, the Team teaches others on the use of the NOAH web portal.

F.4 Advantages and Challenges of Project NOAH

(1) Monitoring Stations

1) Advantages

- It shows a significant progress in flood monitoring capacity, especially in basins where there are a few available gauges. A total of 1,000 rainfall or water level gauges are to be installed within a short period of two years.

2) Challenges

- The priority of Project NOAH is focused on the installation of gauges. In support of the installation, operation, and maintenance, basic concept on the utilization of the system could be developed.
- There is duplication of gauges among several projects such as those provided by foreign donors and by Project NOAH. Although the presence of many gauges may seem like an advantage, some confusion could be encountered in the operation of flood forecasting and warning system. Therefore, appropriate coordination and cooperation among projects should be implemented.
- The rainfall and water level gauges are installed only at readily-accessible locations due to the limitation of the short Project period. In addition, installed water level gauges were set on bridges. The locations of gauges should be carefully selected considering hydrological characteristics and historical flood damages. The deficiency on the use of basic concepts, resulting from the limited time frame, may influence the progress of the Project.

(2) Data Management

1) Advantages

- Through the website of Project NOAH, citizens can easily access and can monitor rainfall and water level data in real time. The locations and observed values of gauges are shown in the website.
- Database system for monitoring and analyzed data (rainfall and water level monitoring stations, weather stations, rainfall radars, satellite images, weather forecasting, and inundation maps) was established.

2) Challenges

- General quality control activities, such as checking of data acquisition rate or checking the accuracy of sensors, could be implemented.
- Reliability of the observed data should be examined to be utilized for flood forecasting and warning.
- Monitored water levels are just shown as height from gauges on the web. Those water levels should be shown with river cross sections as elevation.

(3) Flood Analysis

1) Advantages

- Free software, such as HEC-HMS and HEC-RAS for flood runoff modeling, is used in the Project. This decreases the amount of initial investment for the system.

2) Challenges

- The reliability of models should be examined carefully to determine if further calibration of models for FFWS operation is required.

(4) Equipments

1) Advantages

- Ultrasonic type water level sensors which do not require costly civil works were used.
- Though the sensors that were used were manufactured by foreign countries, several parts were made in the Philippines. Therefore, there is possibility for the development of technologies in the Philippines as well as an accumulation of technical experiences among NOAH staff.
- The observed data is automatically sent either by SMS or satellite communication. The controller first selects SMS as the priority step. If SMS does not work, then satellite communication is used.

2) Challenges

- There are some risks in the sustainability of the system due to the durability of equipments or due to insufficient maintenance. How these gauges would actually work during flood events should be carefully monitored.
- In the situation of a functional data logger with a dysfunctional gauge, the NOAH system would observe a “0 mm of rainfall” instead of indicating that there is an error in the equipment.
- Possibility of vandalism is high due to the lack of equipment fencing.
- The specifications of the equipments are not shown.
- Observed data of water level sensors installed on bridges will be affected by the vibration of the bridges

(5) Operation and Maintenance of Equipments

1) Challenges

- According to the Director of Project NOAH, all products including the 1,000 gauges will be transferred to PAGASA. The current capability of maintenance of equipments in PAGASA is limited. Appropriate actions are needed to strengthen PAGASA's capacity, so that most of the NOAH gauges can be maintained.

(6) Human Resources

1) Advantages

- The average age of the project staff is young so this raises the future level of engineering in the Philippines.

2) Challenges

- Most components under the Project NOAH will be completed by December 2013. Project staffs are selected from related agencies, such as ASTI or UP. After the completion of the Project, they will return to their original agencies and will no longer be a part of the Project. Thus, the sustainability of the system needs to be discussed.

F.5 Preparation for the Transfer of NOAH System to PAGASA

According to the Director of Project NOAH, all products including the 1,000 gauges will be transferred to PAGASA. However, the agreement of the transfer between Project NOAH and PAGASA has not reached a settlement. PAGASA declares that they will do verification of reliability and sustainability of the NOAH system, if the system is transferred to PAGASA.

Hydrological aspects must be considered in the selection of locations of monitoring stations in Project NOAH. The transfer of the system to PAGASA should be examined carefully. Operational FFWS stations and NOAH stations must be integrated.

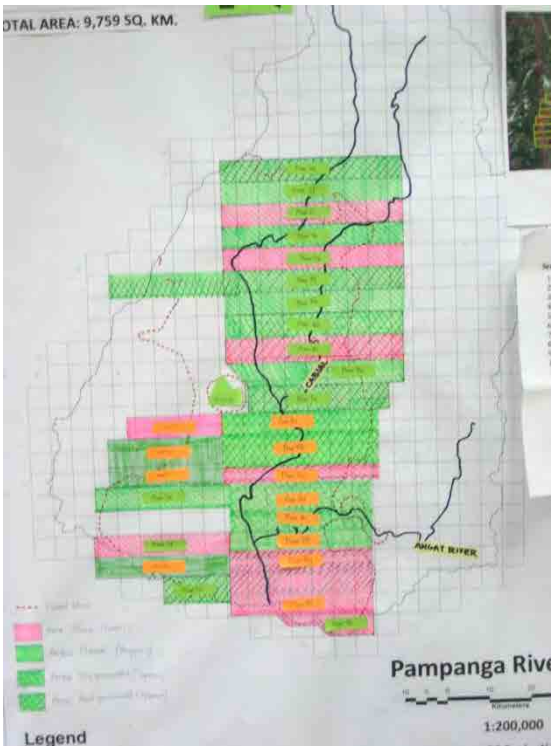
Important NOAH stations for hydrological aspect can become FFWS stations after the improvement or replacement of equipments, considering the reliability and durability of the system. Other equipments should be classified as secondary stations. To avoid confusions on the transfer of the system, the basic concept and process of the transfer should be discussed among related agencies and the agreement should be documented. Also, PAGASA should prepare the strategy for the effective utilization of the NOAH system for its sustainable operation and maintenance.

Table F.1 Status of LIDAR Data and Flood Models of Project NOAH

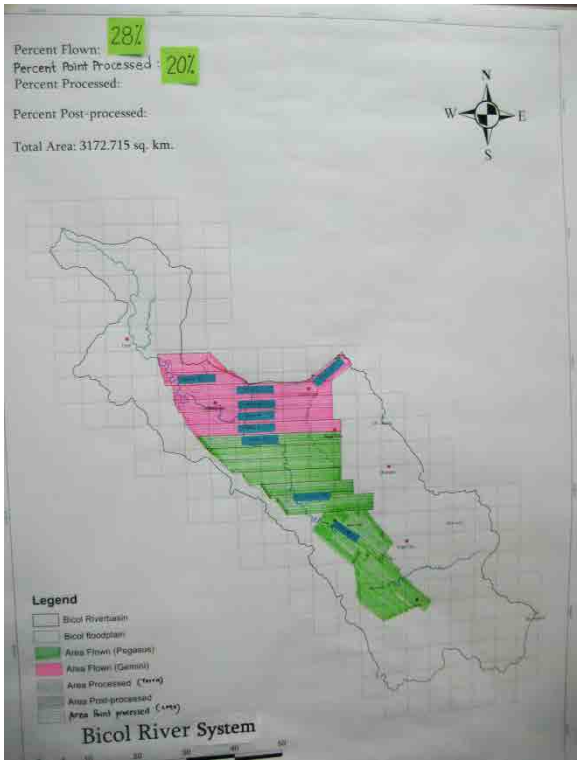
Name of River Basin		LIDAR Data		Flood Model for Flood Forecasting		Flood Model for Hazard Mapping	
		Status	Agency	Status	Agency	Status	Agency
5 FFWS Basin	Cagayan River Basin	To be surveyed	NOAH Project (UP DREAM Project)	To be developed	NOAH Project (UP Flood NET Project)	To be developed	NOAH Project (UP DREAM Project)
	Agno River Basin	LIDAR Survey completed	NOAH Project (UP DREAM Project)	To be developed	NOAH Project (UP Flood NET Project)	To be developed	NOAH Project (UP DREAM Project)
	Pampanga River Basin	LIDAR Survey completed	NOAH Project (UP DREAM Project)	To be developed	NOAH Project (UP Flood NET Project)	To be developed	NOAH Project (UP DREAM Project)
	Pasig-Laguna De Bay	Available	AusAID	Developed using HEC-HMS, RAS	NOAH Project (UP Flood NET Project)	Developed using HEC-HMS, RAS	NOAH Project (UP DREAM Project)
	Bicol River Basin	LIDAR Survey completed	NOAH Project (UP DREAM Project)	To be developed	NOAH Project (UP Flood NET Project)	To be developed	NOAH Project (UP DREAM Project)
Remaining 13 Major Basins	Abulug River Basin	Not covered by NOAH Project		Not covered by NOAH Project		Not covered by NOAH Project	
	Abra River Basin	Not covered by NOAH Project		Not covered by NOAH Project		Not covered by NOAH Project	
	Panay River Basin	LIDAR Survey ongoing	NOAH Project (UP DREAM Project)	To be developed	NOAH Project (UP Flood NET Project)	To be developed	NOAH Project (UP DREAM Project)
	Jalaur River Basin	LIDAR Survey ongoing	NOAH Project (UP DREAM Project)	To be developed	NOAH Project (UP Flood NET Project)	To be developed	NOAH Project (UP DREAM Project)
	Ilog-Hilabangan River Basin	LIDAR Survey ongoing	NOAH Project (UP DREAM Project)	To be developed	NOAH Project (UP Flood NET Project)	To be developed	NOAH Project (UP DREAM Project)
	Agusan River Basin	Available (partly)	NOAH Project (UP DREAM Project)	To be developed	NOAH Project (UP Flood NET Project)	To be developed	NOAH Project (UP DREAM Project)
	Tagoloan River Basin	To be surveyed	NOAH Project (UP DREAM Project)	To be developed	NOAH Project (UP Flood NET Project)	To be developed	NOAH Project (UP DREAM Project)
	Cagayan De Oro River Basin	LIDAR Survey completed	NOAH Project (UP DREAM Project)	To be developed	NOAH Project (UP Flood NET Project)	Developed using HEC-HMS, RAS	NOAH Project (UP DREAM Project)
	Agus-Lake Lanao River Basin	To be surveyed	NOAH Project (UP DREAM Project)	To be developed	NOAH Project (UP Flood NET Project)	To be developed	NOAH Project (UP DREAM Project)
	Davao River Basin	Available	NOAH Project (UP DREAM Project)	To be developed	NOAH Project (UP Flood NET Project)	To be developed	NOAH Project (UP DREAM Project)
	Tagum-Libuganon River Basin	To be surveyed	NOAH Project (UP DREAM Project)	To be developed	NOAH Project (UP Flood NET Project)	To be developed	NOAH Project (UP DREAM Project)
	Mindanao (Cotabato) River Basin	To be surveyed	NOAH Project (UP DREAM Project)	To be developed	NOAH Project (UP Flood NET Project)	To be developed	NOAH Project (UP DREAM Project)
	Buayan-Malungon River Basin	To be surveyed	NOAH Project (UP DREAM Project)	To be developed	NOAH Project (UP Flood NET Project)	To be developed	NOAH Project (UP DREAM Project)
Model Case of Small Basins	Mandulog (Iligan City) River Basin	To be surveyed	NOAH Project (UP DREAM Project)	To be developed	NOAH Project (UP Flood NET Project)	Developed using HEC-HMS, RAS	NOAH Project (UP DREAM Project)

Note: The status is as of May 2013.
Source: NOAH web portal and interview survey to the project team

Agno River Basin



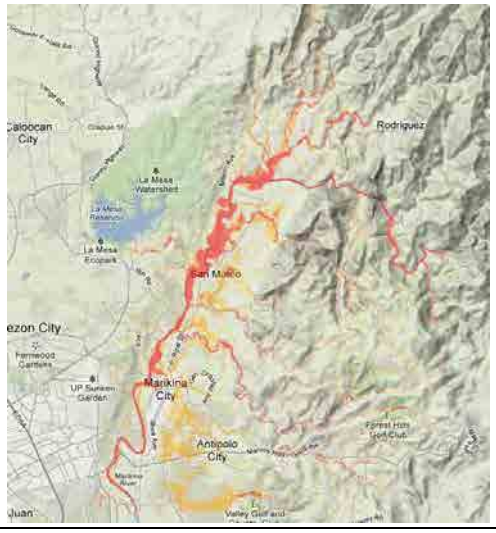
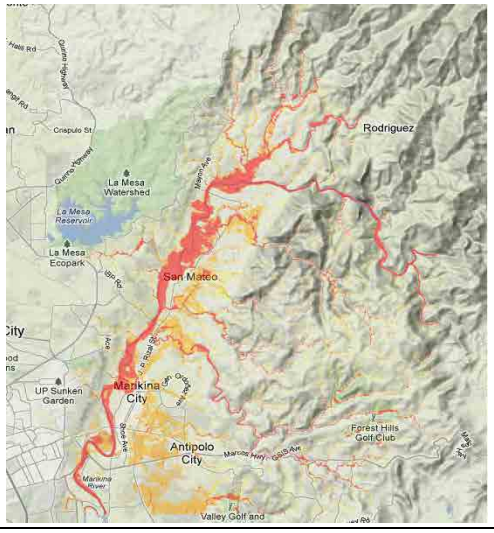
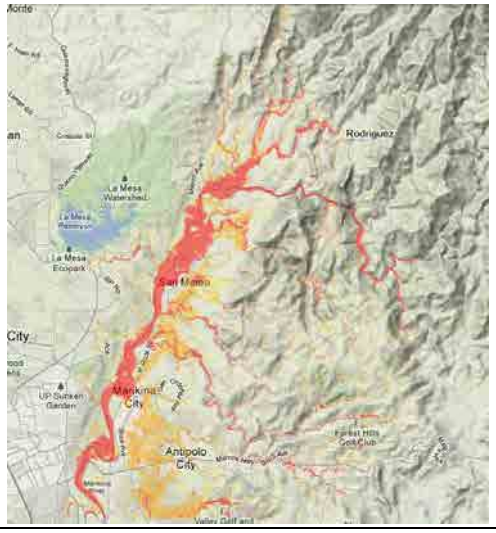
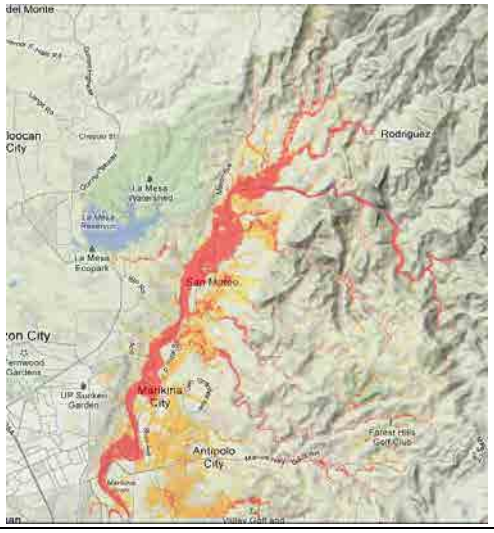
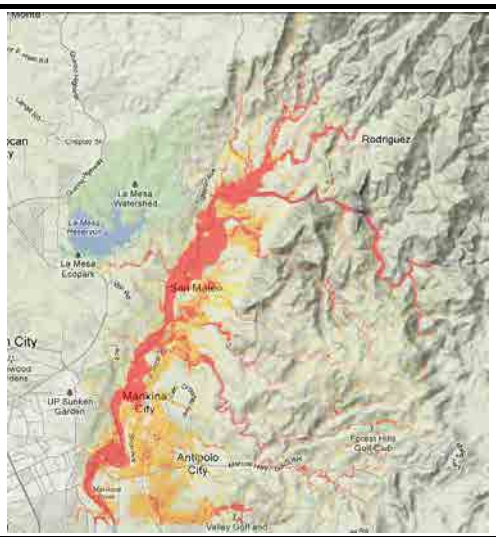
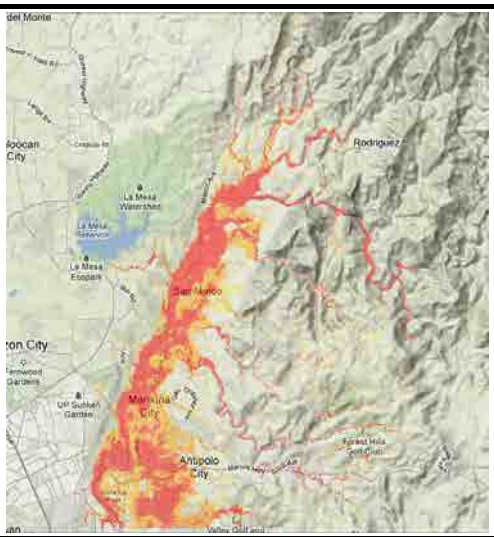
Pampanga River Basin



Bicol River Basin

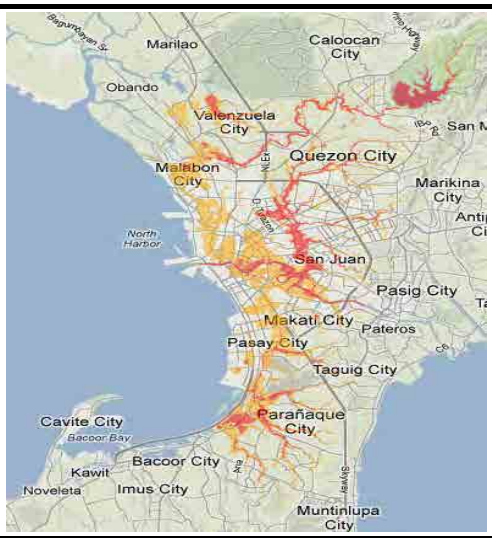
Source: Project NOAH

Figure F.1 Coverage Area of LIDAR

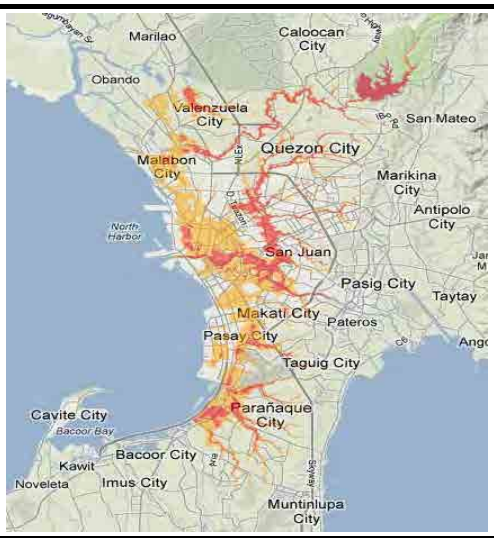
	
Marikina - 5 Year Flood	Marikina - 10 Year Flood
	
Marikina - 25 Year Flood	Marikina - 50 Year Flood
	
Marikina - 100 Year Flood	Marikina - Ondoy Flood

Source: Project NOAH as of May 2013

Figure F.2 Flood Maps of NOAH (1/6)



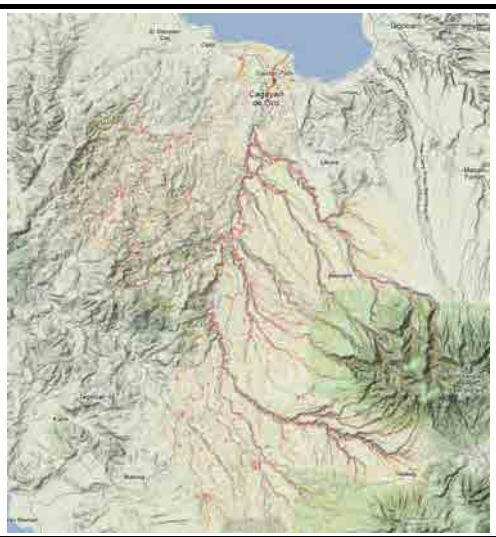
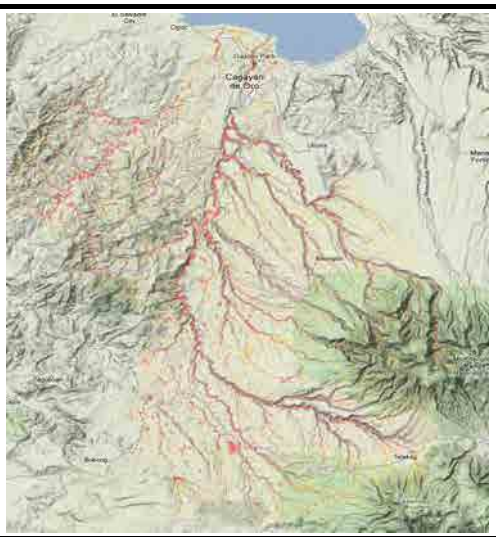
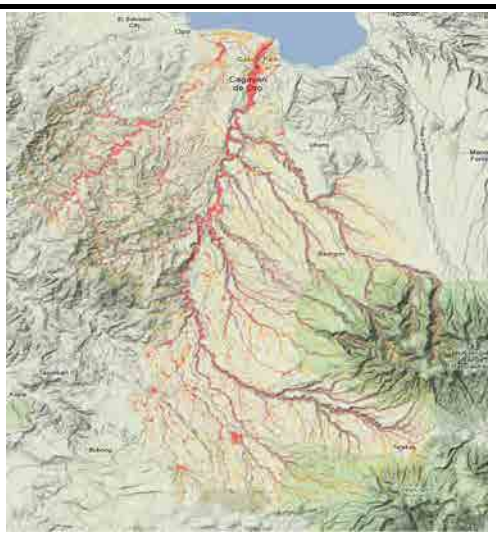
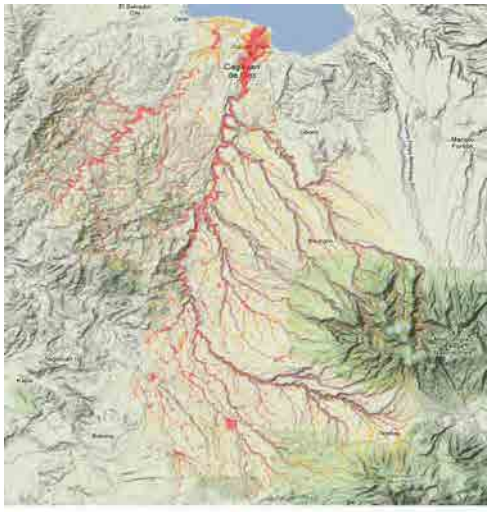
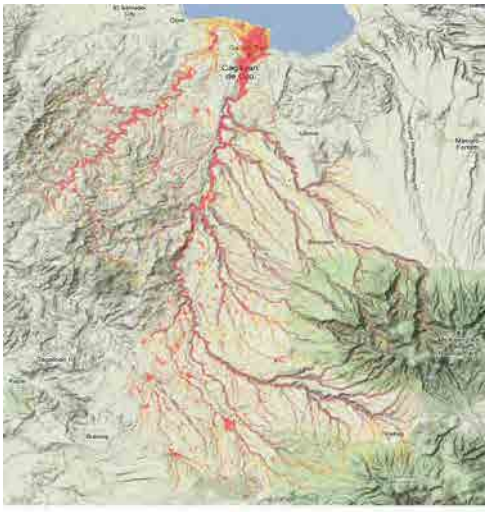
Manila, Makati, Quezon City - 100 Year Flood



Manila, Makati, Quezon City - Ondoy Flood

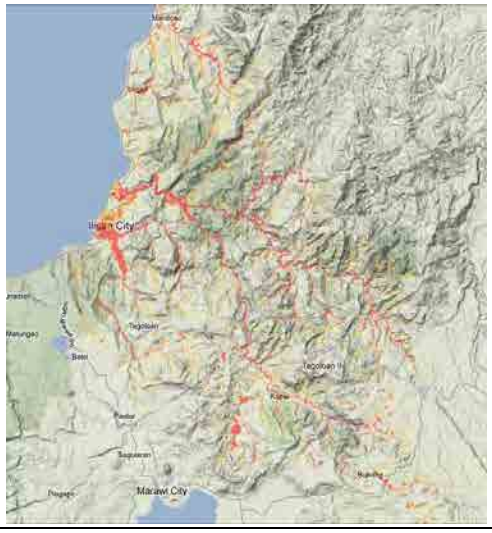
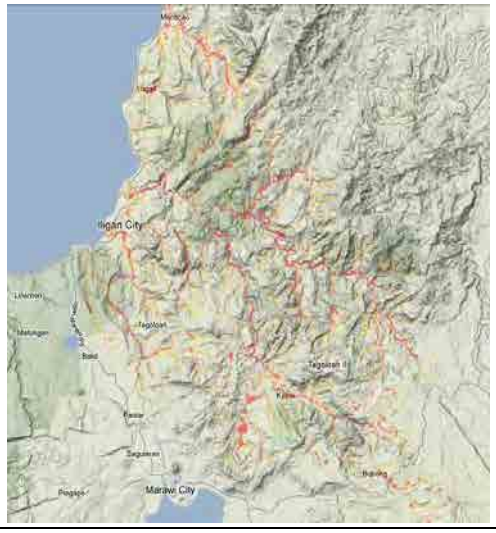
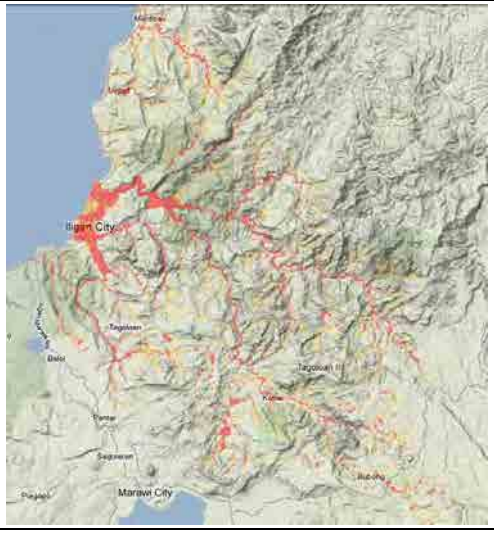
Source: Project NOAH as of May 2013

Figure F.2 Flood Maps of NOAH (2/6)

	
Cagayan de Oro - 5 Year Flood	Cagayan de Oro - 10 Year Flood
	
Cagayan de Oro - 25 Year Flood	Cagayan de Oro - 50 Year Flood
	
Cagayan de Oro - 100 Year Flood	Cagayan de Oro - Ondoy Flood

Source: Project NOAH as of May 2013

Figure F.2 Flood Maps of NOAH (3/6)

	
Iligan - 5 Year Flood	Iligan - 10 Year Flood
	
Iligan - 25 Year Flood	Iligan - 50 Year Flood
	
Iligan - 100 Year Flood	Iligan - Ondoy Flood

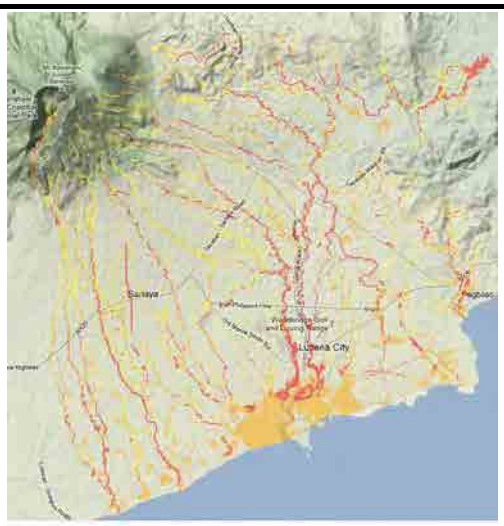
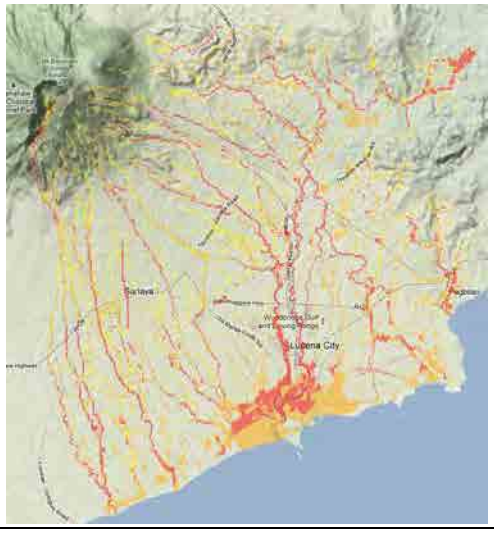
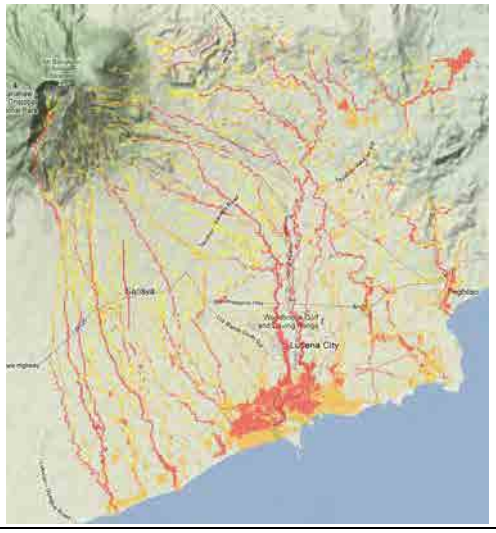
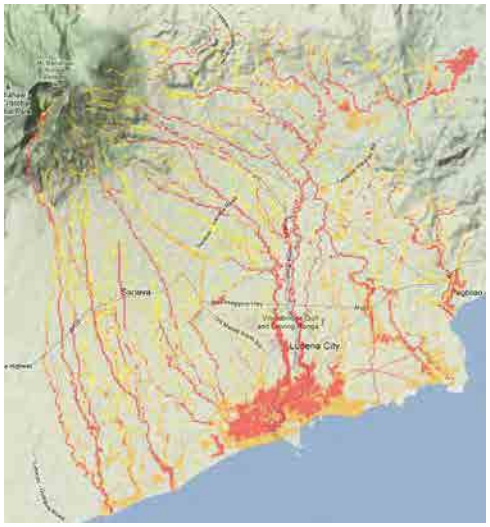
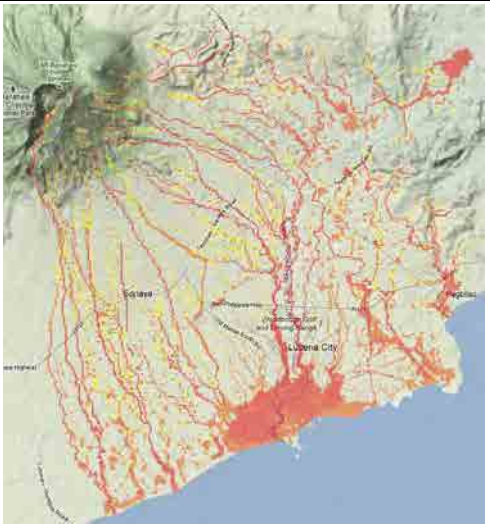
Source: Project NOAH as of May 2013

Figure F.2 Flood Maps of NOAH (4/6)

	
Infanta - 5 Year Flood	Infanta - 10 Year Flood
	
Infanta - 25 Year Flood	Infanta - 50 Year Flood
	
Infanta - 100 Year Flood	Infanta - Ondoy Flood

Source: Project NOAH as of May 2013

Figure F.2 Flood Maps of NOAH (5/6)

	
Lucena - 5 Year Flood	Lucena - 10 Year Flood
	
Lucena - 25 Year Flood	Lucena - 50 Year Flood
	
Lucena - 100 Year Flood	Lucena - Ondoy Flood

Source: Project NOAH as of May 2013

Figure F.2 Flood Maps of NOAH (6/6)

Appendix G

List of Monitoring Stations, Flood Runoff Model, Discharge Measurement and Cross Sections

Current Status of Utilization of Flood Runoff Models

No.01 Cagayan River Basin, Catchment Area : 27,280 km^2

Availability of Flood Runoff Model: (Available) · Not Available

Description of Model

1. Name of Model : Magat River Basin Flood Forecasting Program (Storage Function Method), developed by "The Project for Strengthening Flood Forecasting and Warning System for Dam Operation", JICA (2012)
   Target Area : Magat River Basin, Upstream of Magat dam to before junction with Cagayan River (5,113 km2, 19% of whole River Basin)
   Basin Rainfall : Using 8 telemeter rainfall statons, estimated by Thiessen's polygon method and elevation conversion factor
2. Name of Model : IFAS (Integrated Flood Analysis System), developed by ICHARM
   Target Area : Whole Cagayan River Basin
   Basin Rainfall : Using satelllite rainfall data (3B42RT, GSMap, Qmorph, Cmorph, etc.) or ground rainfall stations

Available Data for Development and Modification of Flood Runoff Model

Rainfall

No.	Station Name	Station Type	Data Type	Duration of Record	Location		Elevation (El.m)	Agency	Address
					Latitude	Longitude			
1	Tuguegarao	ARG	Hourly	1982 - Present	17° 36' 56"N	121° 41' 25" E	15.00	PAGASA (FFWS)	Buntun Bridge, Tuguegarao, Cagayan
2	Tumauini	ARG	Hourly	1982 - Present	17° 16' 26"N	121° 47' 56" E	30.00	PAGASA (FFWS)	Poblacion, Tumauini, Isabela
3	Gamu	ARG	Hourly	1982 - Present	17° 04' 18"N	121° 50' 32" E	60.00	PAGASA (FFWS)	Gamu, Isabela
4	Maris Dam	ARG	Hourly	1982 - Present	16° 50' 20"N	121° 30' 50" E	90.00	PAGASA (FFWS)	Oscariz, Ramon, Isabela
5	Pangat	ARG	Hourly	1982 - Present	16° 36' 37"N	121° 40' 50" E	72.00	PAGASA (FFWS)	Pangal, Echague, Isabela
6	ISF - Palanan	AWS	15 min	-	16° 59' 20"N	122° 23' 48" E	52.00	PAGASA (AWS)	Isabela School of Fisheries, Palanan, Isabela
7	NVSU - Bayonbong	AWS	15 min	-	16° 29' 19"N	121° 09' 32" E	275.00	PAGASA (AWS)	NVSU Campas, Bayombong, Nueva Vizcaya
8	ISU - Echague	AWS	15 min	-	16° 56' 10"N	121° 45' 51" E	58.00	PAGASA (AWS)	ISU Campas, Echague, Isabela
9	Lal-lo	AWS	15 min	-	18° 11' 50"N	121° 39' 53" E	76.00	PAGASA (AWS)	Lal-lo, Aparri, Cagayan
10	Tuguegarao	AWS	15 min	-	17° 38' 52"N	121° 45' 30" E	73.00	PAGASA (AWS)	Capital Hills, Tuguegarao, Cagayan
11	Banawe	AWS	15 min	-	16° 55' 52"N	121° 03' 02" E	1,506.00	PAGASA (AWS)	Hiwang Gohang, Banawe, Ifugao
12	RPC - Baler	AWS	15 min	-	15° 48' 21"N	121° 32' 36" E	12.00	PAGASA (KOICA)	RPC Compound, Bgy.Buhangin, Baler, Aurora
13	Casiguran	AWS	15 min	-	16° 15' 56"N	122° 07' 44" E	3.00	PAGASA (KOICA)	Bgy.Gulod Casiguran, Aurora
14	Aparri	Synoptic	Daily	-	-	-	-	PAGASA (Synoptic)	
15	Tuguegarao	Synoptic	Daily	-	-	-	-	PAGASA (Synoptic)	
16	Magat Damsite	ARG	Hourly	1993 - Present	16° 49' 55"N	121° 30' 14" E	122.86	NIA	Ozcariz, Ramon, Isabela
17	Dumayup	ARG	Hourly	1993 - Present	16° 34' 28"N	121° 16' 22" E	265.20	NIA	Dumayup, Bagabag, Nueva Viscaya
18	Halong	ARG	Hourly	1993 - Present	16° 51' 53"N	121° 03' 32" E	1,266.00	NIA	Mt.Halong, Halong Banaue, Ifugao
19	Santo Domingo	ARG	Hourly	1993 - Present	16° 26' 05"N	121° 07' 01" E	348.50	NIA	Bato Ferry Bridge, Bayombong, Nueva Viscaya
20	Buyoc	ARG	Hourly	1993 - 2009	16° 44' 42"N	121° 11' 37" E	655.00	NIA	Mt Buyoc, Nayon Lamok, Ifugao
21	Dantor	ARG	Hourly	1993 - 2006	16° 56' 46"N	121° 12' 08" E	811.58	NIA	Junction Mapaway, Mayapyap, Ifugao
22	Sta.Ana	AWS	15 min	-	18° 27' 25"N	122° 08' 36" E	13.00	ASTI (NOAH)	Municipal Grounds, Sta.Ana, Cagayan
23	Diffun	AWS	15 min	-	16° 36' 14"N	121° 30' 30" E	135.00	ASTI (NOAH)	Quirino State College, Diffun, Quirino

24	Divilcan	AWS	15 min	-	17° 19' 42"N	122° 17' 46" E	-	ASTI (NOAH)	Divilcan, Isabela
25	Dinalungan	AWS	15 min	-	16° 08' 43"N	121° 57' 23" E	12.00	ASTI (NOAH)	Dinalungan National High School, Dinalungan,
26	Bontoc	AWS	15 min	-	17° 05' 24"N	120° 58' 39" E	-	ASTI (NOAH)	Government Center, Bontoc, Mt.Province
27	Lamut	ARG	15 min	-	16° 42' 58"N	121° 10' 18" E	-	ASTI (NOAH)	Ifugao State University, Nayon, Lamut, Ifugao
28	Bulanao	ARG	15 min	-	17° 24' 02"N	121° 26' 19" E	-	ASTI (NOAH)	Agromet Site of Kalinga Apayao State College (KASC), Bulanao, Kalinga
29	Carig Sur	ARG	15 min	-	17° 39' 07"N	121° 45' 14" E	-	ASTI (NOAH)	DOST RO2 Cmpd., Tuguegarao City
30	Echague	ARG	15 min	-	16° 43' 00"N	121° 41' 00" E	-	ASTI (NOAH)	CVARRD Complex ISU-Echague Compound Echague, Isabera
31	Santiago	ARG	15 min	-	16° 42' 00"N	121° 33' 00" E	-	ASTI (NOAH)	LGU Compaund, Santiago City, Isabela
32	Cauayan	ARG	15 min	-	16° 56' 00"N	121° 46' 00" E	-	ASTI (NOAH)	LGU Compaund, San Pablo, Cauayan City
33	Iligan	ARG	15 min	-	17° 08' 00"N	121° 53' 00" E	-	ASTI (NOAH)	LGU Compaund, Iligan, Isabela
34	Maddela	ARG	15 min	-	17° 08' 24"N	121° 42' 04" E	-	ASTI (NOAH)	Maddela Institute of Technology, Maddela Quirino
35	Dupax del Norte	ARG	15 min	-	16° 20' 00"N	121° 06' 00" E	-	ASTI (NOAH)	Bgy.Holywood (Private), Depax Del Norte, Nueva
36	Camalaniugan	ARG	15 min	-	18° 16' 05"N	121° 40' 59" E	-	ASTI (NOAH)	Camalaniugan, Cagayan
37	Asipulo	ARG	Hourly	Plan	16° 43' 14"N	121° 04' 10" E	994.00	NIA (NORAD)	
38	Bambang 1	ARG	Hourly	Plan	16° 25' 15"N	121° 00' 06" E	1,181.00	NIA (NORAD)	
39	Bambang 2	ARG	Hourly	Plan	16° 23' 43"N	121° 11' 47" E	530.00	NIA (NORAD)	
40	Bunhian	ARG	Hourly	Plan	16° 58' 33"N	121° 20' 07" E	984.00	NIA (NORAD)	
41	Dantor	ARG	Hourly	Plan	16° 00' 00"N	121° 00' 00" E	418.00	NIA (NORAD)	
42	Diadi	ARG	Hourly	Plan	16° 38' 57"N	121° 21' 19" E	236.00	NIA (NORAD)	
43	Lagawe 2	ARG	Hourly	Plan	16° 49' 37"N	121° 12' 38" E	587.00	NIA (NORAD)	
44	Pingkian	ARG	Hourly	Plan	16° 20' 01"N	120° 56' 07" E	598.00	NIA (NORAD)	
45	Santiago	ARG	Hourly	Plan	16° 46' 14"N	121° 23' 27" E	258.00	NIA (NORAD)	
46	Solano	ARG	Hourly	Plan	16° 31' 13"N	121° 11' 20" E	257.00	NIA (NORAD)	
47	Villaverde	ARG	Hourly	Plan	16° 36' 16"N	121° 09' 22" E	287.00	NIA (NORAD)	
48	Ambaguio Bridge	ARG	Hourly	Plan	16° 31' 37"N	121° 03' 08" E	540.00	NIA (NORAD)	
49	Aurora Bridge	ARG	Hourly	Plan	16° 58' 23"N	121° 39' 26" E	50.00	NIA (NORAD)	
50	Baretbet Bridge	ARG	Hourly	Plan	16° 34' 59"N	121° 16' 11" E	258.00	NIA (NORAD)	
51	Lagawe 1	ARG	Hourly	Plan	16° 46' 59"N	121° 08' 04" E	431.00	NIA (NORAD)	
52	Lamo Bridge	ARG	Hourly	Plan	16° 20' 12"N	121° 06' 31" E	397.00	NIA (NORAD)	
53	Lamut Bridge	ARG	Hourly	Plan	16° 38' 52"N	121° 13' 28" E	259.00	NIA (NORAD)	
54	Mayoyao	ARG	Hourly	Plan	16° 54' 51"N	121° 10' 02" E	595.00	NIA (NORAD)	
55	Naguilian Bridge	ARG	Hourly	Plan	17° 00' 22"N	121° 49' 57" E	33.00	NIA (NORAD)	
56	Runruno	ARG	Hourly	Plan	16° 28' 02"N	121° 19' 39" E	377.00	NIA (NORAD)	
57	Tubo Bridge	ARG	Hourly	Plan	16° 19' 11"N	121° 17' 48" E	762.00	NIA (NORAD)	
58	Kabugao	ARG	15 min	Plan	18° 01' 26"N	121° 10' 59" E	-	ASTI (NOAH)	Kabugao, Apayao
59	Conner	ARG	15 min	Plan	17° 47' 42"N	121° 19' 19" E	-	ASTI (NOAH)	Conner, Apayao
60	Paracelis	ARG	15 min	Plan	17° 10' 52"N	121° 24' 14" E	-	ASTI (NOAH)	Paracelis, Mt.Province
61	Mt.Data	ARG	15 min	Plan	16° 51' 14"N	120° 51' 25" E	-	ASTI (NOAH)	Mt.Data, Mt.Province

62	Banaue	ARG	15 min	Plan	16° 54' 50"N	121° 03' 36" E	-	ASTI (NOAH)	Banaue, Ifugao
63	Besao	ARG	15 min	Plan	17° 05' 42"N	120° 51' 25" E	-	ASTI (NOAH)	Besao, Mt.Province
64	Malibcong	ARG	15 min	Plan	17° 33' 47"N	120° 59' 24" E	-	ASTI (NOAH)	Malibcong, Abra
65	Masoc	AWS	15 min	Plan	16° 28' 18"N	121° 08' 33" E	-	ASTI (NOAH)	Masoc, Bayombong, Nueva Vizcaya, Cagayan Valley Campus
66	Masoc	ARG	15 min	Plan	16° 28' 18"N	121° 08' 33" E	-	ASTI (NOAH)	Masoc, Bayombong, Nueva Vizcaya, Cagayan Valley Campus
67									
68									

Note : PAGASA (FFWS) is existing FFWS network under PAGASA Hydrometeorological Division
PAGASA (AWS), PAGASA (KOICA), and PAGASA (Synoptic) is under PAGASA Regional Services Division

Water Level

No.	Station Name	Data Type	Duration of Record	Location		Catchment Area (km^2)	Agency	Address
				Latitude	Longitude			
1	Tuguegarao	Hourly	1982 - Present	17° 36' 56"N	121° 41' 25" E	-	PAGASA (FFWS)	Buntun Bridge, Tuguegarao, Cagayan
2	Tumauini	Hourly	1982 - Present	17° 16' 26"N	121° 47' 56" E	-	PAGASA (FFWS)	Poblacion, Tumauini, Isabela
3	Gamu	Hourly	1982 - Present	17° 04' 18"N	121° 50' 32" E	-	PAGASA (FFWS)	Gamu, Isabela
4	Maris Dam	Hourly	1982 - Present	16° 50' 20"N	121° 30' 50" E	-	PAGASA (FFWS)	Oscariz, Ramon, Isabela
5	Pangat	Hourly	1982 - Present	16° 36' 37"N	121° 40' 50" E	-	PAGASA (FFWS)	Pangal, Echague, Isabela
6	Baretbet	Hourly	2008 - Present	16° 35' 00"N	121° 15' 00" E	-	NIA	Bagabag, Nueva Vizcaya
7	Santo Domingo	Hourly	1999 - Present	16° 26' 05"N	121° 07' 01" E	-	NIA	Bato Ferry Bridge, Bayombong, Nueva Viscaya
8	Ibulao	Hourly	2008 - Present	-	-	-	NIA	Ibulao Bridge, Lagawe, Ifugao
9	Kiangan						NIA	
10	Imugan						NIA	
11	Dupax del Norte						NIA	
12	Banaga						NIA	
13	Magat Dam	Daily	1983 - Present	16° 50' 00"N	121° 27' 02" E	4,143	NIA	Ozcariz, Ramon, Isabela
14	Maris Dam	Daily	1983 - Present	16° 50' 20"N	121° 30' 50" E	4,161	NIA	Ozcariz, Ramon, Isabela
15	Buntun Bridge	10 min	-	17° 36' 50"N	121° 41' 26" E	-	ASTI (NOAH)	Buntun Bridge, Bgy.Buntun, Tuguegarao
16	Ambaguio Bridge	Hourly	Plan	16° 31' 37"N	121° 03' 08" E	-	NIA (NORAD)	
17	Aurora Bridge	Hourly	Plan	16° 58' 23"N	121° 39' 26" E	-	NIA (NORAD)	
18	Baretbet Bridge	Hourly	Plan	16° 34' 59"N	121° 16' 11" E	-	NIA (NORAD)	
19	Lagawe 1	Hourly	Plan	16° 46' 59"N	121° 08' 04" E	-	NIA (NORAD)	
20	Lamo Bridge	Hourly	Plan	16° 20' 12"N	121° 06' 31" E	-	NIA (NORAD)	
21	Lamut Bridge	Hourly	Plan	16° 38' 52"N	121° 13' 28" E	-	NIA (NORAD)	
22	Mayoyao	Hourly	Plan	16° 54' 51"N	121° 10' 02" E	-	NIA (NORAD)	
23	Naguilian Bridge	Hourly	Plan	17° 00' 22"N	121° 49' 57" E	-	NIA (NORAD)	
24	Runruno	Hourly	Plan	16° 28' 02"N	121° 19' 39" E	-	NIA (NORAD)	
25	Tubo Bridge	Hourly	Plan	16° 19' 11"N	121° 17' 48" E	-	NIA (NORAD)	

26	Aluling Bridge	10 min	Plan	-	-	-	ASTI (NOAH)	Aluling Bridge, Mt.Province
27	Chico Karayan Bridge	10 min	Plan	17° 05' 32"N	121° 24' 56" E	-	ASTI (NOAH)	Chico Karayan Bridge, Paracelis, Mt.Province
28	Canao Bridge	10 min	Plan	17° 23' 45"N	121° 19' 17" E	-	ASTI (NOAH)	Canao Bridge, Tabuk, Kalinga
29	Masablang Bridge	10 min	Plan	17° 06' 50"N	121° 01' 38" E	-	ASTI (NOAH)	Masablang Bridge, Paracelis, Mt.Province
30	Ibulao Bridge	10 min	Plan	16° 47' 02"N	121° 07' 16" E	-	ASTI (NOAH)	Ibulao Bridge, Kiangan, Ifugao
31								
32								
33								

Note : PAGASA (FFWS) is existing FFWS network under PAGASA Hydrometeorological Division

Discharge Measurement

No.	Station Name	Duration of Record	Location		No. of Record	Agency
			Latitude	Longitude		
1	Gamu	2001 - 2009	17° 04' 18"N	121° 50' 32" E	64	DPWH
2						
3						
4						
5						

River Cross Section Data

No.	Distance of Survey	Survey Year	No. of Data	Agency
1	Magat River (Maris Dam - Confluence with Cagayan River), 47.5 km	2010	47	NIA
2				
3				
4				

Current Status of Utilization of Flood Runoff Models

No.02 Agno River Basin, Catchment Area : 5,952 km^2

Availability of Flood Runoff Model: (Available) · Not Available

Description of Model

1. Name of Model : Agno River Basin Flood Forecasting Program (Storage Function Method), developed by "The Project for Strengthening Flood Forecasting and Warning System for Dam Operation", JICA (2012)
   Target Area : Upper Agno River Basin, Upstream of Ambuklao, Binga, and San Roque dam to before junction with Tarlac River (5,113 km^2, 43% of whole River Basin)
   Basin Rainfall : Using 10 telemeter rainfall statons, estimated by Thiessen's polygon method and elevation conversion factor
2. Name of Model :
   Target Area :
   Basin Rainfall :

Available Data for Development and Modification of Flood Runoff Model

Rainfall

No.	Station Name	Station Type	Data Type	Duration of Record	Location		Elevation (El.m)	Agency	Address
					Latitude	Longitude			
1	Mt.Ampucao (NPC)	ARG	Hourly	1991 - Present	16° 19' 49"N	120° 39' 43" E	1,437.00		Ampucao, Benguet
	Mt.Ampucao (NIA)								
2	Sta.Barbara	ARG	Hourly	1983 - Present	16° 00' 19"N	120° 24' 09" E	8.00	PAGASA (FFWS)	Poblacion Norte, Sta Barbara, Pangasinan
3	Carmen	ARG	Hourly	1993 - Present	15° 53' 24"N	120° 35' 34" E	24.00	PAGASA (FFWS)	Sison Bridge, Puelay, Villasis, Pangasinan
4	San Vicente (Wawa)	ARG	Hourly	1993 - Present	15° 45' 27"N	120° 26' 48" E	19.00	PAGASA (FFWS)	Romulo Bridge, San Vicente, Bayambang
5	Tibag	ARG	Hourly	1993 - Present	15° 29' 06"N	120° 34' 13" E	50.00	PAGASA (FFWS)	Agana Bridge, Bgy.Tibag, Tarlac
6	Sta.Maria	ARG	Hourly	2011 - Present	15° 58' 58"N	120° 41' 32" E	46.40	PAGASA (FFWS)	Narciso Ramos Bridge, Sta Maria, Pangasinan
7	Binalonan	ARG	Hourly	2011 - Present	16° 02' 48"N	120° 35' 38" E	51.00	PAGASA (FFWS)	CP Primicias Bridge, Poblacion, Binalonan,
8	Mapandan	ARG	Hourly	2011 - Present	16° 01' 48"N	120° 27' 27" E	24.00	PAGASA (FFWS)	Don Cezar M. Calimlim Mem Bridge, Mapandan
9	Bugallon (Banaga)	ARG	Hourly	2011 - Present	15° 59' 17"N	120° 13' 33" E	5.20	PAGASA (FFWS)	Banaga Bridge, Bugallon, Pangasinan
10	Maasin	ARG	Hourly	2011 - Present	15° 40' 02"N	120° 19' 55" E	120.00	PAGASA (FFWS)	Maasin Elementary School, Tarlac
11	Camp O'donnell	ARG	Hourly	2011 - Present	-	-	-	PAGASA (FFWS)	
12	Ambuklao	ARG	Hourly	1992 - Present	16° 27' 36"N	120° 44' 24" E	750.00	NPC	
13	Binga	ARG	Hourly	1992 - Present	16° 23' 24"N	120° 43' 12" E	480.00	NPC	
14	San Roque	ARG	Hourly	2002 - Present	16° 07' 37"N	120° 41' 07" E	98.00	NPC	
15	Badayan	ARG	Hourly	1992 - Present	16° 45' 36"N	120° 49' 48" E	1,580.00	NPC	
16	Apunan	ARG	Hourly	1992 - Present	16° 34' 12"N	120° 49' 12" E	1,162.00	NPC	
17	Bobok	ARG	Hourly	1992 - Present	16° 27' 00"N	120° 49' 12" E	1,360.00	NPC	
18	La Trinidad	ARG	15 min	-	16° 27' 40"N	120° 35' 18" E	-	ASTI (NOAH)	DOST Regional Office, Km6, La Trinidad, Benguet
19	Irisan	ARG	15 min	-	16° 25' 09"N	120° 33' 26" E	-	ASTI (NOAH)	Irisan, Baguio City
20	Alfonso Castaneda	ARG	15 min	-	16° 01' 25"N	120° 49' 00" E	-	ASTI (NOAH)	Alfonso Castaneda, Nueva Vizcaya

21	PSU Sta.Maria Campu	ARG	15 min	-	15° 57' 08"N	120° 40' 50" E	-	ASTI	PSU Sta.Maria Campus, Bgy.Cuangao, Sta.Maria, Pangasinan
22	Dagupan City	AWS	15 min	-	16° 02' 37"N	120° 20' 35" E	-	ASTI (NOAH)	Tondaligan Park, Dagupan City, Pangasinan
23	Baguio	Synoptic	Daily	-	-	-	-	PAGASA (Synoptic)	
24	Dagupan	Synoptic	Daily	-	-	-	-	PAGASA (Synoptic)	
25	BSU - La Trinidad	AWS	15 min	-	16° 26' 55"N	120° 35' 27" E	1,323.00	PAGASA (AWS)	BSU Campus, La Trinidad, Benguet
26	Atok	AWS	15 min	-	16° 37' 38"N	120° 45' 18" E	2,411.00	PAGASA (AWS)	Municipal Nursery Atok, Benguet
27	TCA - Camiling	AWS	15 min	-	15° 38' 12"N	120° 24' 57" E	41.00	PAGASA (AWS)	Tarlac College of Agriculture, Camiling, Tarlac
28	Ambassador	ARG	15 min	-	16° 29' 32"N	120° 37' 26" E	-	PAGASA (ARG)	Ambassador, Benguet
29	Tavora East	ARG	15 min	-	16° 19' 30"N	120° 27' 47" E	-	PAGASA (ARG)	Tavora East, Pugo, La Union
30	Mt.Data	ARG	15 min	Plan	16° 51' 14"N	120° 51' 25" E	-	ASTI (NOAH)	Mt.Data, Mt.Province
31	Bakun	ARG	15 min	Plan	16° 43' 19"N	120° 46' 59" E	-	ASTI (NOAH)	Bakun, Benguet
32	Atok	ARG	15 min	Plan	16° 37' 37"N	120° 46' 01" E	-	ASTI (NOAH)	Atok, Benguet
33	Bokod	ARG	15 min	Plan	16° 29' 28"N	120° 49' 52" E	-	ASTI (NOAH)	Bokod, Benguet
34	Tuba	ARG	15 min	Plan	16° 15' 54"N	120° 38' 13" E	-	ASTI (NOAH)	Tuba, Benguet
35	Kapangan	ARG	15 min	Plan	16° 34' 34"N	120° 36' 22" E	-	ASTI (NOAH)	Kapangan, Benguet
36	San Vicente	AWS	15 min	Plan	16° 24' 07"N	120° 35' 46" E	-	ASTI (NOAH)	San Vicente, Baguio City, Benguet, Cardillera Administrative Campus
37	San Vicente	ARG	15 min	Plan	16° 24' 07"N	120° 35' 46" E	-	ASTI (NOAH)	San Vicente, Baguio City, Benguet, Cardillera Administrative Campus
38									
39									
40									

Note : PAGASA (FFWS) is existing FFWS network under PAGASA Hydrometeorological Division
PAGASA (AWS), PAGASA (ARG), and PAGASA (Synoptic) is under PAGASA Regional Services Division

Water Level

No.	Station Name	Data Type	Duration of Record	Location		Catchment Area (km^2)	Agency	Address
				Latitude	Longitude			
1	Sta.Barbara	Hourly	1983 - Present	16° 00' 19"N	120° 24' 09" E	-	PAGASA (FFWS)	Poblacion Norte, Sta Barbara, Pangasinan
2	Bugallon (Banaga)	Hourly	1983 - Present	15° 59' 17"N	120° 13' 33" E	-	PAGASA (FFWS)	Banaga Bridge, Bugallon, Pangasinan
3	Carmen	Hourly	1983 - Present	15° 53' 24"N	120° 35' 34" E	-	PAGASA (FFWS)	Sison Bridge, Puelay, Villasis, Pangasinan
4	San Vicente (Wawa)	Hourly	1983 - Present	15° 45' 27"N	120° 26' 48" E	-	PAGASA (FFWS)	Romulo Bridge, San Vicente, Bayambang
5	Tibag	Hourly	1983 - Present	15° 29' 06"N	120° 34' 13" E	-	PAGASA (FFWS)	Agana Bridge, Bgy.Tibag, Tarlac
6	Sta.Maria	Hourly	2011 - Present	15° 58' 58"N	120° 41' 32" E	-	PAGASA (FFWS)	Narciso Ramos Bridge, Sta Maria, Pangasinan
7	Binalonan	Hourly	2011 - Present	16° 02' 48"N	120° 35' 38" E	-	PAGASA (FFWS)	CP Primicias Bridge, Poblacion, Binalonan,
8	Mapandan	Hourly	2011 - Present	16° 01' 48"N	120° 27' 27" E	-	PAGASA (FFWS)	Don Cezar M. Calimlim Mem Bridge, Mapandan
9	Ambuklao Dam	Daily	1990 - Present	16° 27' 40"N	120° 44' 38" E	690	NPC	
10	Binga Dam	Daily	1990 - Present	16° 23' 46"N	120° 43' 36" E	936	NPC	
11	San Roque Dam	Daily	2003 - Present	-	-	1,250	NPC	

12	Lao Bridge	10 min	Plan	16° 47' 35"N	120° 49' 44" E	-	ASTI (NOAH)	Lao Bridge, Buguias, Benguet
13	Camp 6 Bridge	10 min	Plan	16° 21' 00"N	120° 36' 47" E	-	ASTI (NOAH)	Camp 6 Bridge, Tuba, Benguet
14								
15								
16								
17								
18								

Note : PAGASA (FFWS) is existing FFWS network under PAGASA Hydrometeorological Division

Discharge Measurement

No.	Station Name	Duration of Record	Location		No. of Record	Agency
			Latitude	Longitude		
1	Carmen	1990 - 2001	15° 53' 24"N	120° 35' 34" E	29	PAGASA
2	Wawa	1992 - 2001	15° 45' 27"N	120° 26' 48" E	13	PAGASA
3	Tibag	1993, 2001	15° 29' 06"N	120° 34' 13" E	2	PAGASA
4	Sta.Barbara	1992 - 2001	16° 00' 19"N	120° 24' 09" E	15	PAGASA
5						

River Cross Section Data

No.	Distance of Survey	Survey Year	No. of Data	Agency
1	Agno River: Casaratan Bridge - Wawa Bridge (60.65km)	1993	311	DPWH
2	Poponto Floodway (10.76km)	1993	41	DPWH
3	Tolongan River (0.97km)	1993	4	DPWH
4	Bakit Bakit River (1.68km)	1993	7	DPWH
5	Chico River (1.59km)	1993	6	DPWH
6	Lagasit River (2.43km)	1993	5	DPWH
7	Tarlac River, before junction with Agno River - Tarlac City (41.6 km)	2002	37	DPWH
8	Agno River: San Roque Dam - Wawa Bridge (67.60km)	2010	48	PAGASA
9				

Current Status of Utilization of Flood Runoff Models

No.03 Pampanga River Basin, Catchment Area : 10,540 km^2

Availability of Flood Runoff Model: (Available) · Not Available

Description of Model

1. Name of Model : Upper Pampanga and Angat River Basin Flood Forecasting Program (Storage Function Method), developed by "The Project for Strengthening Flood Forecasting and Warning System for Dam Operation", JICA (2012)
   Target Area : 1) Upper Pampanga River Basin, Upstream of Pantabangan dam to Mayapyap WLGS including Casecnan River Basin, and 2) Angat River Basin, Upstream of Angat Dam to Tibag including Umiray River Basin (4,213 km^2, 40% of whole River Basin)
   Basin Rainfall : Using 12 telemeter rainfall statons for Upper Pampanga River Basin Model and 7 telemeter rainfall stations for Angat River Basin Model, estimated by Thiessen's polygon method and elevation conversion factor
2. Name of Model : IFAS (Integrated Flood Analysis System), developed by ICHARM
   Target Area : Whole Pampanga River Basin
   Basin Rainfall : Using satelllite rainfall data (3B42RT, GSMap, Qmorph, Cmorph, etc.) or ground rainfall stations

Available Data for Development and Modification of Flood Runoff Model

Rainfall

No.	Station Name	Station Type	Data Type	Duration of Record	Location		Elevation (El.m)	Agency	Address
					Latitude	Longitude			
1	Gabaldon	ARG	Hourly	1986 - Present	15° 29' 55"N	121° 21' 20" E	500.00	PAGASA (FFWS)	
2	Sapang Buho	ARG	Hourly	1973 - Present	15° 35' 39"N	121° 07' 09" E	62.00	PAGASA (FFWS)	Sapang Buho, Palayan City, Nueva Ecija
3	Mayapyap	ARG	Hourly	1988 - Present	15° 30' 52"N	120° 57' 20" E	36.00	PAGASA (FFWS)	Mayapyap Sur, Cabanatuan City, Nueva Ecija
4	Munoz	ARG	Hourly	1986 - Present	15° 44' 17"N	120° 57' 38" E	76.00	PAGASA (FFWS)	Phil. Carabao Center, Muñoz, Nueva Ecija
5	San Isidro	ARG	Hourly	1973 - Present	15° 18' 49"N	120° 54' 09" E	7.00	PAGASA (FFWS)	Poblacion, San Isidro, Nueva Ecija
6	Arayat	ARG	Hourly	1973 - Present	15° 10' 06"N	120° 46' 56" E	9.00	PAGASA (FFWS)	San Agustin Norte, Pampanga
7	Candaba	ARG	Hourly	1973 - Present	15° 06' 56"N	120° 51' 15" E	3.00	PAGASA (FFWS)	Ducma, Candaba, Pampanga
8	Zaragoza	ARG	Hourly	1973 - Present	15° 26' 36"N	120° 45' 03" E	15.00	PAGASA (FFWS)	San Roque, La Paz, Tarlac
9	Sulipan	ARG	Hourly	1973 - Present	14° 56' 21"N	120° 45' 39" E	3.00	PAGASA (FFWS)	Sulipan, Apalit, Pampanga
10	Papaya	ARG	Hourly	1973 - Present	15° 21' 17"N	121° 03' 56" E	48.00	PAGASA (FFWS)	
11	Sibul Spring	ARG	Hourly	1973 - Present	15° 10' 05"N	121° 03' 33" E	40.00	PAGASA (FFWS)	Sibul Spring, San Miguel Bulacan
12	Sasmuan	ARG	Hourly	1974 - Present	14° 56' 17"N	120° 37' 23" E	2.00	PAGASA (FFWS)	Sta Lucia Plaza, Sasmuan, Pampanga
13	San Rafael	ARG	Hourly	1973 - Present	14° 58' 05"N	120° 54' 52" E	2.00	PAGASA (FFWS)	NIA Region 3 Motor Pool comp., Sabang, Baliwag
14	Palali	ARG	Hourly	2009 - Present	15° 22' 50"N	121° 09' 41" E	229.50	PAGASA (FFWS)	NE Stock Farm, Brgy. Nazareth, Gen Tinio, Nueva
15	Penaranda	ARG	Hourly	2009 - Present	15° 21' 14"N	121° 00' 20" E	33.00	PAGASA (FFWS)	Barangay Poblacion I, Penaranda, Nueva Ecija
16	Calaanan	ARG	Hourly	2009 - Present	15° 38' 54"N	121° 11' 09" E	112.40	PAGASA (FFWS)	E. Pesa Elementary School, Bongabon, NE
17	Mexico	ARG	Hourly	2009 - Present	15° 04' 05"N	120° 43' 51" E	10.50	PAGASA (FFWS)	Brgy. Sto Rosario, Mexico, Pampanga
18	Porac	ARG	Hourly	2009 - Present	15° 04' 49"N	120° 32' 44" E	100.00	PAGASA (FFWS)	TESDA training Center, Brgy. Cangatba, Porac
19	Cabanatuan	Synoptic	Daily	-	-	-	-	PAGASA (Synoptic)	
20	Clark	Synoptic	Daily	-	-	-	-	PAGASA (Synoptic)	
21	Dingalan	AWS	15 min	-	15° 23' 27"N	121° 23' 18" E	-	ASTI (NOAH)	Dingalan Central School, Dingalan, Aurora

22	Magalang	AWS	15 min	-	15° 13' 15"N	120° 41' 39" E	-	ASTI (NOAH)	Pampanga Agricultural College (PAC), Magalang, Pampanga
23	Cabanatuan City	AWS	15 min	-	15° 29' 35"N	120° 58' 16" E	-	ASTI (NOAH)	PAGASA station, Cabanatuan City
24	BASC - San Ildefonso	AWS	15 min	-	14° 48' 51"N	121° 03' 25" E	76.00	PAGASA (AWS)	BASC Campus, San Ildefonso, Bulacan
25	CLSU - Munoz	AWS	15 min	-	15° 04' 10"N	120° 56' 05" E	78.00	PAGASA (AWS)	CLSU Campus, Munoz, Nueva Ecija
26	Angat	AWS	15 min	-	14° 54' 11"N	121° 09' 18" E	231.00	PAGASA (AWS)	NPC Compound Angat, Bulacan
27	Angat	ARG	15 min	-	14° 57' 08"N	121° 01' 40" E	-	PAGASA (ARG)	Angat
28	Sapang Palay	ARG	15 min	-	14° 50' 18"N	121° 02' 42" E	-	PAGASA (ARG)	Sapang Palay, San Jose Del Monte
29	San Ildefonso	ARG	15 min	-	15° 02' 50"N	121° 01' 40" E	-	PAGASA (ARG)	San Ildefonso
30	San Miguel	ARG	15 min	-	15° 13' 04"N	121° 03' 46" E	-	PAGASA (ARG)	San Miguel
31	Dona Remedios	ARG	15 min	-	14° 58' 15"N	121° 03' 52" E	-	PAGASA (ARG)	Dona Remedios, Trinidad
32	San Isidro	ARG	15 min	-	14° 49' 26"N	121° 07' 48" E	-	PAGASA (ARG)	San Isidro, San Jose Del Monte
33	Floridablanca	ARG	15 min	-	14° 56' 52"N	120° 29' 43" E	-	PAGASA (ARG)	Floridablanca
34	Magalang	ARG	15 min	-	15° 12' 52"N	120° 39' 43" E	-	PAGASA (ARG)	Magalang
35	Sta.Rita	ARG	15 min	-	14° 57' 30"N	120° 35' 24" E	-	PAGASA (ARG)	Sta.Rita
36	Masantol	ARG	15 min	-	14° 51' 08"N	120° 40' 39" E	-	PAGASA (ARG)	Masantol
37	Sto.Tomas	ARG	15 min	-	14° 59' 00"N	120° 42' 06" E	-	PAGASA (ARG)	Sto.Tomas
38	Mabalacat	ARG	15 min	-	15° 14' 19"N	120° 34' 06" E	-	PAGASA (ARG)	Mabalacat
39	Bunga	ARG	1 hour	-	16° 00' 00"N	121° 02' 35" E	282.00	NIA	Tubong Bunga Caranglan, Nueva Ecija
40	Conversion	ARG	1 hour	-	15° 53' 54"N	121° 07' 38" E	267.00	NIA	
41	Abuyo	ARG	1 hour	-	15° 50' 53"N	121° 13' 48" E	264.00	NIA	
42	Marikit	ARG	1 hour	-	15° 47' 55"N	121° 16' 32" E	405.00	NIA	Marikit, Castaneda, Nueva Ecija
43	Pantabangan	ARG	1 hour	-	15° 48' 43"N	121° 05' 44" E	290.00	NIA	Pantabangan, Nueva Ecija
44	Angat	ARG	1 hour	-	14° 54' 25"N	121° 09' 10" E	350.00	NPC	Angat Dam Site, Norzagaray, Bulacan
45	Talaguio	ARG	1 hour	-	15° 02' 09"N	121° 10' 05" E	670.00	NPC	Talaguio Angat Dam Basin Area, Bulacan
46	Matulid	ARG	1 hour	-	14° 54' 51"N	121° 15' 17" E	560.00	NPC	Matulid, Angat Dam Area, Bulacan
47	Maputi	ARG	1 hour	-	15° 04' 15"N	121° 15' 15" E	740.00	NPC	Maputi, Angat Dam Basin Area, Bulacan
48	Norzagaray	AWS	15 min	Plan	-	-	-	ASTI (NOAH)	Norzagaray, Bulacan
49	Norzagaray	ARG	15 min	Plan	-	-	-	ASTI (NOAH)	Norzagaray, Bulacan
50	Clark Free Port Zone	AWS	15 min	Plan	15° 11' 07"N	120° 32' 22" E	-	ASTI (NOAH)	Clark Free Port Zone, Pampanga, Central Luzon
51	Clark Free Port Zone	ARG	15 min	Plan	15° 11' 07"N	120° 32' 22" E	-	ASTI (NOAH)	Clark Free Port Zone, Pampanga, Central Luzon
52									

Note : PAGASA (FFWS) is existing FFWS network under PAGASA Hydrometeorological Division
PAGASA (AWS), PAGASA (ARG), and PAGASA (Synoptic) is under PAGASA Regional Services Division

Water Level

No.	Station Name	Data Type	Duration of Record	Location		Catchment Area (km^2)	Agency	Address
				Latitude	Longitude			
1	Sapang Buho	Hourly	1973 - Present	15° 35' 39"N	121° 07' 09" E	-	PAGASA (FFWS)	Sapang Buho, Palayan City, Nueva Ecija
2	Mayapyap	Hourly	1974 - Present	15° 30' 52"N	120° 57' 20" E	-	PAGASA (FFWS)	Mayapyap Sur, Cabanatuan City, Nueva Ecija

3	Zaragoza	Hourly	1973 - Present	15° 26' 36"N	120° 45' 03" E	-	PAGASA (FFWS)	San Roque, La Paz, Tarlac
4	San Isidro	Hourly	1973 - Present	15° 18' 49"N	120° 54' 09" E	-	PAGASA (FFWS)	Poblacion, San Isidro, Nueva Ecija
5	Arayat	Hourly	1973 - Present	15° 10' 06"N	120° 46' 56" E	-	PAGASA (FFWS)	San Agustin Norte, Pampanga
6	Candaba	Hourly	1973 - Present	15° 06' 56"N	120° 51' 15" E	-	PAGASA (FFWS)	Ducma, Candaba, Pampanga
7	Sasmuan	Hourly	1974 - Present	14° 56' 17"N	120° 37' 23" E	-	PAGASA (FFWS)	Sta Lucia Plaza, Sasmuan, Pampanga
8	Sulipan	Hourly	1973 - Present	14° 56' 21"N	120° 45' 39" E	-	PAGASA (FFWS)	Sulipan, Apalit, Pampanga
9	Penaranda	Hourly	2009 - Present	15° 21' 14"N	121° 00' 20" E	-	PAGASA (FFWS)	Barangay Poblacion I, Penaranda, Nueva Ecija
10	Mexico	Hourly	2009 - Present	15° 04' 05"N	120° 43' 51" E	-	PAGASA (FFWS)	Brgy. Sto Rosario, Mexico, Pampanga
11	Masiway Dam		-				NIA	
12	Pantabangan Dam							
13	Plaridel-Pulilan Diversion Road	10 min	-	14° 53' 30"N	120° 52' 28" E	-	ASTI	Plaridel-Pulilan Diversion Road, Bulacan
14	M.Calte Road	10 min	-	14° 56' 23"N	121° 01' 20" E	-	ASTI	M.Calte Rd., Angat
15	Norzagaray	10 min	-	14° 54' 37"N	121° 03' 04" E	-	ASTI	Norzagaray, Bulacan
16								

Note : PAGASA (FFWS) is existing FFWS network under PAGASA Hydrometeorological Division

Discharge Measurement

No.	Station Name	Duration of Record	Location		No. of Record	Agency
			Latitude	Longitude		
1	Sapang Buho	1991 - 2009	15° 35' 39"N	121° 07' 09" E	38	PAGASA
2	Mayapyap	1992 - 2009	15° 30' 52"N	120° 57' 20" E	35	PAGASA
3	San Isidro	1990 - 2009	15° 18' 49"N	120° 54' 09" E	37	PAGASA
4	Arayat	1990 - 2009	15° 10' 06"N	120° 46' 56" E	59	PAGASA
5	Slipan	1992 - 2004	14° 56' 21"N	120° 45' 39" E	26	PAGASA
6	Zaragoza	1990 - 2009	15° 26' 36"N	120° 45' 03" E	37	PAGASA
7	Norzagaray	1991 - 1997	14° 54' 37"N	121° 03' 04" E	23	PAGASA
8						

River Cross Section Data

No.	Distance of Survey	Survey Year	No. of Data	Agency
1	Pampanga River (Candaba Viaduct - Manila Bay), 44.22 km	1982	29	DPWH
2	Pampanga River (End of old Pampanga - Manila Bay), 22.72 km	1989	99	DPWH
3	Labangan Floodway, 16.95 km	1989	77	DPWH
4	New Bagbag Channel, 4.62 km	1989	24	DPWH
5	Pampanga River (Pantabangan Dam - San Isidro), 49.50 km	2010	56	PAGASA

6	Angat River (Ipo Dam - MacArthur Highway), 67.19 km	2010	78	PAGASA

Current Status of Utilization of Flood Runoff Models

No.04 Pasig-Laguna de Bay River Basin, Catchment Area : 5,125 km^2

Availability of Flood Runoff Model: (Available) · Not Available

Description of Model

1. Name of Model : HEC-HMS, modeled by University of Philippines (UP).
   Target Area : Pasig-Marikina River Basin (635 km^2, 12.4% of whole River Basin)
   Basin Rainfall : -
2. Name of Model :
   Target Area :
   Basin Rainfall :

Available Data for Development and Modification of Flood Runoff Model

Rainfall

No.	Station Name	Station Type	Data Type	Duration of Record	Location		Elevation (El.m)	Agency	Address
					Latitude	Longitude			
1	Tanauan, Batangas	AWS	15 min	-	14° 05' 16"N	121° 03' 45" E	-	ASTI (NOAH)	Tanauan, Batangas
2	Sangley Point	AWS	15 min	-	14° 29' 40"N	120° 53' 57" E	8.00	ASTI (NOAH)	Sangley Point, Cavite City
3	Bgy.Magsaysay	AWS	15 min	-	14° 33' 05"N	121° 28' 58" E	-	ASTI (NOAH)	Sition New Little Baguio, Bgy.Magsaysay, Infanta, Quezon
4	Tayabas	AWS	15 min	-	14° 01' 05"N	121° 35' 48" E	160.00	ASTI (NOAH)	PAGASA Station, Bgy.Lita, Tayabas, Quezon
5	QCPU	ARG	15 min	-	14° 42' 00"N	121° 02' 00" E	-	ASTI (NOAH)	Quirino Highway, Quezon City
6	Science Garden	ARG	15 min	-	14° 38' 42"N	121° 02' 40" E	43.00	ASTI (NOAH)	PAGASA Science Garden, Quezon City
7	Bgy.Ususan	ARG	15 min	-	14° 31' 49"N	121° 03' 38" E	-	ASTI	The Model House (Along C5), Cayetano Blvd., Bgy.Ususan, Taguig City
8	Muntinlupa	ARG	15 min	-	14° 23' 36"N	121° 03' 11" E	-	ASTI	New Bilibid Prison Compound, Bgy.Poblacion, Muntinlupa City
9	Sampaloc	ARG	15 min	-	14° 36' 39"N	120° 59' 39" E	-	ASTI	1170 E., Quintos Street, Sampaloc, Manila
10	Indang	ARG	15 min	-	14° 11' 52"N	120° 53' 01" E	278.00	ASTI (NOAH)	Agromet Compound, Cavite State University, Indang, Cavite
11	Sta.Cruz	ARG	15 min	-	14° 15' 19"N	121° 24' 27" E	-	ASTI	Laguna University, Bgy.Jasaan, Sta.Cruz, Laguna
12	Looc	ARG	15 min	-	14° 31' 03"N	121° 14' 08" E	-	ASTI	University of Rizal System, J.Sumulong Street, San Juan, Morong, Rizal
13	Part of Mt.Banahaw	ARG	15 min	-	14° 03' 10"N	121° 32' 23" E	-	ASTI	Part of Mt.Banahaw, Bgy.San Cristobal, Tayabas, Quezon
14	San Mateo-2	ARG	15 min	-	14° 41' 47"N	121° 06' 53" E	-	PAGASA (KOICA)	San Mateo, Rizal
15	Napindan-2	ARG	15 min	-	14° 33' 31"N	121° 04' 00" E	-	PAGASA (KOICA)	Napindan-2, San Juaquin Bridge
16	Guadanoville	ARG	15 min	-	14° 45' 00"N	121° 05' 02" E	-	PAGASA (KOICA)	Guadanoville, Caloocan City
17	NAIA (PAGASA)	ARG	15 min	-	14° 30' 21"N	121° 00' 17" E	-	PAGASA (KOICA)	Ninoy Aquino International Airport, PAGASA

18	Youth Camp	ARG	15 min	-	14° 38' 20"N	121° 05' 30" E	-	PAGASA (KOICA)	Youth Camp, Marikina
19	Cainta	ARG	15 min	-	14° 34' 49"N	121° 06' 52" E	-	PAGASA (KOICA)	Cainta, Rizal
20	Pasig City Hall	ARG	15 min	-	14° 33' 34"N	121° 04' 54" E	-	PAGASA (KOICA)	Pasig City Hall
21	Port Area Synop	ARG	15 min	-	14° 35' 18"N	120° 58' 04" E	-	PAGASA (KOICA)	Port Area Synop
22	Antipolo	ARG	15 min	-	14° 35' 10"N	121° 10' 16" E	-	PAGASA (KOICA)	Antopolo
23	La Mesa Dam	ARG	15 min	-	14° 42' 52"N	121° 04' 14" E	-	PAGASA (KOICA)	La Mesa Dam
24	Science Garden	ARG	15 min	-	14° 38' 38"N	121° 02' 39" E	43.00	PAGASA (KOICA)	Science Garden Comp. BIR Road, Quezon City
25	Nangka	ARG	15 min	2003 - present	14° 40' 31"N	121° 06' 27" E	-	MMDA (NOAH)	Near Nangka Bridge of Bgy.Ampid, San Mateo, Rizal
26	Mt.Oro	ARG	15 min	2002 - present	14° 45' 48"N	121° 09' 28" E	-	MMDA (NOAH)	Bgy.San Isidro 2.7 km North of Montalban, Rizal
27	Aries	ARG	15 min	2003 - present	14° 39' 46"N	121° 10' 08" E	-	MMDA (NOAH)	Northeast of Bgy.Pintong, San Mateo, Rizal
28	Boso Boso	ARG	15 min	2002 - present	14° 38' 24"N	121° 13' 23" E	-	MMDA (NOAH)	Near the Peak of Mt.Kayumayunan, Antipolo, Rizal
29	Mt.Campana	ARG	15 min	2003 - 2008	14° 40' 06"N	121° 17' 29" E	-	MMDA (NOAH)	Northeast of Bgy.Batangas, Antipolo, Rizal
30	Science Garden	ARG	15 min	2003 - present	14° 38' 45"N	121° 02' 35" E	-	MMDA (NOAH)	Science Garden Comp. BIR Road, Quezon City
31	Napindan	ARG	15 min	2003 - 2008	14° 33' 26"N	121° 04' 01" E	-	MMDA	Inside Napindan HCS compound, Bgy.Rembo, Makati City
32	UP - Los Banos	AWS	15 min	-	14° 10' 03"N	121° 14' 36" E	39.00	PAGASA (AWS)	UP Campus, Los Banos, Laguna
33	Tanay	AWS	15 min	-	14° 36' 42"N	121° 22' 06" E	522.00	PAGASA (TECO)	Mayagay, Sampaloc, Tanay, Rizal
34	Lipa	ARG	15 min	-	13° 56' 14"N	121° 12' 29" E	-	PAGASA (ARG)	Lipa, San Benito, Batangas
35	Dasmarinas	ARG	15 min	-	14° 19' 39"N	120° 56' 42" E	-	PAGASA (ARG)	Dasmarinas, Burol, Cavite
36	Calamba	ARG	15 min	-	14° 12' 11"N	121° 09' 50" E	-	PAGASA (ARG)	Calamba, NEC Topan 2
37	Sta.Maria	ARG	15 min	-	14° 28' 16"N	121° 24' 40" E	-	PAGASA (ARG)	Sta.Maria, Laguna
38	Bgy.Iyam	ARG	15 min	-	13° 56' 11"N	121° 35' 59" E	-	PAGASA (ARG)	Bgy.Iyam, Lucena
39	Sampaloc	ARG	15 min	-	14° 09' 57"N	121° 39' 14" E	-	PAGASA (ARG)	Sampaloc, Quezon
40	Tanay	ARG	15 min	-	14° 35' 54"N	121° 25' 44" E	-	PAGASA (ARG)	Tanay, Camp Capinpin
41	Science Garden	Synoptic	Daily	-	-	-	-	PAGASA (Synoptic)	
42	Port Area	Synoptic	Daily	-	-	-	-	PAGASA (Synoptic)	
43	NAIA	Synoptic	Daily	-	-	-	-	PAGASA (Synoptic)	
44									
45									

Note : MMDA (NOAH), and MMDA is existing FFWS network under MMDA
PAGASA (AWS), PAGASA (ARG), PAGASA (KOICA), and PAGASA (Synoptic) is under PAGASA Regional Services Division
TECO; Taipei Economic and Cultural Office

Water Level

No.	Station Name	Data Type	Duration of Record	Location		Catchment Area (km^2)	Agency	Address
				Latitude	Longitude			
1	Bgy.Rosario	10 min	-	14° 35' 25"N	121° 04' 59" E	-	ASTI	Ortigas Avenue Extension, Bgy.Rosario, Pasig City
2	G.Araneta Bridge	10 min	-	14° 36' 42"N	121° 01' 11" E	-	ASTI	G.Araneta Bridge, Araneta Ave., Bgy.Dona Imelda, Quezon City
3	Bgy.Tumana	10 min	-	14° 39' 23"N	121° 05' 47" E	-	ASTI	Bgy.Tumana, Marikina City

4	Del Monte Bridge	10 min	-	14° 37' 47"N	121° 00' 54" E	-	ASTI	Del Monte Bridge, Del Monte Ave., Bgy.Paligsahan, Quezon City
5	Bgy.Malinao	10 min	-	14° 33' 35"N	121° 04' 20" E	-	ASTI	F.Manalo St., Bgy.Malinao, Pasig City
6	Sto Nino	10 min	-	14° 38' 09"N	121° 05' 35" E	-	ASTI (NOAH)	Sto Nino Bridge, Marikina City
7	Bgy Santo Domingo	10 min	-	14° 37' 48"N	121° 00' 53" E	-	ASTI	Quezon Ave., Bgy Santo Domingo, Quezon City
8	Maria Clara St.	10 min	-	14° 37' 50"N	121° 00' 40" E	-	ASTI	Maria Clara St., Bgy.Santo Domingo & Talayan Boundary, Quezon City
9	Bgy.Kalusugan	10 min	-	14° 37' 10"N	121° 00' 59" E	-	ASTI	E.Rodriguez Ave., Bgy.Kalusugan, Quezon City
10	Salapan	10 min	-	14° 36' 32"N	121° 01' 19" E	-	ASTI	Aurora Blvd., Salapan, Quezon City
11	Sta.Mesa	10 min	-	14° 36' 06"N	121° 01' 13" E	-	ASTI	N.Domingo St., Sta.Mesa, Manila
12	Bgy.Pinagbuhatan	10 min	-	14° 33' 16"N	121° 05' 35" E	-	ASTI	M.H. del Pilar St., Bgy.Pinagbuhatan, Pasig City
13	Tripa de Gallina P/S	10 min	-	14° 31' 50"N	121° 00' 05" E	-	ASTI (NOAH)	Tripa de Gallina Pumping Station, Apollo 12 St., Pasay City, Manila
14	Bgy.Gen.T. de Leon	10 min	-	14° 43' 08"N	121° 02' 24" E	-	ASTI	Tullahan St., Bgy.Gen.T. de Leon, Valenzuela City
15	Bgy.Marulas	10 min	-	14° 40' 14"N	120° 58' 56" E	-	ASTI	McArther Highway, Bgy.Marulas, Valenzuela City
16	Bgy.Ugong	10 min	-	14° 41' 26"N	121° 01' 21" E	-	ASTI	Bgy.Ugong, Valenzuela City
17	Bgy.Tinejeros	10 min	-	14° 40' 31"N	120° 57' 52" E	-	ASTI	Bgy.Tinejeros, Valenzuela City
18	Bgy.Fairview	10 min	-	14° 42' 23"N	121° 03' 59" E	-	ASTI	Commonwealth Ave., Bgy.Fairview, Quezon City
19	Bgy.Tuktukan	10 min	-	14° 31' 40"N	121° 04' 17" E	-	ASTI	Bgy.Tuktukan, Taguig City
20	P.Tuazon Blvd., Project 4	10 min	-	14° 37' 20"N	121° 03' 54" E	-	ASTI	P.Tuazon Blvd., Project 4, Quezon City
21	Bgy.Loyola Heights	10 min	-	14° 38' 04"N	121° 04' 17" E	-	ASTI	Bgy.Loyola Heights, Quezon City
22	Bgy.Fortuna	10 min	-	14° 40' 08"N	121° 07' 43" E	-	ASTI	Bgy.Fortuna, Marikina City
23	Bgy.San Pedro	10 min	-	14° 32' 45"N	121° 03' 55" E	-	ASTI	B.Morcilla St., Bgy.San Pedro, Pateros
24	Bgy.Poblacion	10 min	-	14° 32' 30"N	121° 03' 45" E	-	ASTI	Bgy.Poblacion, Pateros
25	Bgy.Sta Ana	10 min	-	14° 31' 33"N	121° 04' 25" E	-	ASTI	Bgy.Sta Ana, Taguig City
26	Rosario Manggahan Bridge	10 min	-	14° 35' 25"N	121° 04' 59" E	-	ASTI	Rosario Manggahan Bridge, Pasig City
27	Napindan JS	10 min	-	14° 33' 29"N	121° 04' 06" E	-	ASTI (NOAH)	Napindan, Pasig City
28	Rodriguez	10 min	-	14° 43' 40"N	121° 11' 31" E	-	ASTI	C.Reyes St., Rodriguez, Rizal
29	San Mateo-1	10 min	-	14° 40' 46"N	121° 06' 35" E	-	PAGASA (KOICA)	San Mateo, Rizal
30	Burgos	10 min	-	14° 43' 19"N	121° 08' 40" E	-	PAGASA (KOICA)	Burgos
31	Tumana Bridge	10 min	-	14° 39' 23"N	121° 05' 47" E	-	PAGASA (KOICA)	Tumana Bridge, Marikina City
32	Sto Nino	10 min	-	14° 38' 09"N	121° 05' 35" E	-	PAGASA (KOICA)	Sto Nino Bridge, Marikina City
33	Marcos Highway	10 min	-	14° 37' 35"N	121° 04' 56" E	-	PAGASA (KOICA)	Marcos Highway
34	Rosario LS	10 min	-	14° 35' 25"N	121° 04' 59" E	-	PAGASA (KOICA)	Rosario
35	Rosario JS	10 min	-	14° 36' 14"N	121° 05' 21" E	-	PAGASA (KOICA)	Rosario
36	Napindan-1	10 min	-	14° 33' 14"N	121° 04' 34" E	-	PAGASA (KOICA)	Napindan, Pasig City
37	Napindan-2	10 min	-	14° 33' 31"N	121° 04' 00" E	-	PAGASA (KOICA)	Napindan, Pasig City
38	Mindanao	10 min	-	14° 40' 02"N	121° 02' 05" E	-	MMDA	
39	Montalban	10 min	2002 - present	14° 43' 41"N	121° 07' 55" E	-	MMDA (NOAH)	Near Amang Rodriguez Bridge, Montalban, Rizal
40	Nangka	10 min	2002 - present	14° 40' 26"N	121° 06' 34" E	-	MMDA (NOAH)	Near Nangka Bridge of Bgy.Ampid, San Mateo, Rizal

41	Wawa Dam	10 min	-	14° 43' 39"N	121° 11' 30" E	-	MMDA	
42	Fort Santiago	10 min	2002 - present	14° 35' 45"N	120° 58' 02" E	-	MMDA (NOAH)	Inside Fort Santiago Reservation, Port Area, Manila
43	Pandacan	10 min	2002 - present	14° 35' 40"N	121° 00' 45" E	-	MMDA (NOAH)	Inside Pandacan Independent Floodgate Compound
44	San Juan	10 min	2002 - present	14° 36' 06"N	121° 01' 13" E	-	MMDA (NOAH)	Inside San Juan Elementary School, Luna St.San Juan, Metro Manila
45	Sto Nino	10 min	2002 - present	14° 38' 17"N	121° 05' 35" E	-	MMDA (NOAH)	Left Bank of Malikina Bridge, Bgy.Sto.Nino, Malikina City
46	Angono	10 min	2002 - present	14° 31' 28"N	121° 08' 17" E	-	MMDA (NOAH)	Inside the Ruin of Mabuhay Resort House, Angono, Rizal
47	Napindan (Left side of the gate)	10 min	2002 - 2007	14° 33' 26"N	121° 04' 01" E	-	MMDA	Inside Napindan HCS compound, Brgy. Rembo, Makati City
48	Napindan (Junction side of the gate)	10 min	2002 - present	14° 33' 26"N	121° 04' 01" E	-	MMDA (NOAH)	Inside Napindan HCS compound, Brgy. Rembo, Makati City
49	Rosario (Left side of the gate)	10 min	2002 - present	-	-	-	MMDA	
50	Rosario (Junction side of the gate)	10 min	2002 - present	-	-	-	MMDA (NOAH)	
51								
52								

Note : MMDA (NOAH), and MMDA is existing FFWS network under MMDA

Discharge Measurement

No.	Station Name	Duration of Record	Location		No. of Record	Agency
			Latitude	Longitude		
1	Montalban	2002 - 2005	14° 43' 41"N	121° 07' 55" E	6	MMDA
2	Nangka	2004 - 2005	14° 40' 26"N	121° 06' 34" E	4	MMDA
3	Sto.Nino	2002 - 2005	14° 38' 17"N	121° 05' 35" E	6	MMDA
4	San Juan	2004	14° 36' 06"N	121° 01' 13" E	1	MMDA
5	Quezon Avenue Bridge	2004 - 2005	-	-	3	MMDA
6	E.Rodriguez Bridge	2004 - 2005	-	-	2	MMDA
7	Aurora Bridge	2004 - 2005	-	-	2	MMDA
8	Araneta Bridge	2004 - 2005	-	-	2	MMDA
9	N.Domingo Bridge	2004 - 2005	-	-	2	MMDA
10	Sevilla Bridge	2004 - 2005	-	-	2	MMDA
11	Marcos Highway Bridge	2004	-	-	3	MMDA
12	Rosario Bridge	2004	-	-	2	MMDA
13	Sandoval Bridge	2004	-	-	2	MMDA
14	Vargas Bridge	2004	-	-	2	MMDA
15	C-5 Bridge	2004	-	-	2	MMDA
16	Guadalupe Bridge	2004	-	-	2	MMDA
17	Makati Bridge	2004	-	-	2	MMDA
18	Pandacan Bridge	2004	-	-	1	MMDA

19	Nagtahan Bridge	2004	-	-	1	MMDA
20	Alaya Bridge	2004	-	-	1	MMDA
21	Quezon Bridge	2004	-	-	1	MMDA
22	McArther Bridge	2004	-	-	1	MMDA
23	Jones Bridge	2004	-	-	1	MMDA
24	Delpan Bridge	2004	-	-	1	MMDA
25	RMCS Bridge	2004	-	-	2	MMDA
26	Mandaluyong Bridge	2004	-	-	1	MMDA
27	Manalo Bridge	2004	-	-	1	MMDA
28						
29						

River Cross Section Data

No.	Distance of Survey	Survey Year	No. of Data	Agency
1	Meycauayan River, Manila Bay - Saog (13.3	2008	6	DPWH
2				
3				
4				

Current Status of Utilization of Flood Runoff Models

No.05 Bicol River Basin, Catchment Area : 3,771 km^2

Availability of Flood Runoff Model: Available · Not Available

Description of Model

1. Name of Model :
   Target Area :
   Basin Rainfall :
2. Name of Model :
   Target Area :
   Basin Rainfall :

Available Data for Development and Modification of Flood Runoff Model

Rainfall

No.	Station Name	Station Type	Data Type	Duration of Record	Location		Elevation (El.m)	Agency	Address
					Latitude	Longitude			
1	Camaligan	ARG	Hourly	-	13° 37' 16"N	123° 09' 41" E	2.00	PAGASA (FFWS)	San Mateo, Camaligan, Camarines Sur
2	Ombao	ARG	Hourly	-	13° 28' 29"N	123° 14' 29" E	53.00	PAGASA (FFWS)	Ombao, Bula, Camarines Sur
3	Ocampo	ARG	Hourly	-	13° 33' 26"N	123° 22' 20" E	53.00	PAGASA (FFWS)	Municipal Compound, Ocampo, Camarines Sur
4	Napolidan	ARG	Hourly	-	13° 53' 48"N	122° 55' 42" E	100.00	PAGASA (FFWS)	Napolidan, Lupi Viejo, Camarines Sur
5	Sipocot Gauging	ARG	Hourly	-	13° 46' 22"N	122° 58' 24" E	20.00	PAGASA (FFWS)	Azusena, Sipocot, Camarines Sur
6	Bato	ARG	Hourly	-	13° 21' 13"N	123° 21' 52" E	12.00	PAGASA (FFWS)	Divina Pastora, Bato, Camarines Sur
7	Ligao	ARG	Hourly	-	13° 14' 13"N	123° 32' 08" E	30.00	PAGASA (FFWS)	Sta. Cruz, Ligao, Albay
8	Buhi	ARG	Hourly	-	13° 26' 00"N	123° 30' 33" E	95.00	PAGASA (FFWS)	San Buena, Buhi, Camarines Sur
9	Calsada	ARG	Hourly	-	13° 14' 59"N	123° 30' 38" E	48.00	PAGASA (FFWS)	
10	Kaguskos	ARG	Hourly	-	13° 13' 59"N	123° 19' 49" E	370.00	PAGASA (FFWS)	
11	Bagamillon	ARG	Hourly	-	13° 35' 52"N	123° 01' 23" E	118.00	PAGASA (FFWS)	
12	Daet	Synoptic	Daily	-	-	-	-	PAGASA (Synoptic)	
13	Pili	Synoptic	Daily	-	-	-	-	PAGASA (Synoptic)	
14	Legaspi	Synoptic	Daily	-	-	-	-	PAGASA (Synoptic)	
15	Ragay	AWS	15 min	-	13° 49' 25"N	122° 44' 00" E	-	ASTI (NOAH)	Raray National Agricultural and Fisheries School (RNAFS), Liboro, Ragay, Camarines Sur
16	Tinambac	AWS	15 min	-	13° 48' 50"N	123° 20' 26" E	-	ASTI (NOAH)	Partido State University (PSU), Tinambac Campus, Tinambac, Camarines Sur
17	Tiwi	AWS	15 min	-	13° 27' 25"N	123° 40' 48" E	-	ASTI (NOAH)	San Rafael St., Tiwi, Albay
18	Libon	AWS	15 min	-	13° 17' 58"N	123° 26' 13" E	-	ASTI (NOAH)	Municipality of Libon (near Police station), Libon, Albay
19	Legazpi City	AWS	15 min	-	13° 09' 03"N	123° 43' 42" E	-	ASTI (NOAH)	PAGASA Station, Magayon Drive, Legazpi, Albay

20	Daet	ARG	15 min	-	14° 08' 17"N	122° 45' 48" E	-	ASTI (NOAH)	College of Business in Public Admin Bldg., Camarines Norte State Colleges Compound, Daet, Camarines Norte
21	Naga	ARG	15 min	-	13° 31' 30"N	123° 20' 55" E	-	ASTI (NOAH)	Raul S.Roco Library Bldg., Naga City Hall Compound, Naga City
22	Legazpi	ARG	15 min	-	13° 10' 37"N	123° 31' 41" E	-	ASTI (NOAH)	DOST V Compound, Rawis, Legazpi City, Albay
23	CNSC	AWS	15 min	-	13° 17' 19"N	123° 41' 08" E	-	ASTI	CNSC, Jose Panganiban, Camarines Norte
24	Calamoan	AWS	15 min	-	13° 46' 56"N	123° 51' 27" E	-	ASTI	Partido State University (PSU), Caramoan, Camarines Sur
25	CBSUA - Pili	AWS	15 min	-	13° 35' 00"N	123° 15' 43" E	53.00	PAGASA (AWS)	CBSUA Campus Pili, Camarines Sur
26	Guinobatan	AWS	15 min	-	13° 11' 35"N	123° 35' 33" E	74.00	PAGASA (AWS)	BUCAF, Guinobatan, Albay
27	Labo	ARG	15 min	-	14° 09' 58"N	122° 49' 02" E	-	PAGASA (ARG)	Labo, Camatines Norte
28	Jovellar	ARG	15 min	-	13° 04' 41"N	123° 36' 14" E	-	PAGASA (ARG)	Jovellar, Albay
29	Donsol	ARG	15 min	-	12° 56' 38"N	123° 35' 17" E	-	PAGASA (ARG)	Donsol, Butanding, Sorogon
30	Bgy.Misibis	AWS	15 min	Plan	13° 14' 53"N	123° 44' 02" E	-	ASTI (NOAH)	Bgy.Misibis, Cagraray Island, Bacacay, Albay
31	Malilipot	ARG	15 min	Plan	13° 19' 05"N	123° 44' 02" E	-	ASTI (NOAH)	Poblacion, Malilipot, Albay
32	Daraga	ARG	15 min	Plan	13° 09' 04"N	123° 42' 47" E	-	ASTI (NOAH)	Poblacion, Daraga, Albay
33	Bula	ARG	15 min	Plan	13° 28' 12"N	123° 16' 34" E	-	ASTI (NOAH)	Poblacion, Bula, Camarines Sur
34	Minalabac	ARG	15 min	Plan	13° 34' 01"N	123° 11' 02" E	-	ASTI (NOAH)	Poblacion, Minalabac, Camarines Sur
35	Donsol	AWS	15 min	Plan	-	-	-	ASTI (NOAH)	Donsol, Sorsogon
36	Donsol	ARG	15 min	Plan	-	-	-	ASTI (NOAH)	Donsol, Sorsogon
37	Pasacao	AWS	15 min	Plan	-	-	-	ASTI (NOAH)	Pasacao, Camarines Sur
38	Pasacao	ARG	15 min	Plan	-	-	-	ASTI (NOAH)	Pasacao, Camarines Sur
39	Ragay	AWS	15 min	Plan	-	-	-	ASTI (NOAH)	Ragay, Camarines Sur
40	Ragay	ARG	15 min	Plan	-	-	-	ASTI (NOAH)	Ragay, Camarines Sur
41	Balatan	AWS	15 min	Plan	-	-	-	ASTI (NOAH)	Balatan, Camarines Sur
42	Balatan	ARG	15 min	Plan	-	-	-	ASTI (NOAH)	Balatan, Camarines Sur
43	Rapurapu	AWS	15 min	Plan	-	-	-	ASTI (NOAH)	Rapurapu, Albay
44	Rapurapu	ARG	15 min	Plan	-	-	-	ASTI (NOAH)	Rapurapu, Albay
45	Polangui	AWS	15 min	Plan	-	-	-	ASTI (NOAH)	Polangui, Albay
46	Polangui	ARG	15 min	Plan	-	-	-	ASTI (NOAH)	Polangui, Albay
47	Pioduran	AWS	15 min	Plan	-	-	-	ASTI (NOAH)	Pioduran, Albay
48	Pioduran	ARG	15 min	Plan	-	-	-	ASTI (NOAH)	Pioduran, Albay
49	Oas	AWS	15 min	Plan	-	-	-	ASTI (NOAH)	Oas, Albay
50	Oas	ARG	15 min	Plan	-	-	-	ASTI (NOAH)	Oas, Albay
51	Jovellar	AWS	15 min	Plan	-	-	-	ASTI (NOAH)	Jovellar, Albay
52	Jovellar	ARG	15 min	Plan	-	-	-	ASTI (NOAH)	Jovellar, Albay
53	Sto.Domingo	AWS	15 min	Plan	-	-	-	ASTI (NOAH)	Sto.Domingo, Albay
54	Sto.Domingo	ARG	15 min	Plan	-	-	-	ASTI (NOAH)	Sto.Domingo, Albay
55									

56									

Note : PAGASA (FFWS) is existing FFWS network under PAGASA Hydrometeorological Division
PAGASA (AWS), PAGASA (ARG), and PAGASA (Synoptic) is under PAGASA Regional Services Division

Water Level

No.	Station Name	Data Type	Duration of Record	Location		Catchment Area (km^2)	Agency	Address
				Latitude	Longitude			
1	Camaligan	Hourly	-	13° 37' 16"N	123° 09' 41" E	-	PAGASA (FFWS)	San Mateo, Camaligan, Camarines Sur
2	Balongay	Hourly	-	13° 42' 53"N	123° 07' 38" E	-	PAGASA (FFWS)	Balongay, Calabanga, Camarines Sur
3	Ombao	Hourly	-	13° 28' 29"N	123° 14' 29" E	-	PAGASA (FFWS)	Ombao, Bula, Camarines Sur
4	Sipocot	Hourly	-	13° 46' 22"N	122° 58' 24" E	-	PAGASA (FFWS)	Azusena, Sipocot, Camarines Sur
5	Bato	Hourly	-	13° 21' 13"N	123° 21' 52" E	-	PAGASA (FFWS)	Divina Pastora, Bato, Camarines Sur
6	Buhi	Hourly	-	13° 26' 00"N	123° 30' 33" E	-	PAGASA (FFWS)	San Buena, Buhi, Camarines Sur
7	Calsada	Hourly	-	13° 14' 59"N	123° 30' 38" E	-	PAGASA (FFWS)	
8	Guinobatan	10 min	Plan	-	-	-	ASTI (NOAH)	Minto, Guinobatan, Albay
9	Polangui River	10 min	Plan	-	-	-	ASTI (NOAH)	Polangui River, Albay
10	Libon	10 min	Plan	-	-	-	ASTI (NOAH)	Libon, Kinale River, Albay
11	Oas	10 min	Plan	-	-	-	ASTI (NOAH)	Oas River, Albay
12	Donsol	10 min	Plan	-	-	-	ASTI (NOAH)	Donsol River, Sorsogon
13								
14								

Note : PAGASA (FFWS) is existing FFWS network under PAGASA Hydrometeorological Division

Discharge Measurement

No.	Station Name	Duration of Record	Location		No. of Record	Agency
			Latitude	Longitude		
1	Camaligan	2012	13° 37' 16"N	123° 09' 41" E	2	PAGASA
2	Ombao	2012	13° 28' 29"N	123° 14' 29" E	2	PAGASA
3	Sipocot	2012	13° 46' 22"N	122° 58' 24" E	3	PAGASA
4	Buhi	2012	13° 26' 00"N	123° 30' 33" E	3	PAGASA
5	Calsada	2012	13° 14' 59"N	123° 30' 38" E	2	PAGASA
6						
7						

River Cross Section Data

No.	Distance of Survey	Survey Year	No. of Data	Agency
1	Bicol River	2012	51	PAGASA
2				
3				

Current Status of Utilization of Flood Runoff Models

No.06 Abulog River Basin, Catchment Area : 3,372 km^2

Availability of Flood Runoff Model: Available · Not Available

Description of Model

1. Name of Model :
   Target Area :
   Basin Rainfall :

Available Data for Development and Modification of Flood Runoff Model

Rainfall

No.	Station Name	Station Type	Data Type	Duration of Record	Location		Elevation (El.m)	Agency	Address
					Latitude	Longitude			
1	Luna	ARG	15 min	-	17° 36' 12"N	120° 36' 57" E	-	ASTI (NOAH)	Luna, Apayao (ARG)
2	RBS Dingras	ARG	15 min	-	18° 07' 53"N	120° 40' 11" E	-	PAGASA (ARG)	RBS Dingras, Ilocos Norte
3	Vintar	ARG	15 min	-	18° 13' 42"N	120° 38' 46" E	-	PAGASA (ARG)	Vintar, Ilocos Norte
4	Bacarra	ARG	15 min	-	18° 16' 19"N	120° 36' 58" E	-	PAGASA (ARG)	Bacarra, Ilocos Norte
5	Calanasan	ARG	15 min	Plan	18° 15' 14"N	121° 10' 59" E	-	ASTI (NOAH)	Calanasan, Apayao
6	Kabugao	ARG	15 min	Plan	18° 01' 26"N	121° 10' 59" E	-	ASTI (NOAH)	Kabugao, Apayao
7	Conner	ARG	15 min	Plan	17° 47' 42"N	121° 19' 19" E	-	ASTI (NOAH)	Conner, Apayao

Note : PAGASA (ARG) is under PAGASA Regional Services Division

Water Level

No.	Station Name	Data Type	Duration of Record	Location		Catchment Area (km^2)	Agency	Address
				Latitude	Longitude			
1	Pudtol Bridge	10 min	Plan	18° 01' 19"N	121° 10' 55" E		ASTI (NOAH)	Pudtol Bridge, Pudtol, Apayao
2								

Discharge Measurement

No.	Station Name	Duration of Record	Location		No. of Record	Agency
			Latitude	Longitude		
1						

River Cross Section Data

No.	Distance of Survey	Survey Year	No. of Data	Agency
1				

Current Status of Utilization of Flood Runoff Models

No.07 Abra River Basin, Catchment Area : 5,125 km^2

Availability of Flood Runoff Model : Available • ~~Not Available~~

Description of Model

1. Name of Model :
   Target Area :
   Basin Rainfall :

Available Data for Development and Modification of Flood Runoff Model

Rainfall

No.	Station Name	Station Type	Data Type	Duration of Record	Location		Elevation (El.m)	Agency	Address
					Latitude	Longitude			
1	Vigan City	ARG	15 min	-	17° 33' 43"N	120° 22' 52" E	-	ASTI (NOAH)	Univercity of Northern Philippines, Bgy.Tamag, Vigan City, Ilocos Sur
2	Lagangilang	ARG	15 min	-	17° 36' 45"N	120° 44' 10" E	-	ASTI (NOAH)	Abra State Institute of Science and Technology (ASIST), Lagangilang Campus, Abra
3	Mt.Province	ARG	15 min	-	17° 05' 24"N	120° 58' 39" E	-	ASTI (NOAH)	Government Center, Bontoc, Mt.Province
4	Bangued	AWS	15 min	-	17° 36' 12"N	120° 36' 57" E	-	ASTI (NOAH)	Bangued East Central School, Bangued, Abra
5	Sta.Maria	AWS	15 min	-	17° 22' 12"N	120° 28' 25" E	-	ASTI (NOAH)	ISPSC, Sta.Maria, Ilocos Sur
6	DMMSU - Batac	AWS	15 min	-	18° 03' 37"N	120° 32' 56" E	17.00	PAGASA (AWS)	DMMSU Campus, Barac, Ilocos Norte
7	Bangued	ARG	15 min	-	17° 35' 32"N	120° 37' 23" E	-	PAGASA (ARG)	Bangued, Abra
8	Manado	ARG	15 min	-	17° 27' 07"N	120° 42' 25" E	-	PAGASA (ARG)	Manado, Abra
9	Danglas	ARG	15 min	-	17° 41' 38"N	120° 39' 57" E	-	PAGASA (ARG)	Danglas, Abra
10	Bangar TP	ARG	15 min	-	16° 53' 37"N	120° 26' 02" E	-	PAGASA (ARG)	Bangar TP, La Union
11	Alilem	ARG	15 min	-	16° 53' 11"N	120° 31' 52" E	-	PAGASA (ARG)	Alilem, La Union
12	Suyo	ARG	15 min	-	16° 58' 40"N	120° 31' 34" E	-	PAGASA (ARG)	Suyo
13	Cervantes	ARG	15 min	-	16° 59' 52"N	120° 43' 48" E	-	PAGASA (ARG)	Cervantes, Ilocos Sur
14	Salcedo (baugen)	ARG	15 min	-	17° 08' 59"N	120° 32' 13" E	-	PAGASA (ARG)	Salcedo (baugen), Ilocos Sur
15	Sta.Maria	ARG	15 min	-	17° 21' 32"N	120° 29' 56" E	-	PAGASA (ARG)	Sta.Maria, Ilocos Sur
16	Vigan 3	ARG	15 min	-	17° 32' 40"N	120° 22' 49" E	-	PAGASA (ARG)	Vigan 3, Caoayan
17	RBS Dingras	ARG	15 min	-	18° 07' 53"N	120° 40' 11" E	-	PAGASA (ARG)	RBS Dingras, Ilocos Norte
18	Conner	ARG	15 min	Plan	17° 47' 42"N	121° 19' 19" E	-	ASTI (NOAH)	Conner, Apayao
19	Mt.Data	ARG	15 min	Plan	16° 51' 14"N	120° 51' 25" E	-	ASTI (NOAH)	Mt.Data, Mt.Province
20	Bakun	ARG	15 min	Plan	16° 43' 19"N	120° 46' 59" E	-	ASTI (NOAH)	Bakun, Benguet
21	Besao	ARG	15 min	Plan	17° 05' 42"N	120° 51' 25" E	-	ASTI (NOAH)	Besao, Mt.Province
22	Boliney	ARG	15 min	Plan	17° 22' 44"N	120° 49' 12" E	-	ASTI (NOAH)	Boliney, Abra
23	Pilar	ARG	15 min	Plan	17° 24' 54"N	120° 35' 46" E	-	ASTI (NOAH)	Pilar, Abra
24	Malibcong	ARG	15 min	Plan	17° 33' 47"N	120° 59' 24" E	-	ASTI (NOAH)	Malibcong, Abra

25	Tineg	ARG	15 min	Plan	17° 49' 12"N	120° 48' 07" E	-	ASTI (NOAH)	Tineg, Abra
26	Bgy.Poblacion East	AWS	15 min	Plan	17° 35' 15"N	120° 21' 44" E	-	ASTI (NOAH)	Bgy.Poblacion East, San Ilocos Sur, Ilocos Region Campus
27	Bgy.Poblacion East	ARG	15 min	Plan	17° 35' 15"N	120° 21' 44" E	-	ASTI (NOAH)	Bgy.Poblacion East, San Ilocos Sur, Ilocos Region Campus
28	Vigan	Synoptic	Daily	-	-	-	-	PAGASA (Synoptic)	
29									

Note : PAGASA (AWS), PAGASA (ARG), and PAGASA (Synoptic) is under PAGASA Regional Services Division

Water Level

No.	Station Name	Data Type	Duration of Record	Location		Catchment Area (km^2)	Agency	Address
				Latitude	Longitude			
1								
2								
3								
4								
5								

Discharge Measurement

No.	Station Name	Duration of Record	Location		No. of Record	Agency
			Latitude	Longitude		
1						
2						
3						
4						
5						

River Cross Section Data

No.	Distance of Survey	Survey Year	No. of Data	Agency
1				
2				
3				
4				
5				

Current Status of Utilization of Flood Runoff Models

No.08 Panay River Basin, Catchment Area : 1,843 km^2

Availability of Flood Runoff Model : Available • ~~Not Available~~

Description of Model

1. Name of Model :
   Target Area :
   Basin Rainfall :

Available Data for Development and Modification of Flood Runoff Model

Rainfall

No.	Station Name	Station Type	Data Type	Duration of Record	Location		Elevation (El.m)	Agency	Address
					Latitude	Longitude			
1	Madalag	ARG	15 min	-	11° 31' 34"N	122° 18' 25" E	-	ASTI (NOAH)	Aklan, Madalag
2	Dumarao	ARG	15 min	-	11° 15' 06"N	122° 40' 34" E	-	ASTI (NOAH)	CapSU, Vet Med, Dumarao Campus, Bgy.Codingle, Dumarao, Capiz, Aklan
3	Cabatuan	ARG	15 min	-	10° 53' 49"N	122° 26' 48" E	-	ASTI (NOAH)	Bgy.Cahigon, Maasin, Iloilo
4	Estancia	AWG	15 min	-	11° 27' 20"N	123° 08' 50" E	-	ASTI (NOAH)	Iloilo East Coastal-Capiz Road
5	Ajuy	AWG	15 min	-	11° 10' 31"N	123° 01' 24" E	-	ASTI (NOAH)	Urban Center Pob.Ajuy
6	PSPC - Mambusao	AWS	15 min	-	11° 25' 46"N	122° 35' 49" E	21.00	PAGASA (AWS)	PSPC Campus, Mambusao, Capiz
7	SEPC San Enrique	AWS	15 min	-	11° 04' 35"N	122° 39' 33" E	35.00	PAGASA (KOICA)	SEPC San Enrique, Iloilo
8	Aklan, Madalag	ARG	15 min	-	11° 31' 52"N	122° 18' 40" E	-	PAGASA (ARG)	Aklan, Madalag
9	Sigma, Capiz	ARG	15 min	-	11° 25' 26"N	122° 39' 52" E	-	PAGASA (ARG)	Sigma, Capiz
10	Roxas	Synoptic	Daily	-	-	-	-	PAGASA (Synoptic)	

Note : PAGASA (AWS), PAGASA (ARG), PAGASA (Synoptic), and PAGASA (KOICA) is under PAGASA Regional Services Division

Water Level

No.	Station Name	Data Type	Duration of Record	Location		Catchment Area (km^2)	Agency	Address
				Latitude	Longitude			
1								

Discharge Measurement

No.	Station Name	Duration of Record	Location		No. of Record	Agency
			Latitude	Longitude		
1						

River Cross Section Data

No.	Distance of Survey	Survey Year	No. of Data	Agency
1				

Current Status of Utilization of Flood Runoff Models

No.09 Jalaur River Basin, Catchment Area : 1,503 km^2

Availability of Flood Runoff Model: Available · (Not Available)

Description of Model

1. Name of Model :
   Target Area :
   Basin Rainfall :

Available Data for Development and Modification of Flood Runoff Model

Rainfall

No.	Station Name	Station Type	Data Type	Duration of Record	Location		Elevation (El.m)	Agency	Address
					Latitude	Longitude			
1	Dumarao	ARG	15 min	-	11° 15' 06"N	122° 40' 34" E	-	ASTI (NOAH)	CapSU, Vet Med, Dumarao Campus, Bgy.Codingle, Dumarao, Capiz, Aklan
2	Cabatuan	ARG	15 min	-	10° 53' 49"N	122° 26' 48" E	-	ASTI (NOAH)	Bgy.Cahigon, Maasin, Iloilo
3	Alimodian	ARG	15 min	-	-	-	-	ASTI (NOAH)	
4	San Miguel	ARG	15 min	-	-	-	-	ASTI (NOAH)	
5	La Paz	ARG	15 min	-	10° 43' 13"N	122° 33' 44" E	-	ASTI (NOAH)	DOST Regional Office No.VI, Iloilo City
6	Jaro	AWS	15 min	-	10° 46' 20"N	122° 34' 45" E	-	ASTI (NOAH)	Wesviarc, Iloilo City
7	MC-Dumangas	AWS	15 min	-	10° 50' 48"N	122° 41' 51" E	8.00	PAGASA (AWS)	Viorfort College, Dumangas, Iloilo
8	SEPC San Enrique	AWS	15 min	-	11° 04' 35"N	122° 39' 33" E	35.00	PAGASA (KOICA)	SEPC San Enrique, Iloilo
9	Sta.Barbara	ARG	15 min	-	10° 49' 32"N	122° 31' 55" E	-	PAGASA (ARG)	Sta.Barbara, Iloilo
10	Bito-on	AWS	15 min	Plan	10° 45' 24"N	122° 35' 23" E	-	ASTI (NOAH)	Bito-on, Jaro District, Iloilo City, Iloilo
11	Bito-on	ARG	15 min	Plan	10° 45' 24"N	122° 35' 23" E	-	ASTI (NOAH)	Bito-on, Jaro District, Iloilo City, Iloilo
12	Iloilo	Synoptic	Daily	-	-	-	-	PAGASA (Synoptic)	
13									

Note : PAGASA (AWS), PAGASA (ARG), PAGASA (KOICA), and PAGASA (Synoptic) is under PAGASA Regional Services Division

Water Level

No.	Station Name	Data Type	Duration of Record	Location		Catchment Area (km^2)	Agency	Address
				Latitude	Longitude			
1	Cahigon Bridge	10 min	-	10° 53' 49"N	122° 26' 48" E	-	ASTI (NOAH)	Bgy.Cahigon, Maasin, Iloilo
2	Pagsanga-an Bridge	10 min	-	10° 45' 56"N	122° 33' 04" E	-	ASTI (NOAH)	Bgy.Anilao, Pavia, Iloilo
3	Jaro Bridge	10 min	-	10° 43' 44"N	122° 33' 32" E	-	ASTI (NOAH)	Washington St., Bgy.Simon Ledesma, Jaro, Iloilo
4	Tigum River	10 min	Plan	10° 52' 57"N	122° 28' 18" E	-	ASTI (NOAH)	
5								

Discharge Measurement

No.	Station Name	Duration of Record	Location		No. of Record	Agency
			Latitude	Longitude		
1						
2						
3						
4						
5						

River Cross Section Data

No.	Distance of Survey	Survey Year	No. of Data	Agency
1				
2				
3				
4				
5				

Current Status of Utilization of Flood Runoff Models

No.10 Ilog-Hilabangan River Basin, Catchment Area : 1,945 km^2

Availability of Flood Runoff Model: Available • (Not Available)

Description of Model

1. Name of Model :
   Target Area :
   Basin Rainfall :

Available Data for Development and Modification of Flood Runoff Model

Rainfall

No.	Station Name	Station Type	Data Type	Duration of Record	Location		Elevation (El.m)	Agency	Address
					Latitude	Longitude			
1	Kabankalan City	AWS	15 min	-	10° 00' 20"N	122° 51' 10" E	-	ASTI (NOAH)	Bgy.Hilamonan, Sitio Cabangahan, Kabankalan City, Negros Occ.
2	Sipalay City	AWS	15	-	09° 45' 18"N	122° 23' 58" E	-	ASTI (NOAH)	Bgy.Five, Sipalay City, Negros Occ.
3	Negros	ARG	15	-	09° 37' 42"N	122° 59' 20" E	-	ASTI (NOAH)	Oriental
4	Kabankalan	ARG	15	-	09° 57' 27"N	122° 48' 58" E	-	PAGASA (ARG)	Kabankalan
5									

Note : PAGASA (ARG) is under PAGASA Regional Services Division

Water Level

No.	Station Name	Data Type	Duration of Record	Location		Catchment Area (km^2)	Agency	Address
				Latitude	Longitude			
1								
2								

Discharge Measurement

No.	Station Name	Duration of Record	Location		No. of Record	Agency
			Latitude	Longitude		
1						
2						

River Cross Section Data

No.	Distance of Survey	Survey Year	No. of Data	Agency
1	Panay Gulf - Tomumbo (26.3 km)	2008	6	DPWH
2				

Current Status of Utilization of Flood Runoff Models

No.11 Agusan River Basin, Catchment Area : 10,621 km^2

Availability of Flood Runoff Model : Available · (Not Available)

Description of Model

1. Name of Model :
   Target Area :
   Basin Rainfall :

Available Data for Development and Modification of Flood Runoff Model

Rainfall

No.	Station Name	Station Type	Data Type	Duration of Record	Location		Elevation (El.m)	Agency	Address
					Latitude	Longitude			
1	Baganga	AWS	15 min	-	07° 37' 59"N	126° 32' 12" E	-	ASTI (NOAH)	Baganga, Davao Oriental
2	Sta.Josefa	AWS	15 min	-	07° 59' 00"N	126° 02' 00" E	-	ASTI (NOAH)	Sta.Josefa, Agusan del Sur
3	Butuan	AWS	15 min	-	08° 56' 51"N	125° 32' 26" E	-	ASTI (NOAH)	Butuan, Agusan del Norte
4	San Agustin	AWS	15 min	-	08° 43' 53"N	126° 12' 10" E	-	ASTI (NOAH)	San Agustin, Surigao del Sur
5	Malaybalay	ARG	15 min	-	08° 09' 07"N	125° 07' 57" E	-	ASTI (NOAH)	PAGASA Malaybalay Station, Capitol Compound, Malaybalay City, Bukindon
6	Panabo	ARG	15 min	-	07° 33' 42"N	125° 39' 12" E	-	ASTI (NOAH)	Panabo, Davao del Norte
7	Gingoog City	ARG	15 min	-	08° 49' 08"N	125° 06' 10" E	-	ASTI (NOAH)	City Engineers Compound, Gingoog City, Misamis Oriental
8	Bgy.Mahayahay, Mara	ARG	15 min	-	07° 24' 16"N	126° 03' 30" E	-	ASTI	Bgy.Mahayahay, Maragusan, Compostella Valley
9	San Francisco	AWS	15 min	-	08° 30' 10"N	125° 58' 53" E	-	PAGASA (AWS)	San Francisco, Agusan del Sur
10	Nabunturan	AWS	15 min	-	07° 34' 40"N	125° 59' 34" E	-	PAGASA (AWS)	Nabunturan, Compostela Valley
11	Tandag	AWS	15 min	-	09° 04' 03"N	126° 11' 39" E	-	PAGASA (AWS)	Tandag, Surigao del Sur
12	Nasipit	AWS	15 min	-	08° 58' 27"N	125° 21' 01" E	-	PAGASA (AWS)	Nasipit, Agusan del Norte
13	RTR	AWS	15 min	-	08° 57' 01"N	125° 32' 08" E	5.00	PAGASA (UNDP)	PhilRice Cpd. RTR, Agusan del Norte
14	Gamot	ARG	15 min	-	08° 56' 51"N	126° 07' 05" E	-	PAGASA (ARG)	Gamot (crossing San Miguel), Surigao del Sur
15	Lapaz	ARG	15 min	-	08° 19' 26"N	125° 50' 56" E	-	PAGASA (ARG)	Lapaz, Rosario, Agusan del Sur
16	Butuan	Synoptic	Daily	-	-	-	-	PAGASA (Synoptic)	
17	Hinatuan	Synoptic	Daily	-	-	-	-	PAGASA (Synoptic)	
18									
19									
20									
21									
22									
23									

Note : PAGASA (AWS), PAGASA (KOICA), and PAGASA (Synoptic) is under PAGASA Regional Services Division

Water Level

No.	Station Name	Data Type	Duration of Record	Location		Catchment Area (km^2)	Agency	Address
				Latitude	Longitude			
1								
2								
3								
4								
5								

Discharge Measurement

No.	Station Name	Duration of Record	Location		No. of Record	Agency
			Latitude	Longitude		
1						
2						
3						
4						
5						

River Cross Section Data

No.	Distance of Survey	Survey Year	No. of Data	Agency
1				
2				
3				
4				
5				

Current Status of Utilization of Flood Runoff Models

No.12 Tagoloan River Basin, Catchment Area : 1,704 km^2

Availability of Flood Runoff Model	Available · Not Available

Description of Model

1. Name of Model :
   Target Area :
   Basin Rainfall :

Available Data for Development and Modification of Flood Runoff Model

Rainfall

No.	Station Name	Station Type	Data Type	Duration of Record	Location		Elevation (El.m)	Agency	Address
					Latitude	Longitude			
1	Gingoog City	ARG	15 min	-	08° 49' 08"N	125° 06' 10" E	-	ASTI (NOAH)	City Engineers Compound, Gingoog City, Misamis Oriental
2	Libona	AWS	15 min	-	08° 19' 57"N	124° 44' 55" E	-	ASTI (NOAH)	Libona, Bukidnon
3	Malaybalay	ARG	15 min	-	08° 09' 07"N	125° 07' 57" E	-	ASTI (NOAH)	PAGASA Malaybalay Station, Capitol Compound, Malaybalay City, Bukindon
4	Bukidnon	ARG	15 min	-	08° 20' 50"N	124° 48' 44" E	-	PAGASA (ARG)	Bukidnon, Dumilag
5	Moscat	ARG	15 min	-	08° 36' 34"N	124° 53' 10" E	-	PAGASA (ARG)	Moscat, Misamis Oriental
6	Malaybalay	Synoptic	Daily	-	-	-	-	PAGASA (Synoptic)	
7									

Note : PAGASA (ARG), and PAGASA (Synoptic) is under PAGASA Regional Services Division

Water Level

No.	Station Name	Data Type	Duration of Record	Location		Catchment Area (km^2)	Agency	Address
				Latitude	Longitude			
1								

Discharge Measurement

No.	Station Name	Duration of Record	Location		No. of Record	Agency
			Latitude	Longitude		
1						

River Cross Section Data

No.	Distance of Survey	Survey Year	No. of Data	Agency
1				

Current Status of Utilization of Flood Runoff Models

No.13 Cagayan de Oro River Basin, Catchment Area : 1,521 km^2

Availability of Flood Runoff Model: Available • (Not Available)

Description of Model

1. Name of Model :
   Target Area :
   Basin Rainfall :

Available Data for Development and Modification of Flood Runoff Model

Rainfall

No.	Station Name	Station Type	Data Type	Duration of Record	Location		Elevation (El.m)	Agency	Address
					Latitude	Longitude			
1	Libona	AWS	15 min	-	08° 19' 57"N	124° 44' 55" E	-	ASTI (NOAH)	Libona, Bukidonon
2	Kinawe	ARG	15 min	-	08° 21' 25"N	124° 41' 33" E	-	ASTI (NOAH)	Kinawe, Libona, Bukidnon
3									
4	Baungon	ARG	15 min	-	08° 18' 16"N	124° 41' 57" E	-	ASTI (NOAH)	NIA Compound, Poblacion, Baungon, Bukidnon
5	Talakag	ARG	15 min	-	08° 11' 09"N	124° 35' 16" E	-	ASTI (NOAH)	Sto.Nino, Talakag, Bukidnon
6	Pigsag-an	ARG	15 min	-	08° 21' 00"N	124° 29' 31" E	-	ASTI (NOAH)	Bgy.Hall, Pigsag-an, Cagayan de Oro City
7	Bubunawan Bridge	ARG	15 min	-	08° 18' 45"N	124° 41' 54" E	-	ASTI (NOAH)	Bubunawan Bridge, Baungon, Bukidnon
8	CDO Bridge	ARG	15 min	-	08° 28' 17"N	124° 38' 28" E	-	ASTI (NOAH)	CDO Bridge, Cagayan de Oro City
9	San Simon Bridge	ARG	15 min	-	08° 26' 27"N	124° 34' 08" E	-	ASTI (NOAH)	San Simon Bridge, Cagayan de Oro City
10	Bukidnon	ARG	15 min	-	08° 20' 50"N	124° 48' 44" E	-	PAGASA (ARG)	Bukidnon, Dumilag
11	Talakag	ARG	15 min	-	08° 06' 55"N	124° 47' 39" E	-	PAGASA (ARG)	Talakag
12	Jasaan	ARG	15 min	-	08° 23' 38"N	124° 27' 05" E	-	PAGASA (ARG)	Jasaan, Misamis Oriental
13	Cagayan de Oro	Synoptic	Daily	-	-	-	-	PAGASA (Synoptic)	
14	Malaybalay	Synoptic	Daily	-	-	-	-	PAGASA (Synoptic)	
15									

Note : PAGASA (ARG), and PAGASA (Synoptic) is under PAGASA Regional Services Division

Water Level

No.	Station Name	Data Type	Duration of Record	Location		Catchment Area (km^2)	Agency	Address
				Latitude	Longitude			
1	Kabula Bridge	10 min	-	08° 23' 19"N	124° 36' 49" E	-	ASTI (NOAH)	Bgy.Pualas, Baungon
2	Bubunawan Bridge	10 min	-	08° 18' 45"N	124° 41' 54" E	-	ASTI (NOAH)	Bubunawan Bridge, Baungon, Bukidnon
3	CDO Bridge	10 min	-	08° 28' 17"N	124° 38' 28" E	-	ASTI (NOAH)	CDO Bridge, Cagayan de Oro City
4								

Discharge Measurement

No.	Station Name	Duration of Record	Location		No. of Record	Agency
			Latitude	Longitude		
1	Cabula Bridge	1991 - 2012	08° 23' 19"N	124° 36' 49" E	220	DPWH
2						
3						
4						
5						

River Cross Section Data

No.	Distance of Survey	Survey Year	No. of Data	Agency
1	Cagayan de Oro River (Makajarar Bay - Cabula Bridge), 17.6 km	2013	38	DPWH (JICA)
2				
3				
4				
5				

Current Status of Utilization of Flood Runoff Models

No.14 Agus-Lake Lanao River Basin, Catchment Area : 1,645 km^2

Availability of Flood Runoff Model	Available · Not Available

Description of Model

1. Name of Model :
   Target Area :
   Basin Rainfall :

Available Data for Development and Modification of Flood Runoff Model

Rainfall

No.	Station Name	Station Type	Data Type	Duration of Record	Location		Elevation (El.m)	Agency	Address
					Latitude	Longitude			
1	Bgy.Digkilaan	ARG	15 min	-	08° 14' 47"N	124° 19' 24" E	-	ASTI (NOAH)	Digkilaan Red Cross Village, Digkilaan, Iligan City
2									
3									

Water Level

No.	Station Name	Data Type	Duration of Record	Location		Catchment Area (km^2)	Agency	Address
				Latitude	Longitude			
1								
2								

Discharge Measurement

No.	Station Name	Duration of Record	Location		No. of Record	Agency
			Latitude	Longitude		
1						
2						

River Cross Section Data

No.	Distance of Survey	Survey Year	No. of Data	Agency
1				
2				

Current Status of Utilization of Flood Runoff Models

No.15 Davao River Basin, Catchment Area : 1,623 km^2

Availability of Flood Runoff Model: Available · Not Available

Description of Model

1. Name of Model :
   Target Area :
   Basin Rainfall :

Available Data for Development and Modification of Flood Runoff Model

Rainfall

No.	Station Name	Station Type	Data Type	Duration of Record	Location		Elevation (El.m)	Agency	Address
					Latitude	Longitude			
1	Panabo	ARG	15 min	-	07° 33' 42"N	125° 39' 12" E	-	ASTI (NOAH)	Panabo, Davao del Norte
2	Malaybalay	ARG	15 min	-	08° 09' 07"N	125° 07' 57" E	-	ASTI (NOAH)	PAGASA Malaybalay Station, Capitol Compound, Malaybalay City, Bukindnon
3	Davao City	AWS	15 min	-	07° 07' 40"N	125° 39' 18" E	-	ASTI (NOAH)	PAGASA Office, Davao City
4	Bansalan	ARG	15 min	-	06° 47' 18"N	125° 12' 17" E	-	ASTI (NOAH)	Bansalan, Davao del Sur
5									
6	USEP - Tagum	AWS	15 min	-	07° 26' 46"N	125° 48' 23" E	22.00	PAGASA (AWS)	USEP Campus Tagum, Davao del Norte
7	Valencia	AWS	15 min	-	07° 53' 12"N	125° 06' 01" E	315.00	PAGASA (AWS)	Valencia, Bukidnon
8	CMSU - Musuan	AWS	15 min	-	07° 51' 24"N	125° 03' 35" E	301.00	PAGASA (AWS)	CMSU Campus, Musuan, Bukidnon
9	Kabacan	AWS	15 min	-	07° 06' 34"N	124° 50' 50" E	245.00	PAGASA (AWS)	Kabacan, North Cotabato
10	Digos	AWS	15 min	-	06° 42' 53"N	125° 18' 23" E	50.00	PAGASA (AWS)	Digos, Davao Del Sur
11	Sto.Nino	AWS	15 min	-	07° 05' 08"N	125° 30' 29" E	-	ASTI (NOAH)	Sto.Nino, Tugbok District, Davao City
12	Sto.Nino	ARG	15 min	-	-	-	-	ASTI (NOAH)	Sto.Nino, Tugbok District, Davao City
13	Davao	Synoptic	Daily	-	-	-	-	PAGASA (Synoptic)	
14	Malaybalay	Synoptic	Daily	-	-	-	-	PAGASA (Synoptic)	
15									
16									
17									
18									

Note : PAGASA (AWS), and PAGASA (Synoptic) is under PAGASA Regional Services Division

Water Level

No.	Station Name	Data Type	Duration of Record	Location		Catchment Area (km^2)	Agency	Address
				Latitude	Longitude			
1								
2								

Discharge Measurement

No.	Station Name	Duration of Record	Location		No. of Record	Agency
			Latitude	Longitude		
1						
2						
3						
4						
5						

River Cross Section Data

No.	Distance of Survey	Survey Year	No. of Data	Agency
1				
2				
3				
4				
5				

Current Status of Utilization of Flood Runoff Models

No.16 Tagum-Libuganon River Basin, Catchment Area : 3,064 km^2

Availability of Flood Runoff Model: Available · (Not Available)

Description of Model

1. Name of Model :
   Target Area :
   Basin Rainfall :

Available Data for Development and Modification of Flood Runoff Model

Rainfall

No.	Station Name	Station Type	Data Type	Duration of Record	Location		Elevation (El.m)	Agency	Address
					Latitude	Longitude			
1	Panabo	ARG	15 min	-	07° 33' 42"N	125° 39' 12" E	-	ASTI (NOAH)	Panabo, Davao del Norte
2	Malaybalay	ARG	15 min	-	08° 09' 07"N	125° 07' 57" E	-	ASTI (NOAH)	PAGASA Malaybalay Station, Capitol Compound, Malaybalay City, Bukindnon
3	Davao City	AWS	15 min	-	07° 07' 40"N	125° 39' 18" E	-	ASTI (NOAH)	PAGASA Office, Davao City
4									
5	Nabunturan	AWS	15 min	-	07° 34' 40"N	125° 59' 34" E	82.00	PAGASA (AWS)	Nabunturan, Compostela Valley
6	USEP - Tagum	AWS	15 min	-	07° 26' 46"N	125° 48' 23" E	22.00	PAGASA (AWS)	USEP Campus Tagum, Davao del Norte
7	Sat.Josefa	AWS	15 min	-	07° 59' 00"N	126° 02' 00" E	-	ASTI (NOAH)	Sat.Josefa, Agusan del Sur
8	Tagum-Magdum	ARG	15 min	-	07° 27' 36"N	125° 49' 37" E	-	PAGASA (ARG)	Tagum-Magdum, Davao
9	Davao	Synoptic	Daily	-	-	-	-	PAGASA (Synoptic)	

Note : PAGASA (AWS), PAGASA (ARG), and PAGASA (Synoptic) is under PAGASA Regional Services Division

Water Level

No.	Station Name	Data Type	Duration of Record	Location		Catchment Area (km^2)	Agency	Address
				Latitude	Longitude			
1								

Discharge Measurement

No.	Station Name	Duration of Record	Location		No. of Record	Agency
			Latitude	Longitude		
1						

River Cross Section Data

No.	Distance of Survey	Survey Year	No. of Data	Agency
1	Tuganay River, Davao Bay - Dujali (22.1 km)	2008	6	DPWH
2				

Current Status of Utilization of Flood Runoff Models

No.17 Mindanao (Cotabato) River Basin, Catchment Area : 23,169 km^2

Availability of Flood Runoff Model: Available · (Not Available) (Mindanao River Basin has the plan to introduce IFAS by ICHARM)

Description of Model

1. Name of Model : IFAS (Integrated Flood Analysis System), developed by ICHARM
   Target Area : Whole Mindanao (Cotabato) River Basin
   Basin Rainfall : Using satelllite rainfall data (3B42RT, GSMap, Qmorph, Cmorph, etc.) or ground rainfall stations

Available Data for Development and Modification of Flood Runoff Model

Rainfall

No.	Station Name	Station Type	Data Type	Duration of Record	Location		Elevation (El.m)	Agency	Address
					Latitude	Longitude			
1	Palimbang	AWS	15 min	-	06° 13' 18"N	124° 12' 25" E	-	ASTI	Bgy.Bandiangon, Palimbang, Sultan Kudarat
2	People's Palace Groun	AWS	15 min	-	07° 11' 46"N	124° 14' 07" E	-	ASTI	People's Palace Grounds, Cotabato City
3	Bansalan	ARG	15 min	-	06° 47' 18"N	125° 12' 17" E	-	ASTI	Bansalan, Davao del Sur
4	Malaybalay	ARG	15 min	-	08° 09' 07"N	125° 07' 57" E	-	ASTI (NOAH)	PAGASA Malaybalay Station, Capitol Compound, Malaybalay City, Bukindnon
5	Sultan Kudarat	ARG	15 min	-	06° 30' 25"N	124° 25' 11" E	-	ASTI (NOAH)	Isulan, Sultan Kudarat
6	Carmen	ARG	15 min	-	07° 13' 00"N	124° 15' 00" E	-	ASTI (NOAH)	Carmen, North Cotabato
7	Sarangani	AWS	15 min	-	05° 55' 36"N	124° 59' 41" E	-	ASTI (NOAH)	Kiamba, Sarangani
8	Maguindanao	ARG	15 min	-	07° 01' 44"N	124° 09' 54" E	-	ASTI (NOAH)	Poblacion 1, Parang Maguindanao
9	Balabagan	ARG	15 min	-	07° 32' 03"N	124° 07' 00" E	-	ASTI (NOAH)	Near Municipal Hall of Balabagan, Lanao del Sur
10	Upi Maguindanao	ARG	15 min	-	07° 20' 00"N	124° 19' 00" E	-	ASTI (NOAH)	Motorpol, Upi Maguindanao
11	Panabo	ARG	15 min	-	07° 33' 42"N	125° 39' 12" E	-	ASTI (NOAH)	Panabo, Davao del Norte
12	Kabacan	AWS	15 min	-	07° 06' 34"N	124° 50' 50" E	34.00	PAGASA (AWS)	Kabacan, North Cotabato
13	Digos	AWS	15 min	-	06° 42' 53"N	125° 18' 23" E	50.00	PAGASA (AWS)	Digos, Davao del Sur
14	Valencia	AWS	15 min	-	07° 53' 12"N	125° 06' 01" E	315.00	PAGASA (AWS)	Valencia, Bukidnon
15	Tantangan	AWS	15 min	-	06° 31' 47"N	124° 48' 40" E	63.00	PAGASA (AWS)	Tantangan, South Catabato
16	CMSU - Musuan	AWS	15 min	-	07° 51' 24"N	125° 03' 35" E	301.00	PAGASA (AWS)	CMSU Campus, Musuan, Bukidnon
17	Bagumbayan	ARG	15 min	-	06° 28' 41"N	124° 34' 23" E	-	PAGASA (ARG)	Bagumbayan, Sultan Kudarat
18	Cotabato	Synoptic	Daily	-	-	-	-	PAGASA (Synoptic)	
19	Malaybalay	Synoptic	Daily	-	-	-	-	PAGASA (Synoptic)	
20									
21									
22									

Note : PAGASA (AWS), PAGASA (ARG), and PAGASA (Synoptic) is under PAGASA Regional Services Division

Water Level

No.	Station Name	Data Type	Duration of Record	Location		Catchment Area (km^2)	Agency	Address
				Latitude	Longitude			
1								
2								
3								
4								
5								

Discharge Measurement

No.	Station Name	Duration of Record	Location		No. of Record	Agency
			Latitude	Longitude		
1						
2						
3						
4						
5						

River Cross Section Data

No.	Distance of Survey	Survey Year	No. of Data	Agency
1				
2				
3				
4				
5				

Current Status of Utilization of Flood Runoff Models

No.18 Buayan-Malungon River Basin, Catchment Area : 1,434 km^2

Availability of Flood Runoff Model: Available · (Not Available)

Description of Model

1. Name of Model :
   Target Area :
   Basin Rainfall :

Available Data for Development and Modification of Flood Runoff Model

Rainfall

No.	Station Name	Station Type	Data Type	Duration of Record	Location		Elevation (El.m)	Agency	Address
					Latitude	Longitude			
1	General Santos City	AWS	15 min	-	06° 03' 20"N	125° 05' 51" E	-	ASTI (NOAH)	General Santos City Airport, South Cotabato
2	Jose Abad Santos	AWS	15 min	-	05° 55' 00"N	125° 39' 00" E	-	ASTI (NOAH)	Jose Abad Santos, Davao del Sur
3	Sarangani Province Capitol	AWS	15 min	-	06° 06' 05"N	125° 16' 23" E	-	ASTI	Sarangani Province Capitol, Alabel, Sarangani Province
4	Sarangani	ARG	15 min	-	05° 55' 36"N	124° 59' 41" E	-	ASTI (NOAH)	Kiamba, Sarangani
5									
6	Tantangan	AWS	15 min	-	06° 31' 47"N	124° 48' 40" E	63.00	PAGASA (AWS)	Tantangan, South Cotabato
7	Nagpar	ARG	15 min	-	06° 12' 15"N	125° 09' 20" E	-	PAGASA (ARG)	Nagpar, Saranggani
8	Malapatan	ARG	15 min	-	05° 57' 57"N	125° 17' 06" E	-	PAGASA (ARG)	Malapatan, Saranggani
9	General Santos	Synoptic	Daily	-	-	-	-	PAGASA (Synoptic)	

Note : PAGASA (AWS), PAGASA (ARG), and PAGASA (Synoptic) is under PAGASA Regional Services Division

Water Level

No.	Station Name		Data Type	Duration of Record	Location		Catchment Area (km^2)	Agency	Address
					Latitude	Longitude			
1									

Discharge Measurement

No.	Station Name		Duration of Record	Location		No. of Record	Agency
				Latitude	Longitude		
1							

River Cross Section Data

No.	Distance of Survey	Survey Year	No. of Data	Agency
1				

Current Status of Utilization of Flood Runoff Models

No.19 Mandulog River Basin, Catchment Area : 782 km^2

Availability of Flood Runoff Model : Available · (Not Available)

Description of Model

1. Name of Model :
   Target Area :
   Basin Rainfall :

Available Data for Development and Modification of Flood Runoff Model

Rainfall

No.	Station Name	Station Type	Data Type	Duration of Record	Location		Elevation (El.m)	Agency	Address
					Latitude	Longitude			
1	Bgy.Digkilaan	ARG	15 min	-	08° 14' 47"N	124° 19' 24" E	-	ASTI (NOAH)	Digkilaan Red Cross Village, Digkilaan, Iligan City
2	Talakag	ARG	15 min	-	08° 11' 09"N	124° 35' 16" E	-	ASTI (NOAH)	Santo Nino, Talakag, Bukidnon
3	Jasaan	ARG	15 min	-	08° 23' 38"N	124° 27' 05" E	-	PAGASA (ARG)	Jasaan, Misamis Oriental
4	Baloi	AWS	15 min	Plan	08° 07' 00"N	124° 13' 00" E	-	ASTI (NOAH)	Baloi, Lanao del Norte
5	Baloi	ARG	15 min	Plan	08° 07' 00"N	124° 13' 00" E	-	ASTI (NOAH)	Baloi, Lanao del Norte
6									
7	Bayug River	AWS	15 min	Plan	-	-	-	ASTI (NOAH)	Bayug River, Iligan City, Lanao del Norte

Note : PAGASA (ARG) is under PAGASA Regional Services Division

Water Level

No.	Station Name	Data Type	Duration of Record	Location		Catchment Area (km^2)	Agency	Address
				Latitude	Longitude			
1								
2	Abuno Bridge	10 min	-	08° 10' 55"N	124° 15' 01" E	-	ASTI (NOAH)	Bgy.Abuno, Iligan City, Lanao del Norte

Discharge Measurement

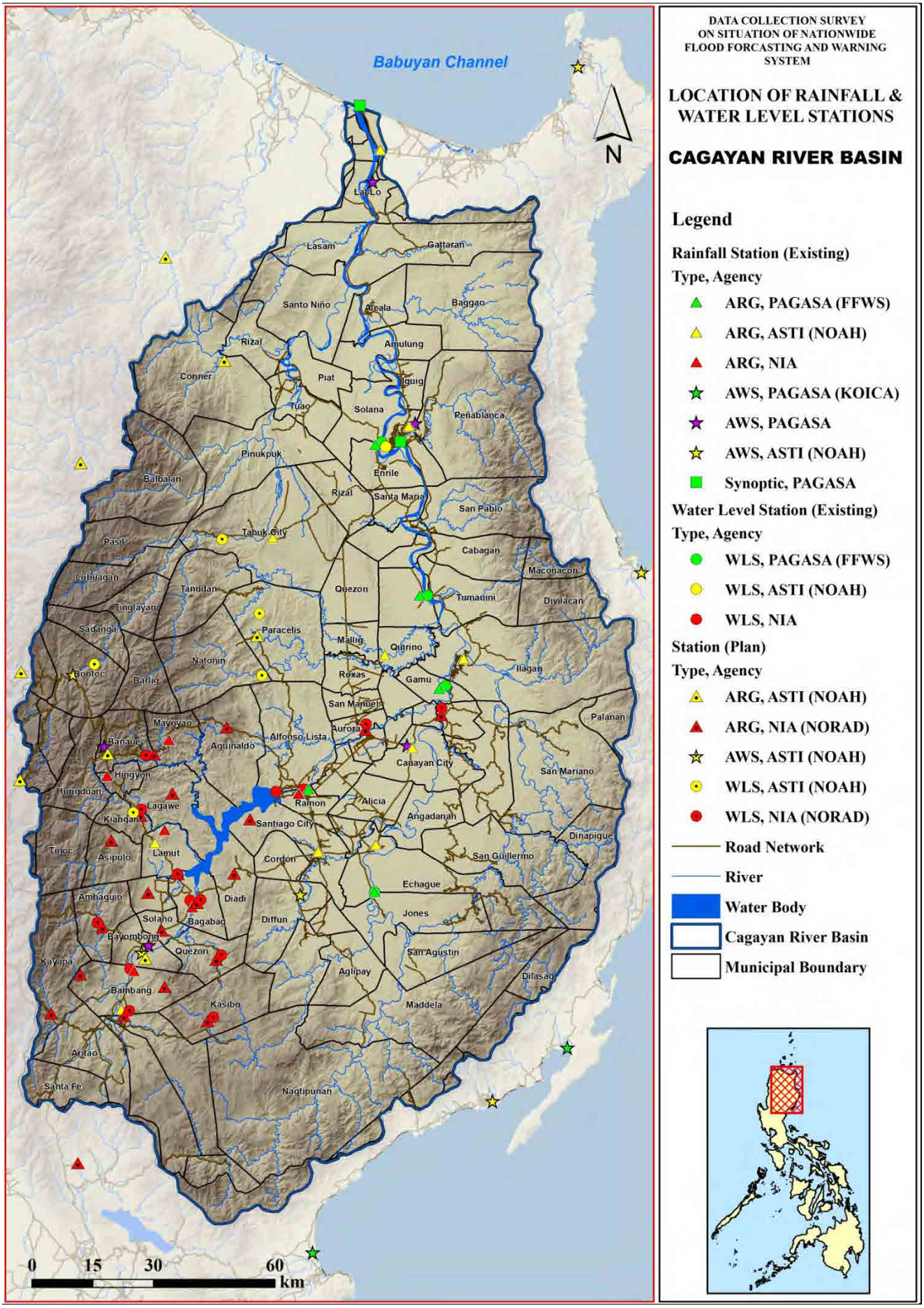
No.	Station Name	Duration of Record	Location		No. of Record	Agency
			Latitude	Longitude		
1						

River Cross Section Data

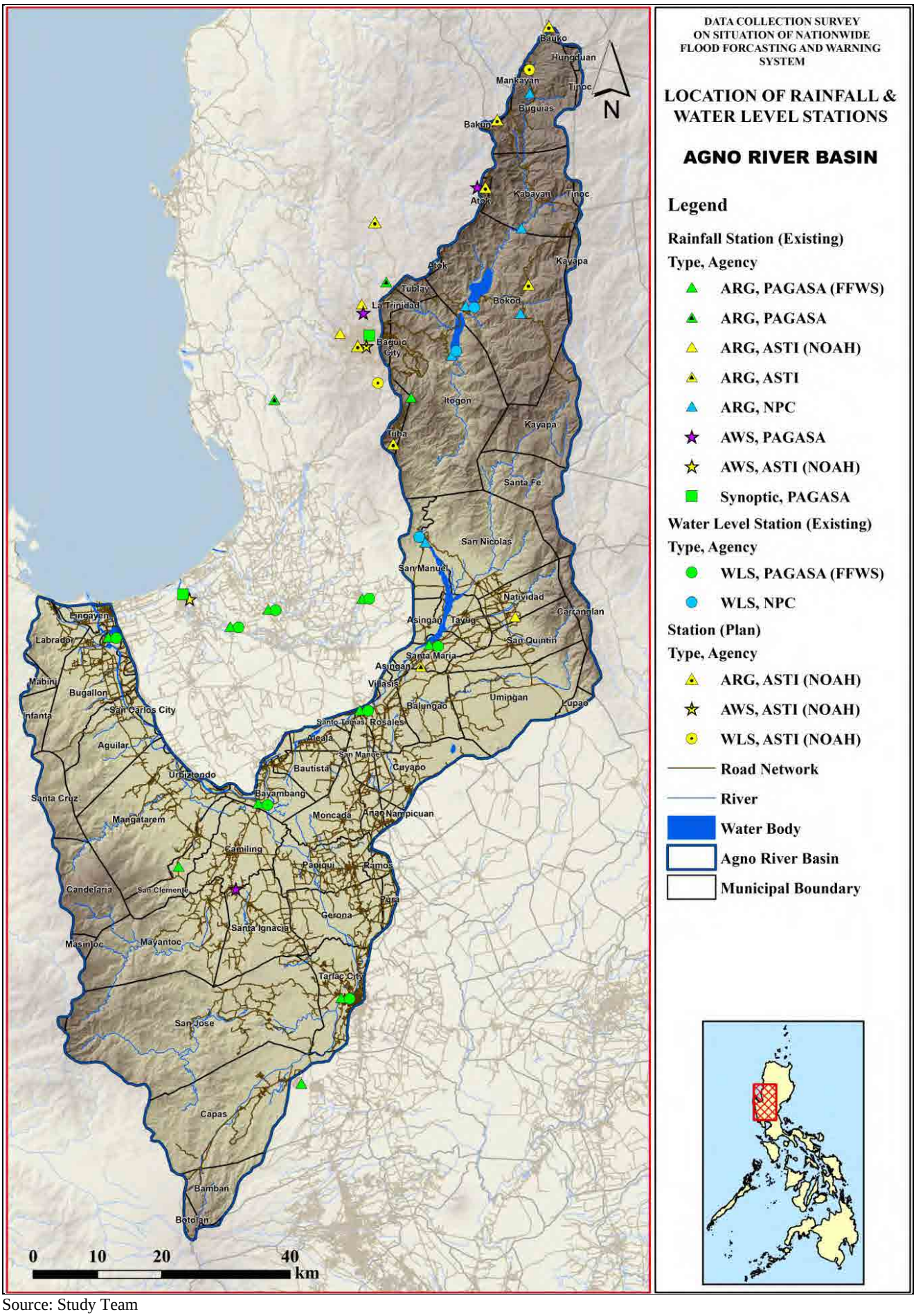
No.	Distance of Survey	Survey Year	No. of Data	Agency
1				
2				

Appendix H

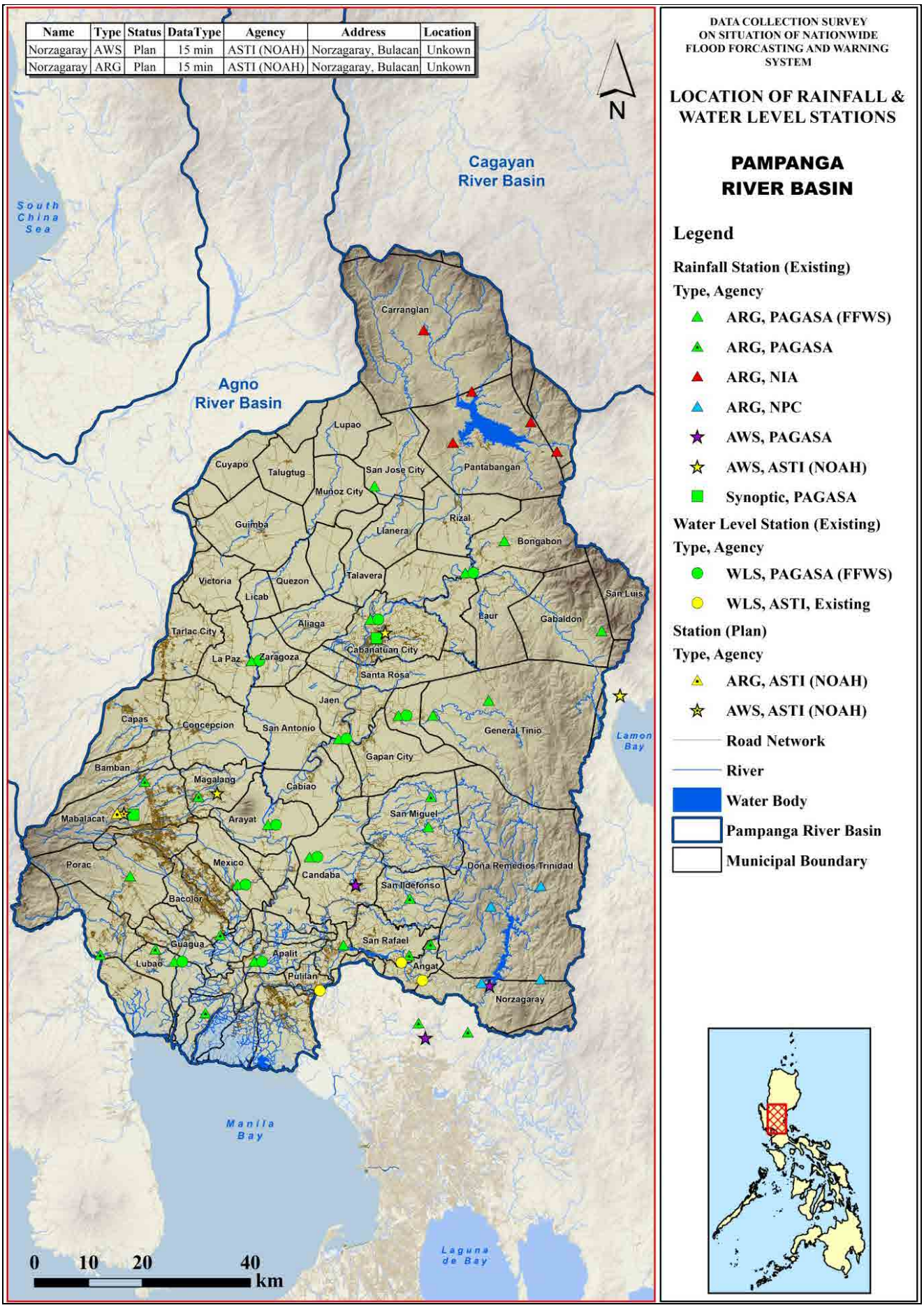
Location of Rainfall, Water Level and Weather Stations

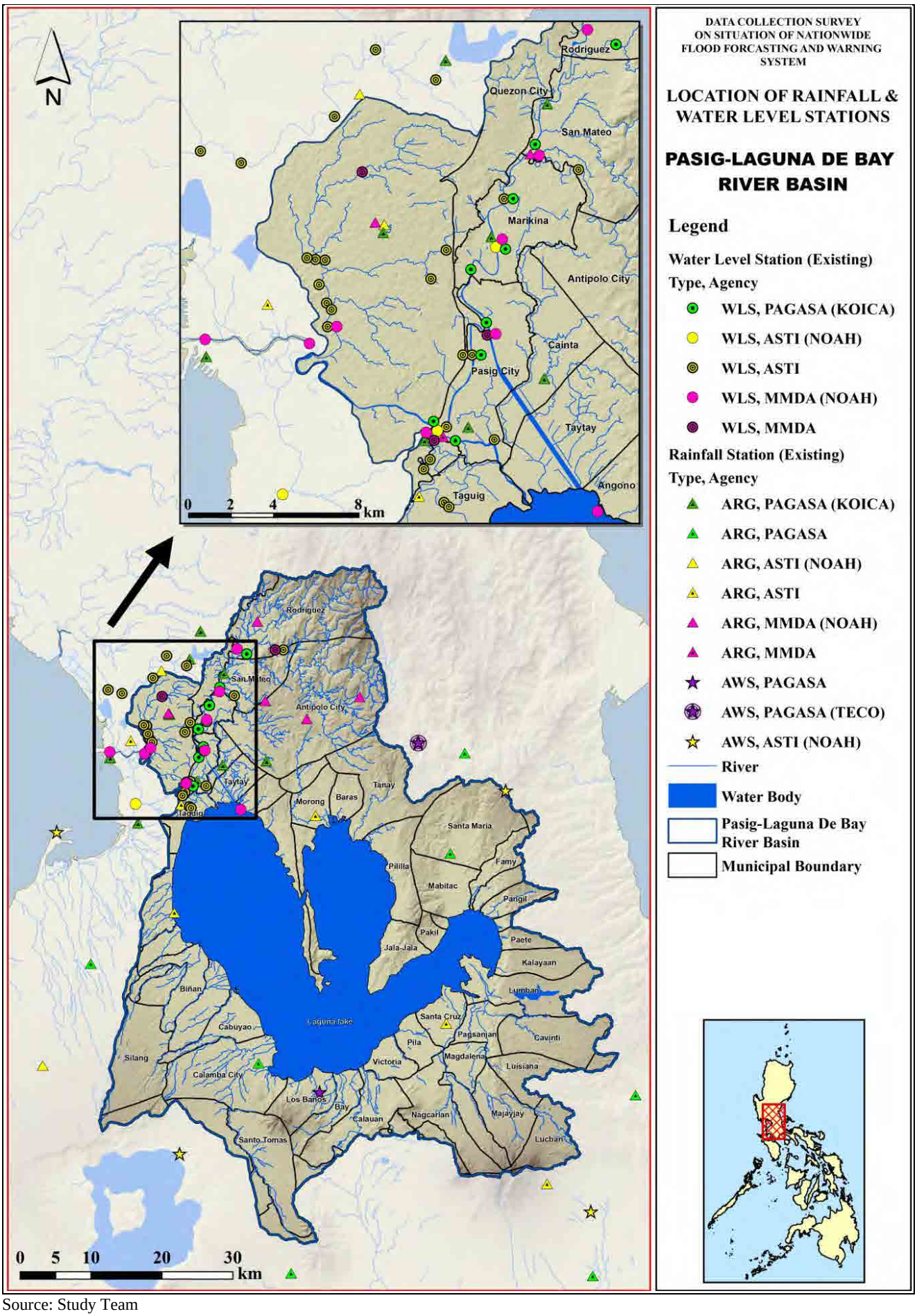


Source: Study Team

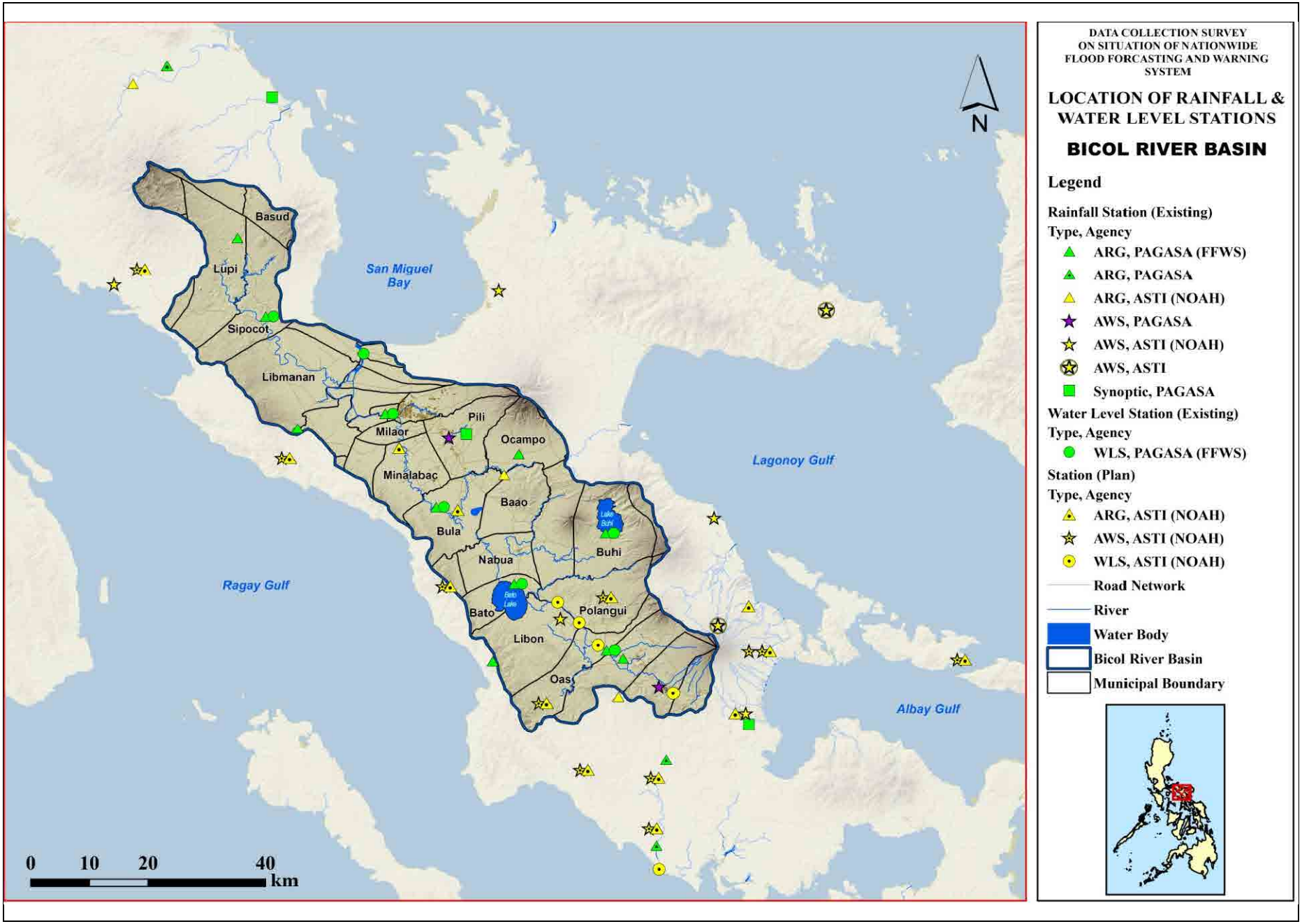


Source: Study Team

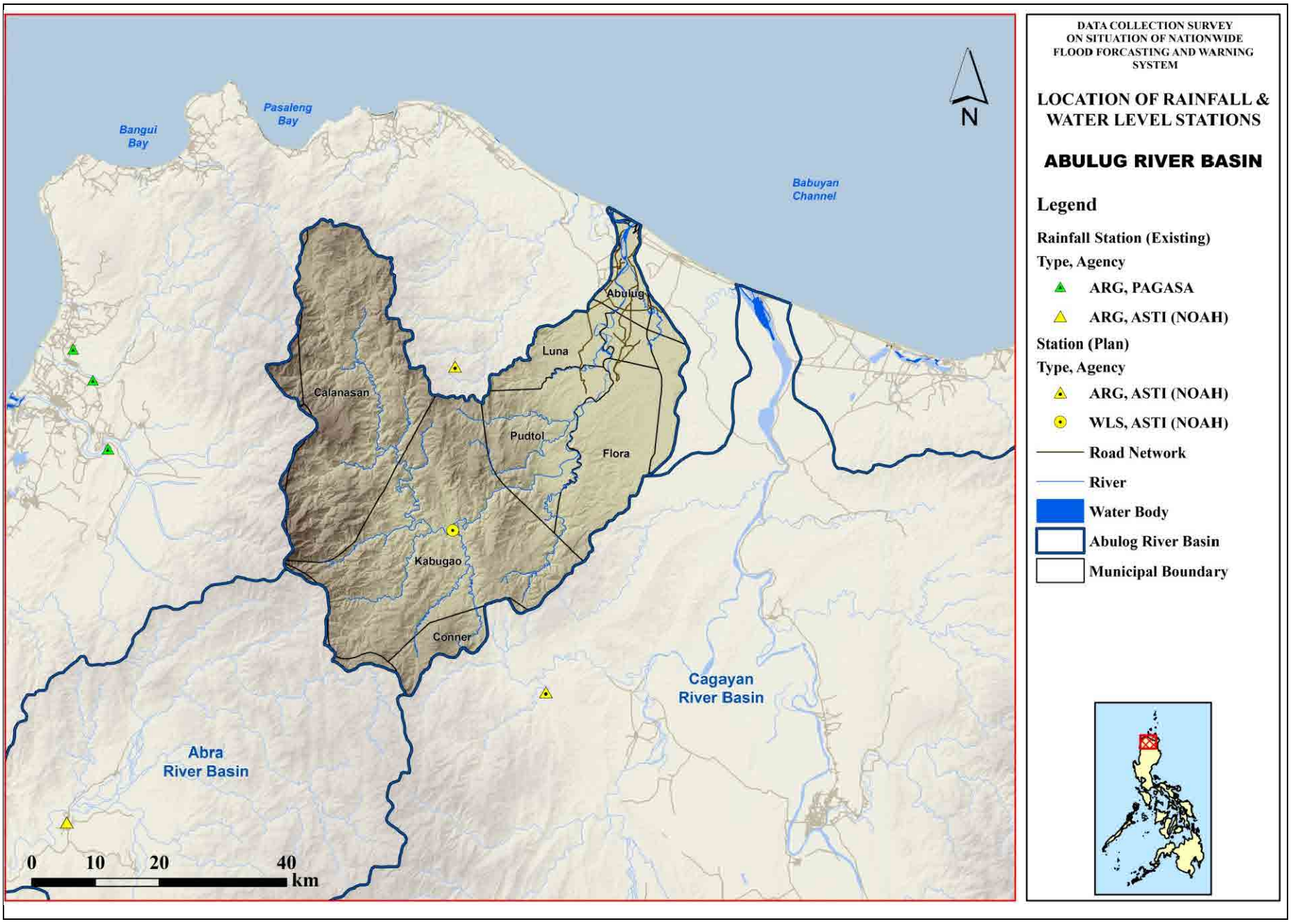

Name | Type | Status | DataType | Agency | Address | Location
Norzagaray | AWS | Plan | 15 min | ASTI (NOAH) | Norzagaray, Bulacan | Unkown
Norzagaray | ARG | Plan | 15 min | ASTI (NOAH) | Norzagaray, Bulacan | Unkown
N
Cagayan River Basin
South China Sea
Agno River Basin
Carranglan
Lupao
Cuyapo
Talugtug
San Jose City
Pantabangan
Munoz City
Rizal
Guimba
Llanera
Bongabon
Victoria
Quezon
Talavera
Licab
San Luis
Aliaga
Laur
Gabaldon
Tarlac City
Cabanatuan City
La Paz
Zaragoza
Santa Rosa
Jaen
Capas
Concepcion
San Antonio
General Tinio
Lamon Bay
Gapan City
Bamban
Magalang
Cabiao
Mabalacat
Arayat
San Miguel
Porac
Mexico
Candaba
Doña Remedios Trinidad
San Ildefonso
Bacolor
Guagua
San Rafael
Apalit
Lubao
Angat
Pulilan
Norzagaray
Manila Bay
Laguna de Bay
0 10 20 40
km
DATA COLLECTION SURVEY ON SITUATION OF NATIONWIDE FLOOD FORCASTING AND WARNING SYSTEM
LOCATION OF RAINFALL & WATER LEVEL STATIONS
PAMPANGA RIVER BASIN
Legend
Rainfall Station (Existing)
Type, Agency
ARG, PAGASA (FFWS)
ARG, PAGASA
ARG, NIA
ARG, NPC
AWS, PAGASA
AWS, ASTI (NOAH)
Synoptic, PAGASA
Water Level Station (Existing)
Type, Agency
WLS, PAGASA (FFWS)
WLS, ASTI, Existing
Station (Plan)
Type, Agency
ARG, ASTI (NOAH)
AWS, ASTI (NOAH)
Road Network
River
Water Body
Pampanga River Basin
Municipal Boundary



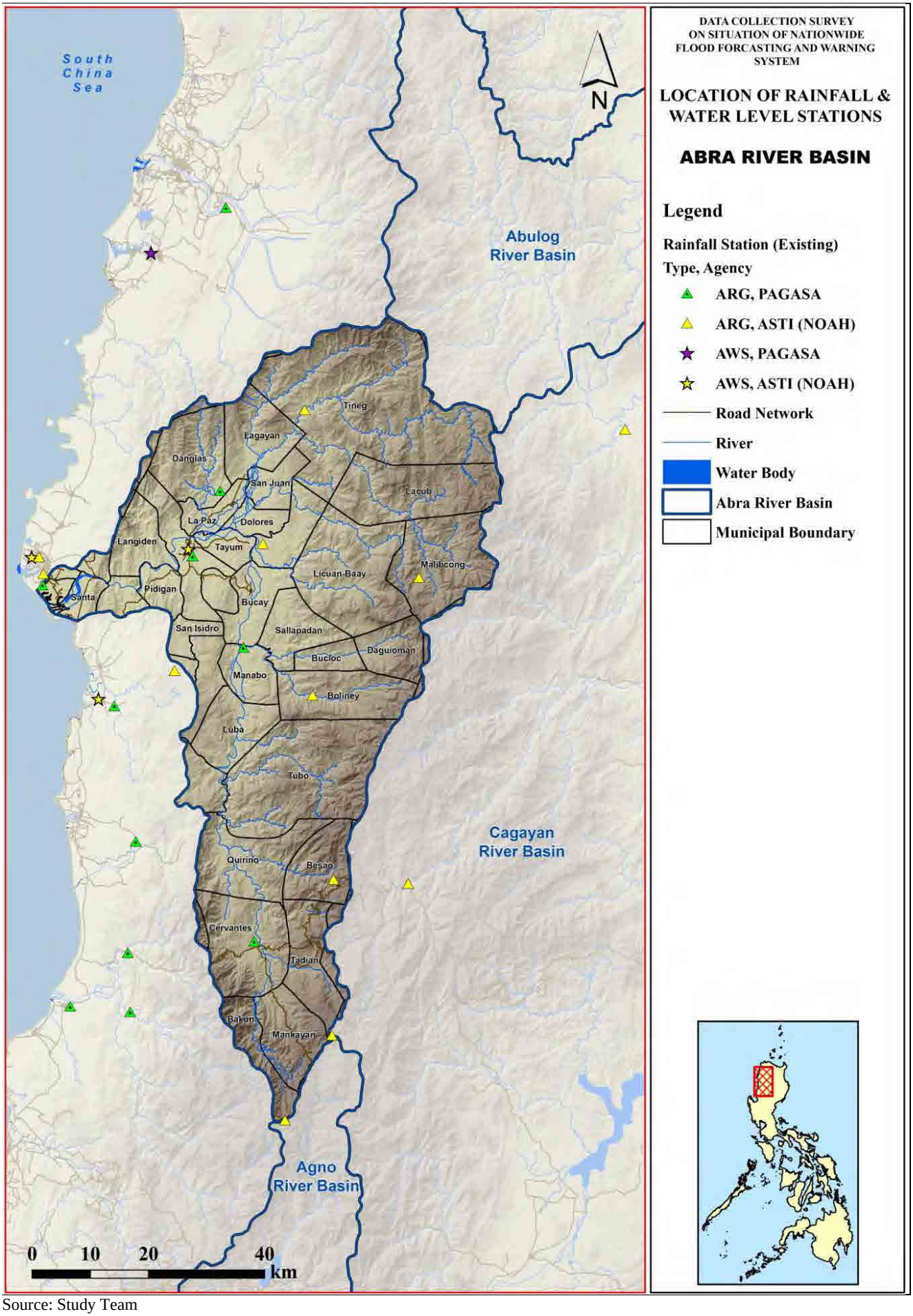
Source: Study Team



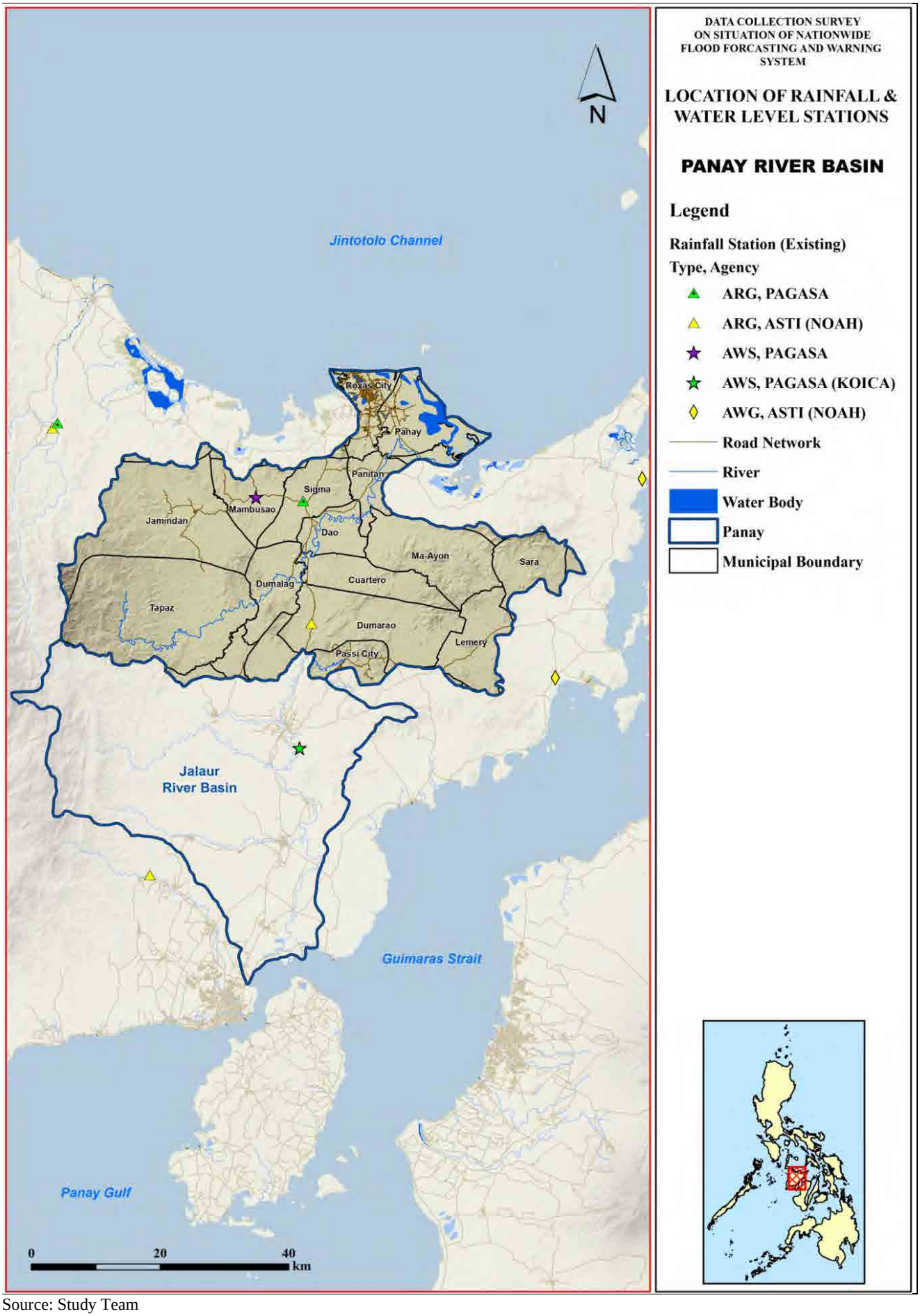
Source: Study Team



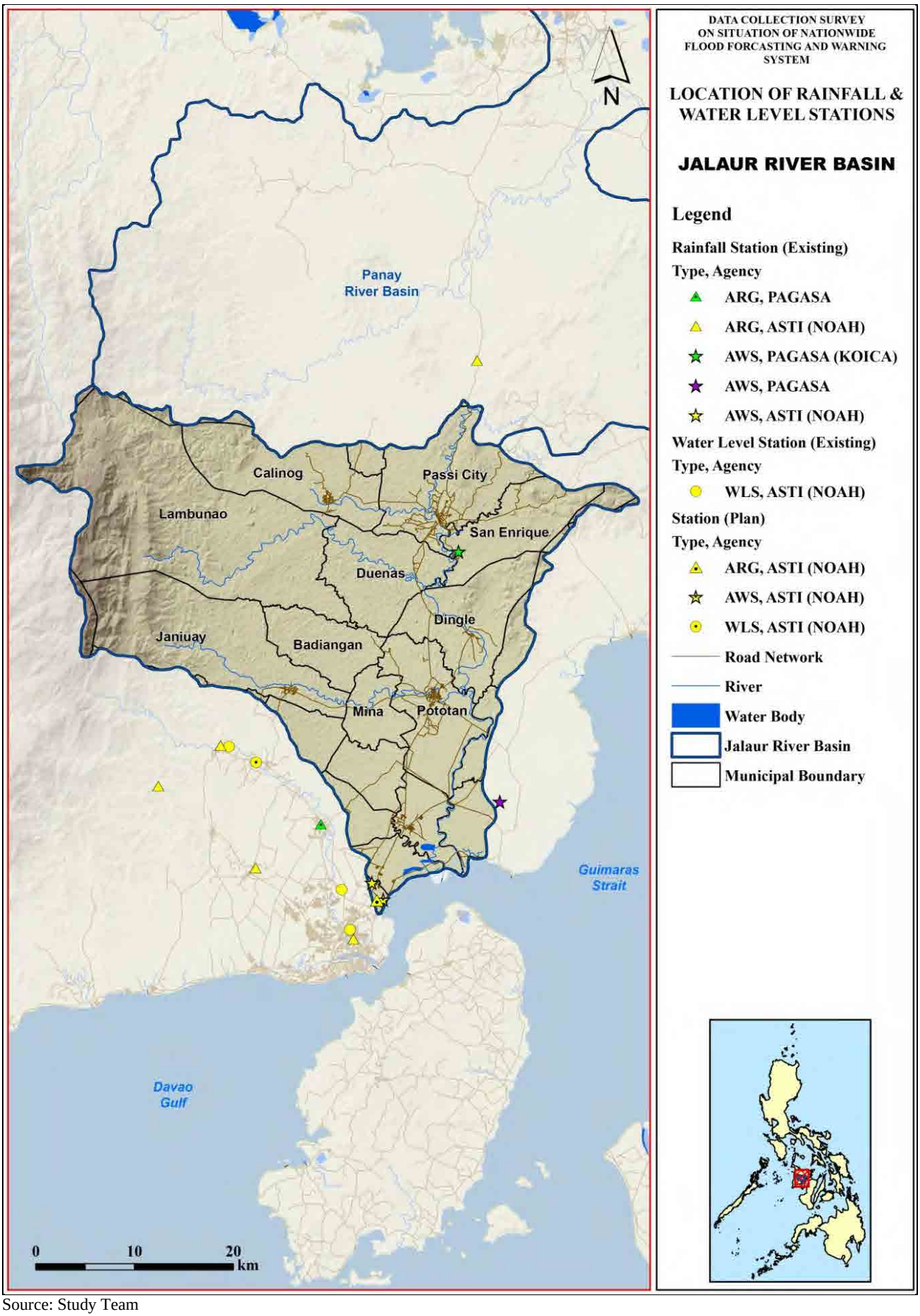
Source: Study Team



Source: Study Team



Source: Study Team



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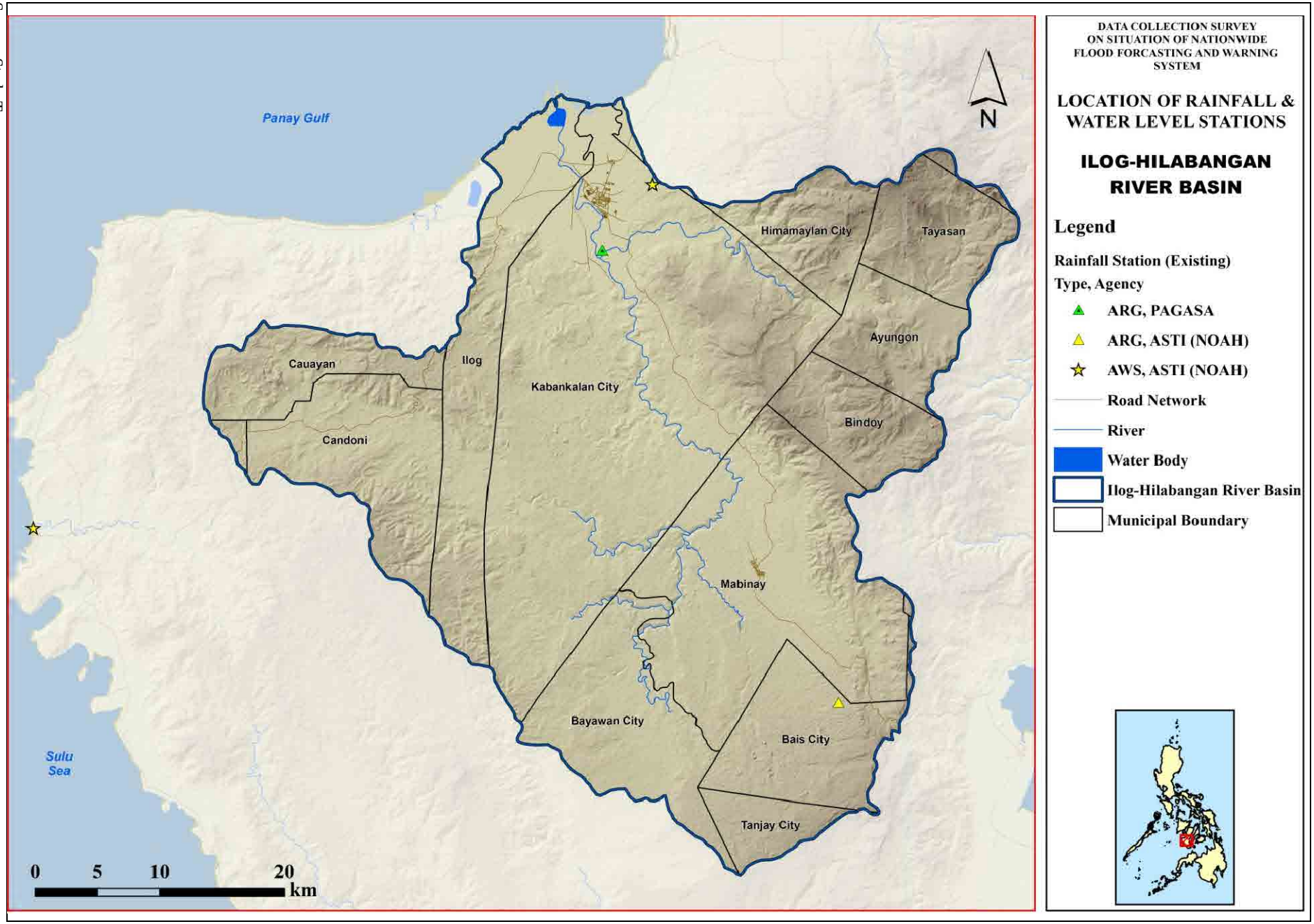

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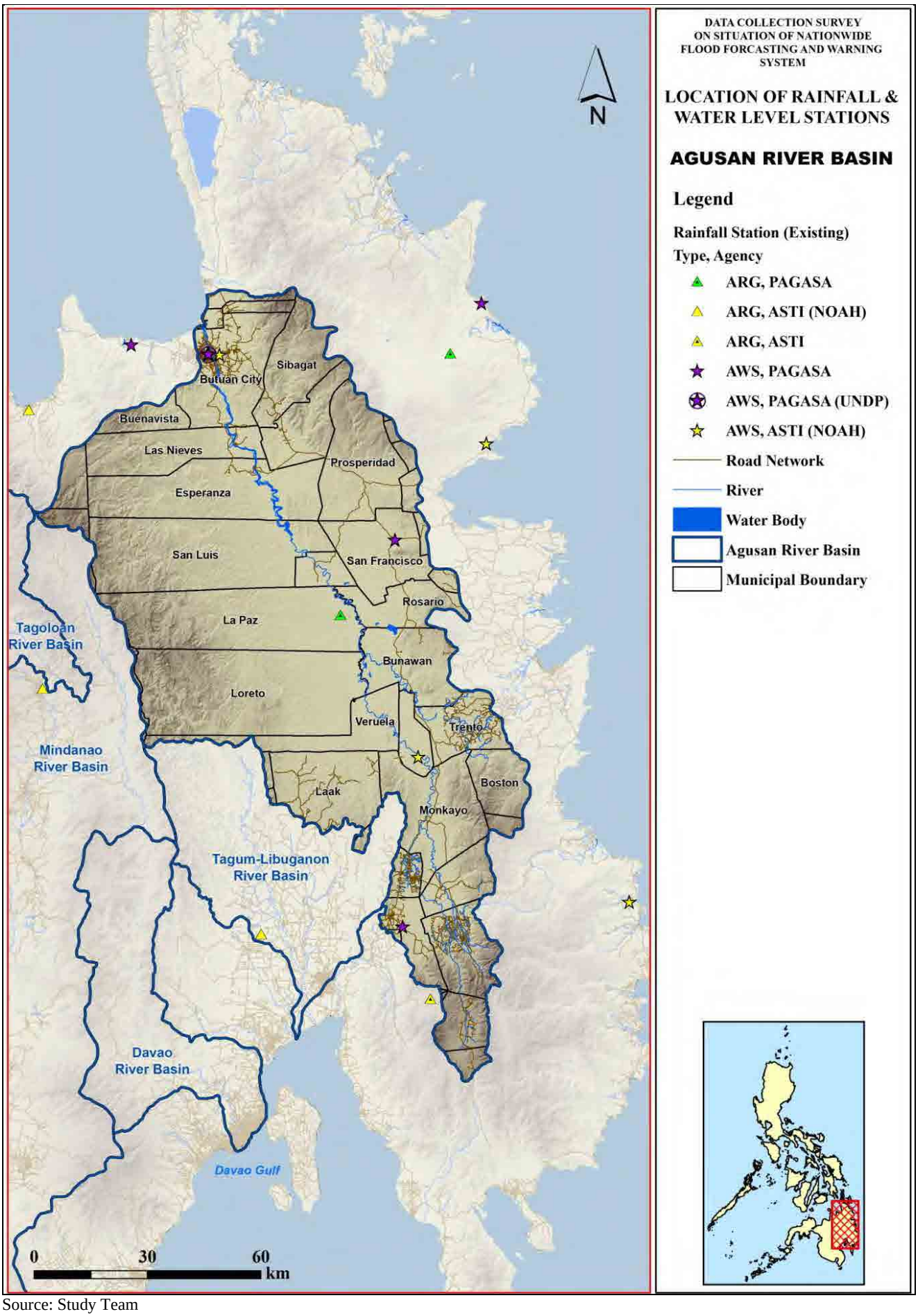

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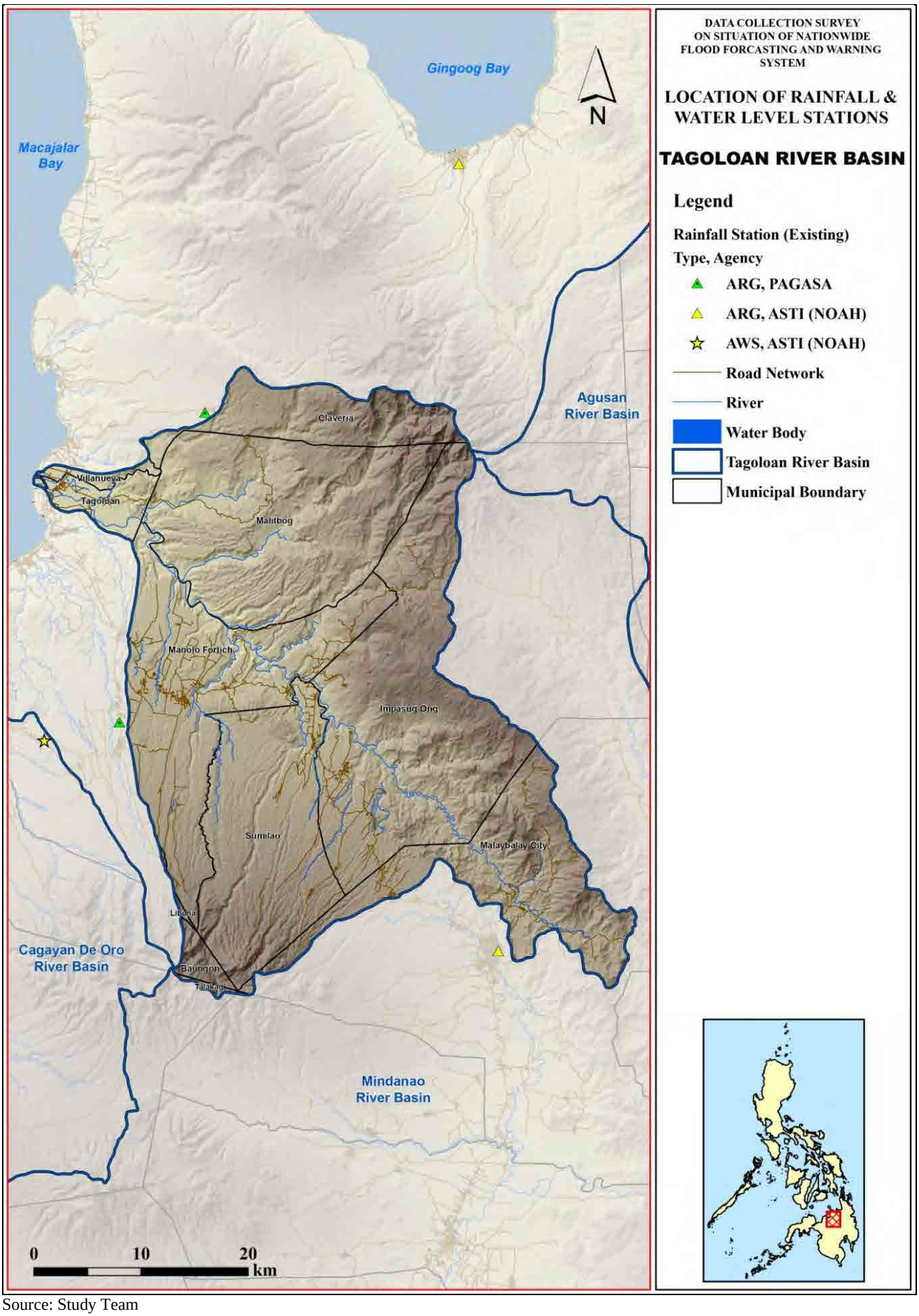
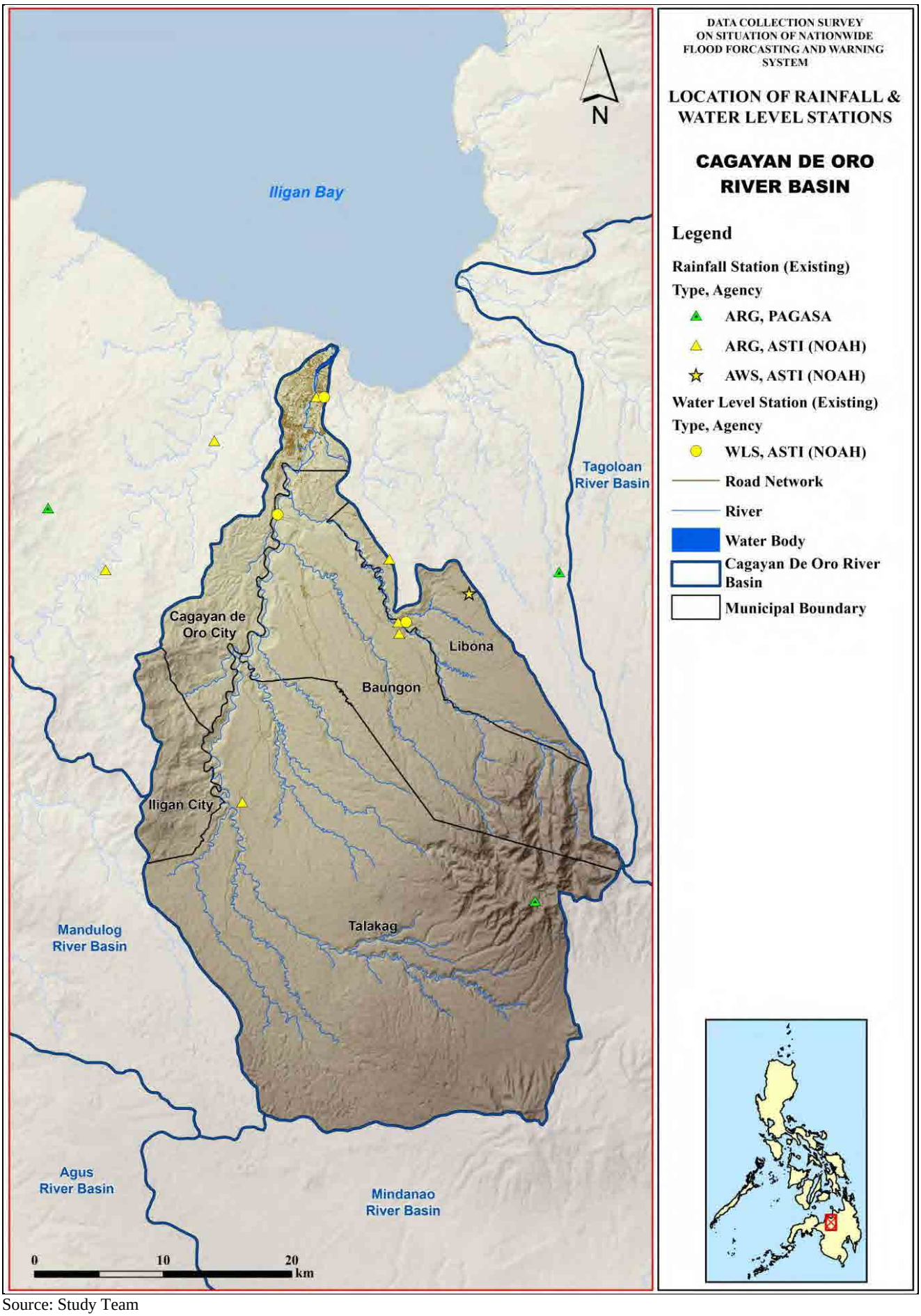
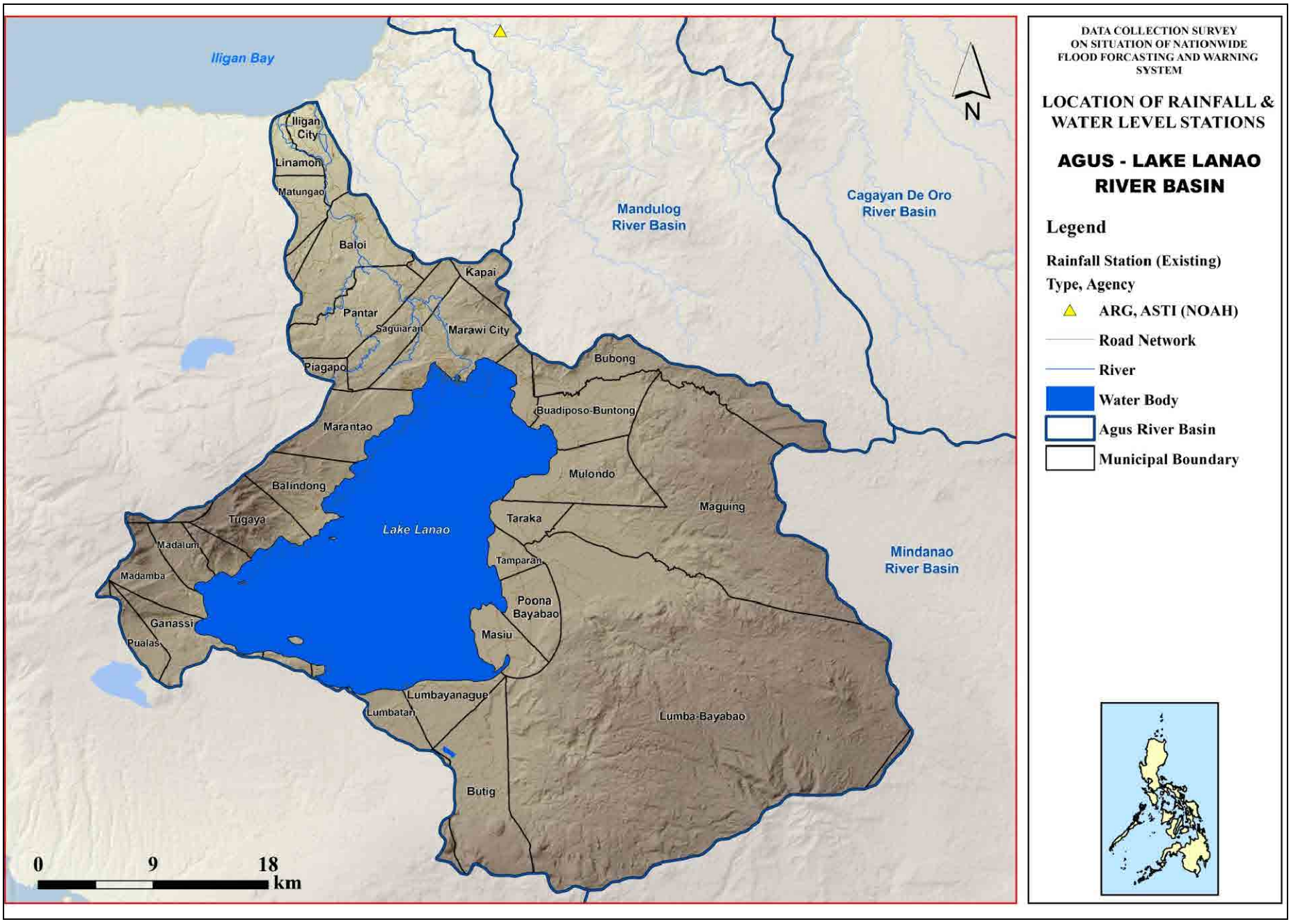


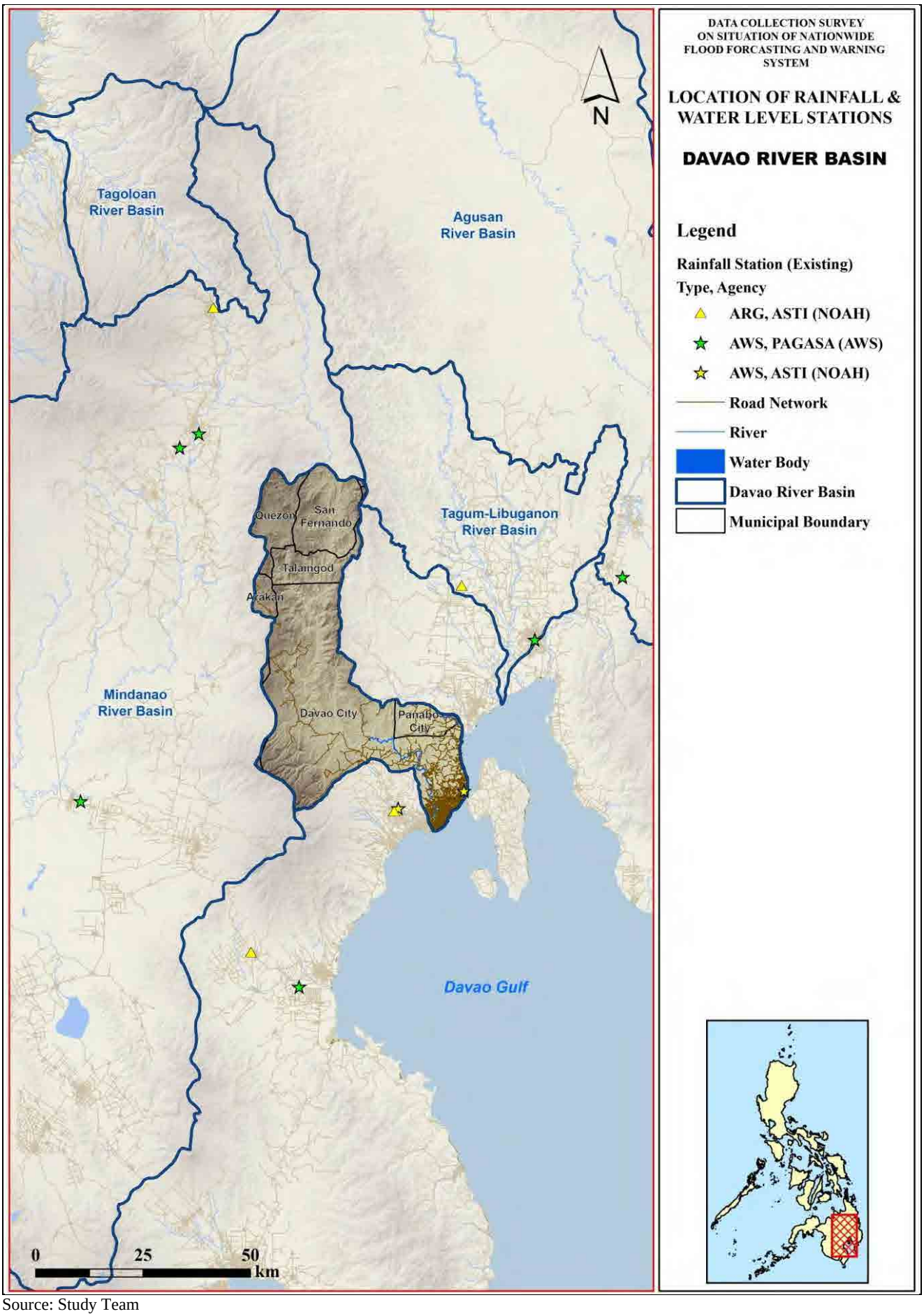
Source: Study Team



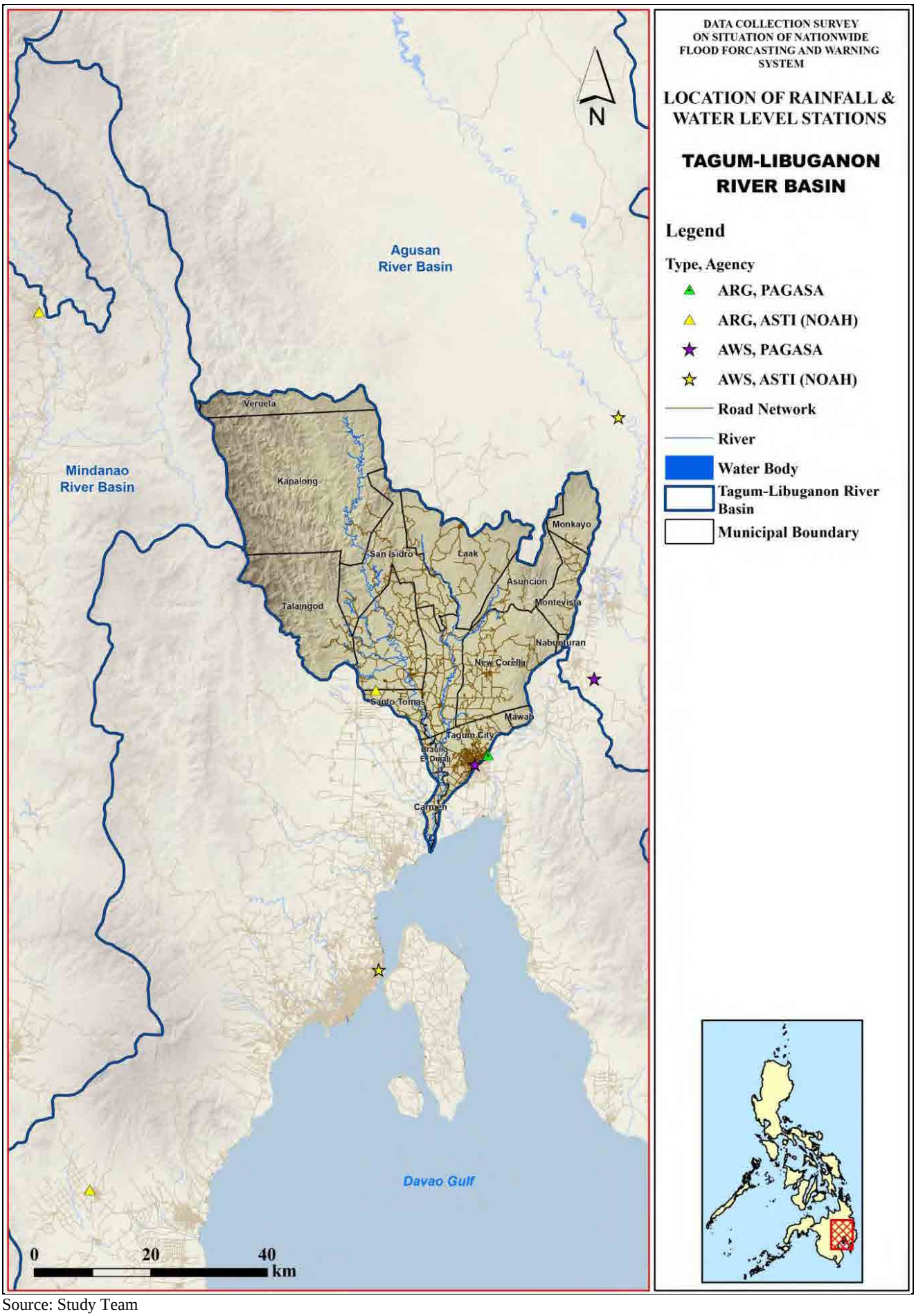
Source: Study Team



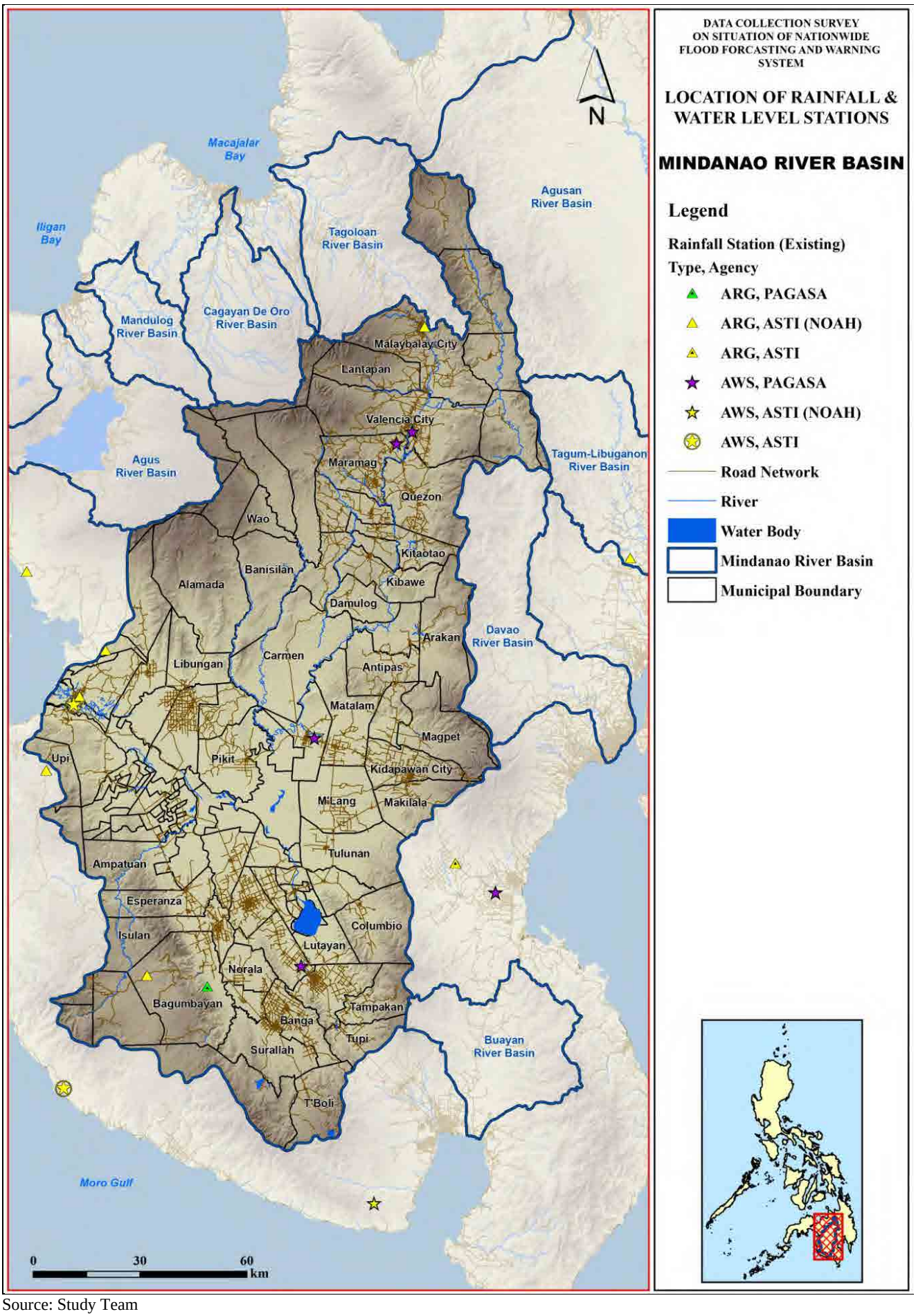
Source: Study Team



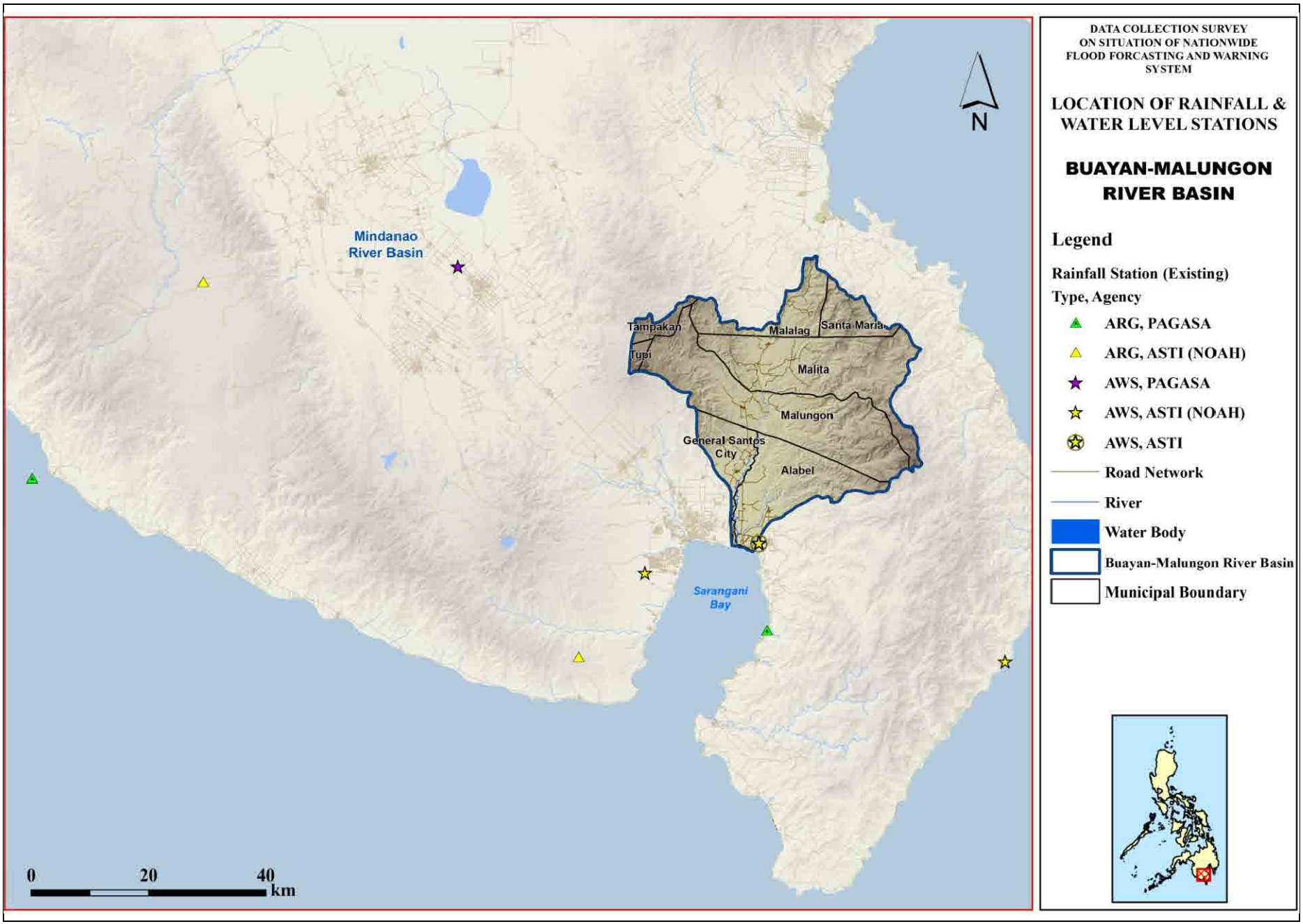
Source: Study Team



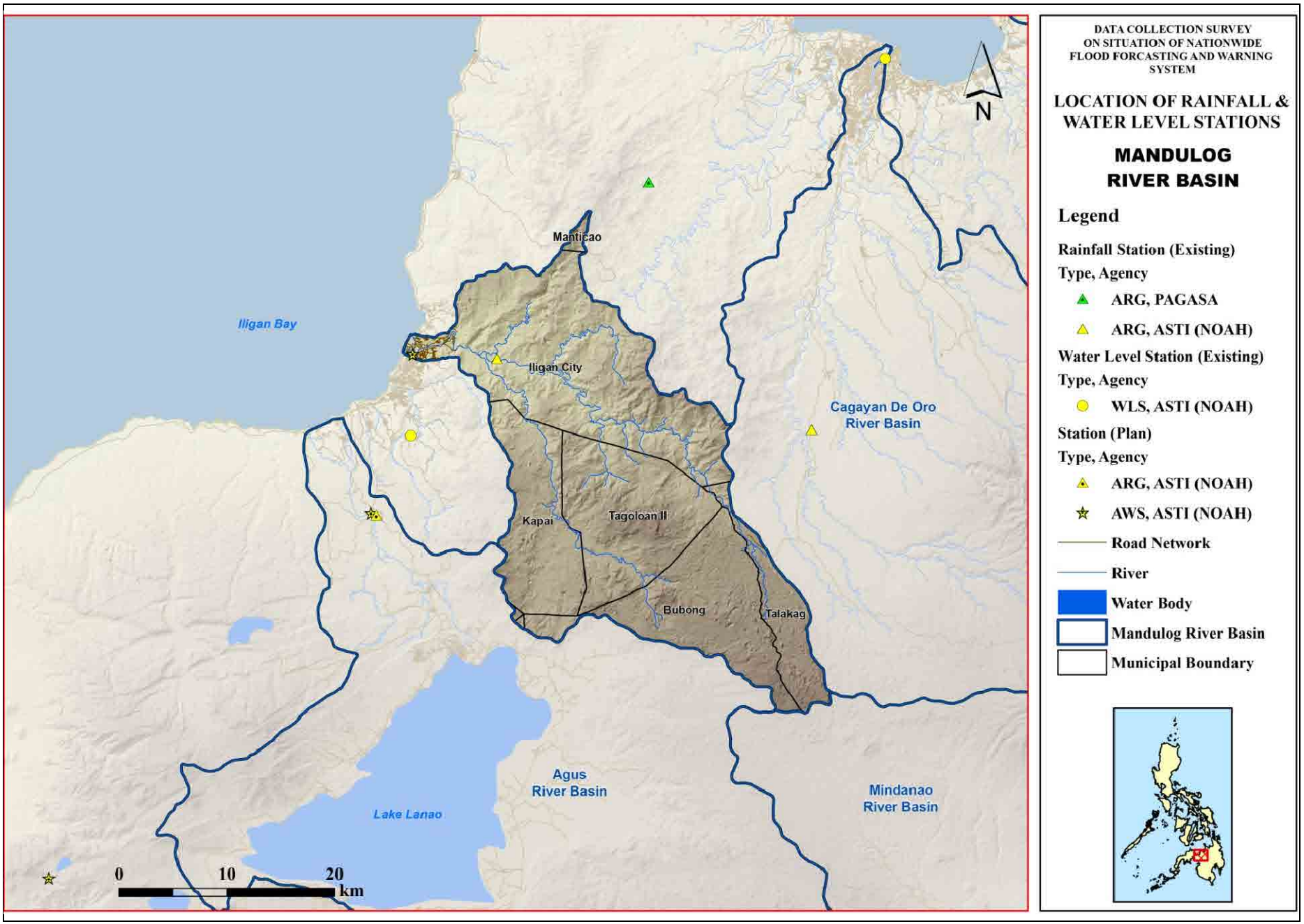
Source: Study Team



Source: Study Team



Source: Study Team



Source: Study Team

Appendix I

Rainfall and Water Level Records on 2013 August Flood Event

Appendix I Rainfall and Water Level Records on 2013 August Flood Event

I.1 Collected Data

There was a flood event in 2013 August in Metro Manila, caused by monsoon. Rainfall and water level records during the event were collected for verification of data. The duration of data is from August 17 to August 24, 2013.

List of Collected Data

Data	Station	Name	Interval	Observation	Gauge Type
Rainfall	Science Garden	Synoptic	1 hour	Manual	Standard type
		ASTI AWS	15 minutes	Automated	
		DPAWS (KOICA I)	1 hour	Automated	
Water Level	Sto. Nino	KOICA II	10 minutes	Automated	Floating type
		EFCOS	1 hour	Automated	Radar pulse type

[Data source]
Synoptic: PRSD Science Garden Complex Station. The data is collected from the station directory and is without quality control.
ASTI AWS: PAGASA METTSS/ETSP
DPAWS (KOICA I): PAGASA METTSS/ETSP
KOICA II: KOICA Database
EFCOS: EFCOS Database in WFFC. The data is extracted through csv converter as 1 hour interval data, but the original data is in 10 minutes interval.

I.2 Rainfall Data at Science Garden Station

Daily rainfall depth by AWS (ASTI AWS, DPAWS) shows smaller rainfall depth than Synoptic.

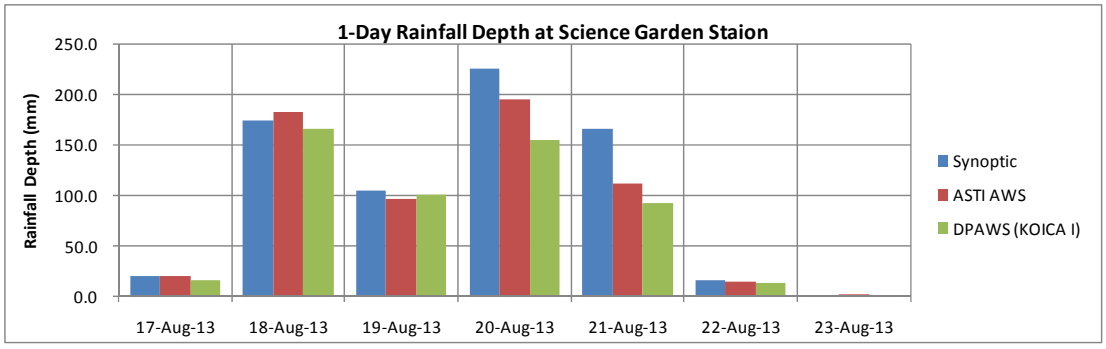
The difference of rainfall depth among three data becomes large during heavy rainfall event as shown in scatter plots in next page. In addition, hourly rainfall data of ASTI AWS and DPAWS are very similar.

Data acquisition rate of DPAWS is row comparing with Synoptic and ASTI AWS. One of the reasons of small rainfall depth at DPAWS seems to be caused by low data acquisition rate.

1-Day Rainfall Depth at Science Garden Station

Date	Synoptic	ASTI AWS	DPAWS (KOICA I)
17-Aug-13	20.2	20.1	16.5
18-Aug-13	174.3	182.9	166.5
19-Aug-13	105.5	96.0	101.5
20-Aug-13	225.7	195.3	154.5
21-Aug-13	166.1	112.5	93.0
22-Aug-13	16.6	14.7	13.5
23-Aug-13	1.4	1.8	1.0
Total	709.8	623.3	546.5

Source: Study Team



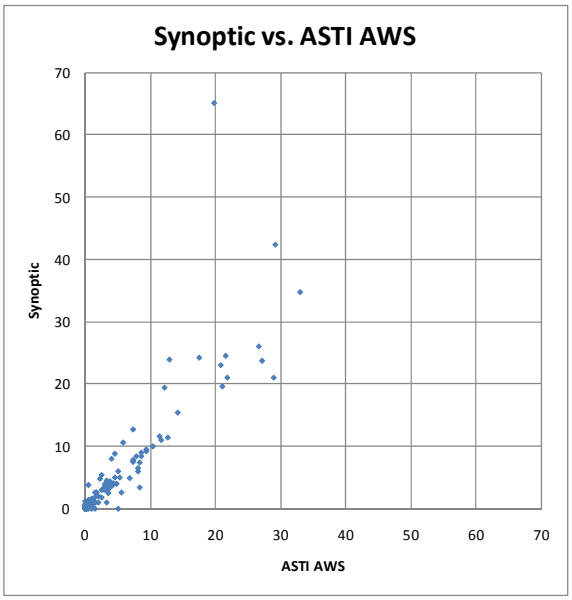
Source: Study Team

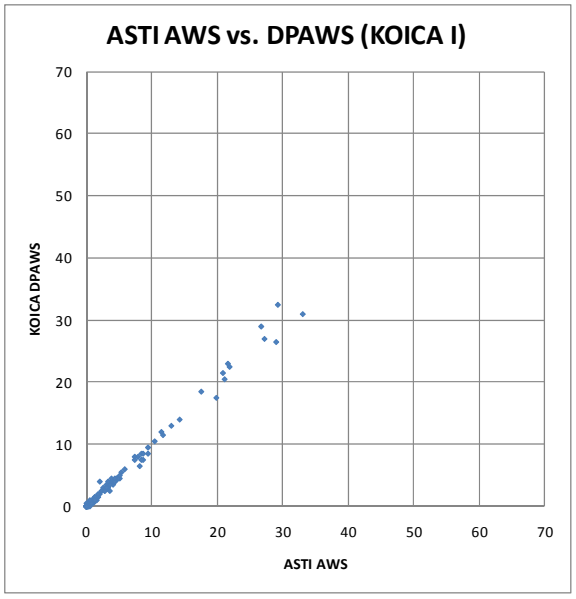
1-Day Rainfall Depth at Science Garden Station

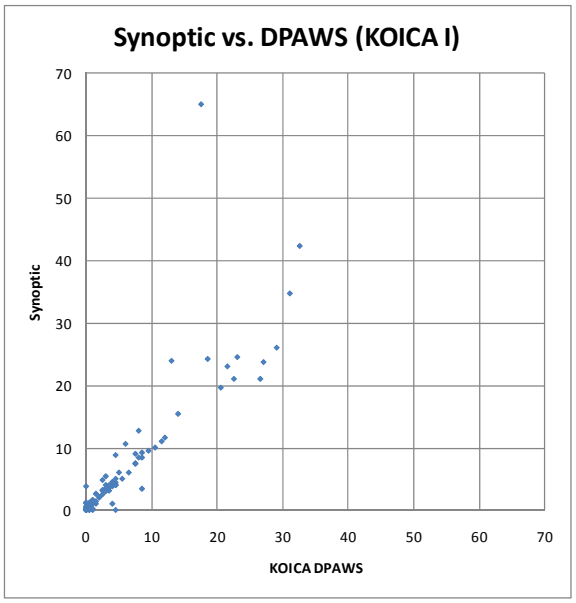
Data Acquisition Rate at Science Garden Station

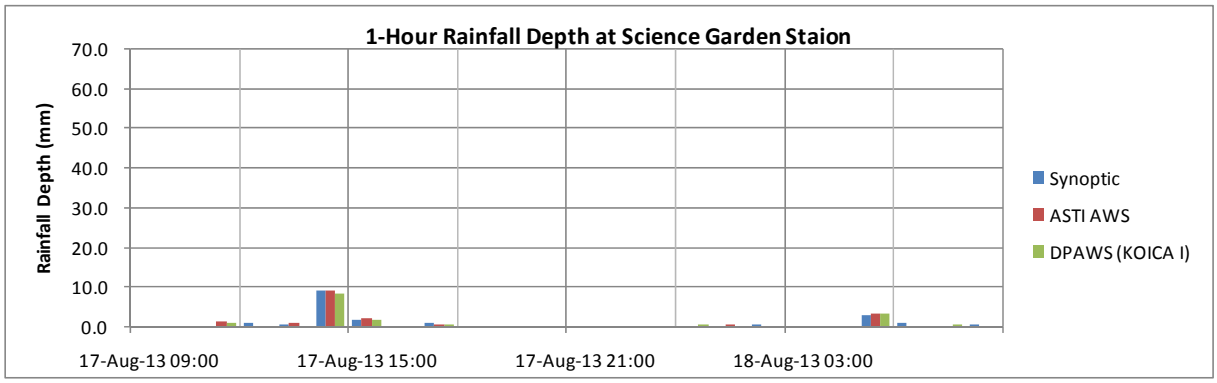
Type	Synoptic	ASTI AWS	DPAWS (KOICA I)
Interval	1 hr	15 min	1 hr
Recorded	168	672	124
Total	168	672	168
Percentage	100%	100%	74%

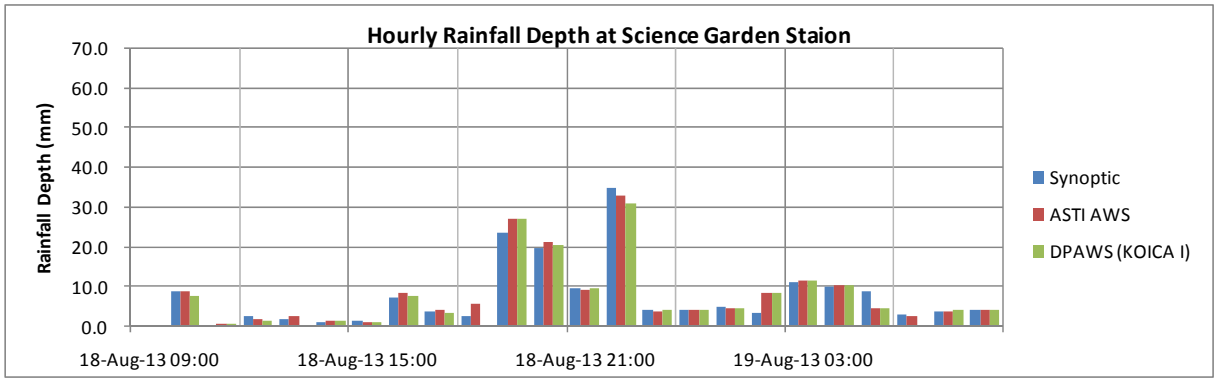
Source: Study Team

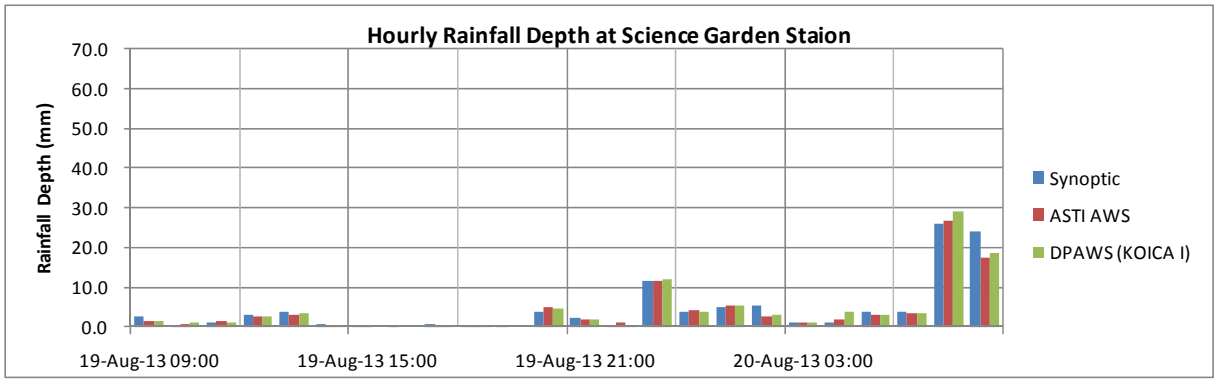

Synoptic vs. ASTI AWS
Synoptic
ASTI AWS
0
10
20
30
40
50
60
70

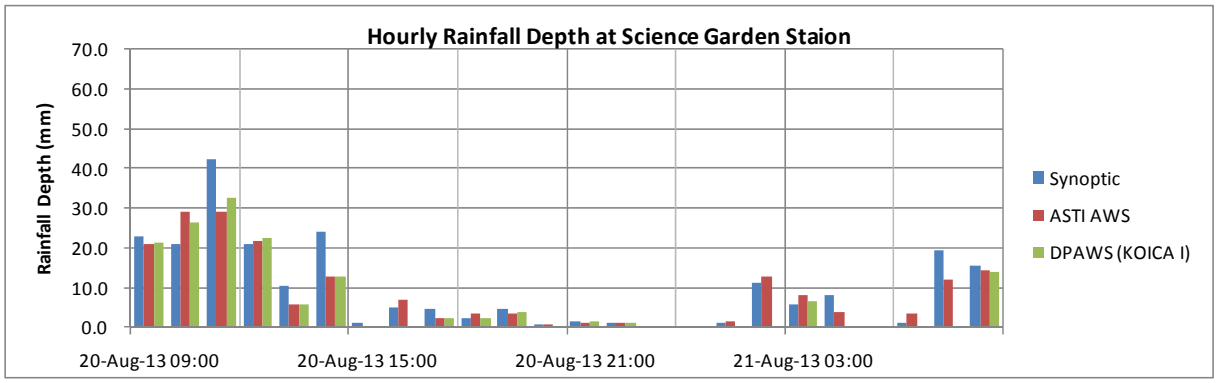

ASTI AWS vs. DPAWS (KOICA I)
KOICA DPAWS
ASTI AWS
0
10
20
30
40
50
60
70

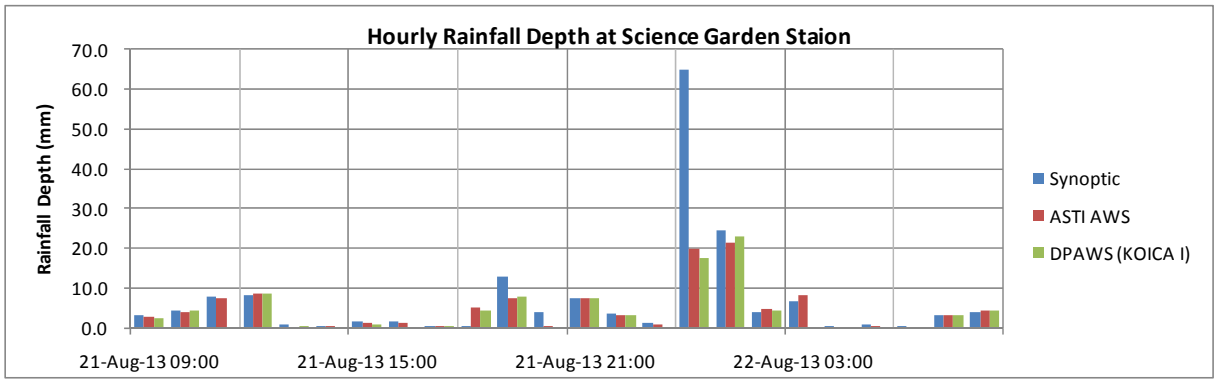

Synoptic vs. DPAWS (KOICA I)
Synoptic
KOICA DPAWS
0
10
20
30
40
50
60
70

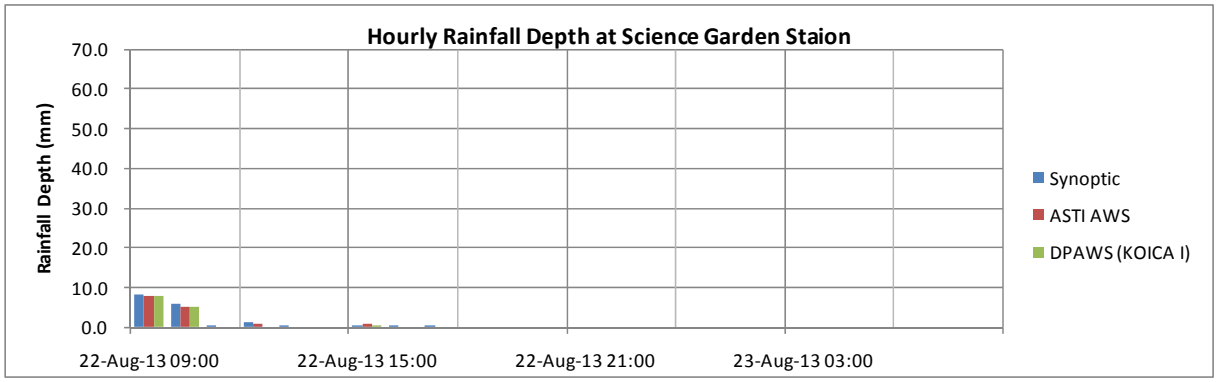

1-Hour Rainfall Depth at Science Garden Staion
Rainfall Depth (mm)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
17-Aug-13 09:00
17-Aug-13 15:00
17-Aug-13 21:00
18-Aug-13 03:00
Synoptic
ASTI AWS
DPAWS (KOICA I)

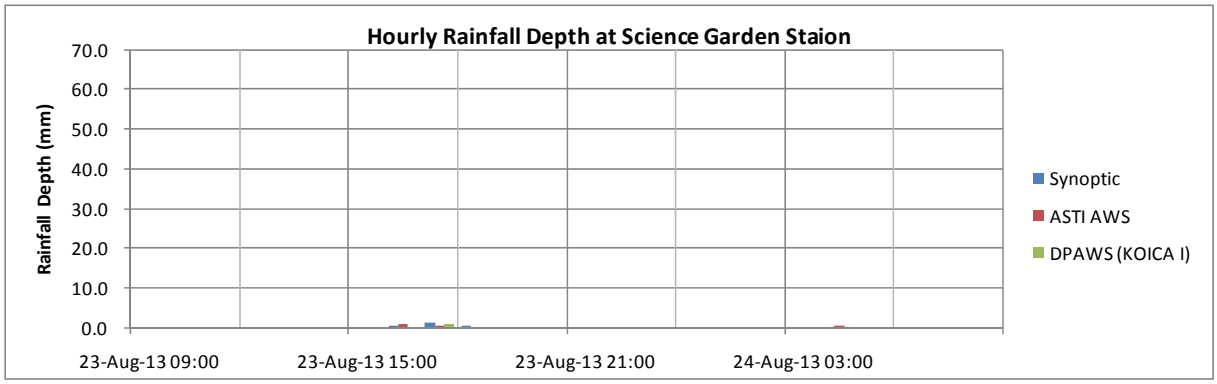

Hourly Rainfall Depth at Science Garden Staion
Rainfall Depth (mm)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
18-Aug-13 09:00
18-Aug-13 15:00
18-Aug-13 21:00
19-Aug-13 03:00
Synoptic
ASTI AWS
DPAWS (KOICA I)


Hourly Rainfall Depth at Science Garden Staion
Rainfall Depth (mm)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
19-Aug-13 09:00
19-Aug-13 15:00
19-Aug-13 21:00
20-Aug-13 03:00
Synoptic
ASTI AWS
DPAWS (KOICA I)


Hourly Rainfall Depth at Science Garden Staion
Rainfall Depth (mm)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
20-Aug-13 09:00
20-Aug-13 15:00
20-Aug-13 21:00
21-Aug-13 03:00
Synoptic
ASTI AWS
DPAWS (KOICA I)

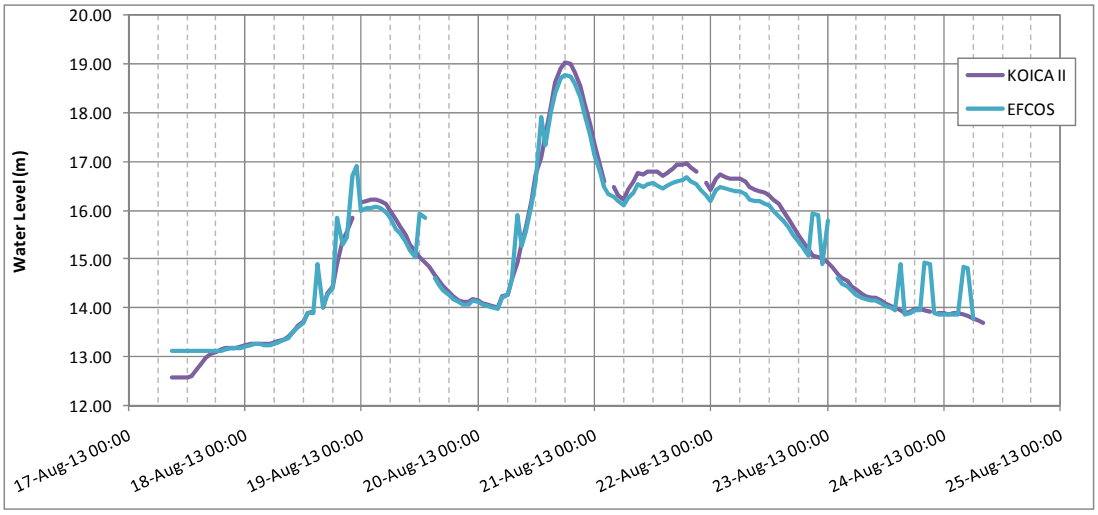

Hourly Rainfall Depth at Science Garden Staion
Rainfall Depth (mm)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
21-Aug-13 09:00
21-Aug-13 15:00
21-Aug-13 21:00
22-Aug-13 03:00
Synoptic
ASTI AWS
DPAWS (KOICA I)


Hourly Rainfall Depth at Science Garden Staion
Rainfall Depth (mm)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
22-Aug-13 09:00
22-Aug-13 15:00
22-Aug-13 21:00
23-Aug-13 03:00
Synoptic
ASTI AWS
DPAWS (KOICA I)


Hourly Rainfall Depth at Science Garden Staion
Rainfall Depth (mm)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
23-Aug-13 09:00
23-Aug-13 15:00
23-Aug-13 21:00
24-Aug-13 03:00
Synoptic
ASTI AWS
DPAWS (KOICA I)

I.3 Water Level Data at Sto. Nino Station

Water level data of KOICA II and EFCOS shows similar hydrograph. The number of error data of EFCOS seems to be larger than KOICA II. The observed water level by KOICA II is slightly higher than EFCOS during flood event.
Data acquisition rate of KOICA II and EFCOS is similar.



Source: Study Team

Water Level at Sto. Nino Station

Data Acquisition Rate at Sto. Nino Station

Type	KOICA II	EFCOS
Interval	10 min	1 hr
Recorded	838	165
Total	864	168
Percentage	97%	98%

Note: 10 minutes data of KOICA II was collected for 6 days only.
Source: Study Team

Rainfall and Water Level Data				(17 to 19 August 2013)		PAGE 1
		1. RAINFALL: Science Garden			2. WATER LEVEL: Sto. Niño	
Date	Time	1.1 Synoptic [1] (mm)	1.2 ASTI AWS [2] (mm)	1.3 KOICA DPAWS [2] (mm)	2.1 KOICA [3] (m)	2.2 EFCOS [4] (m)
17-Aug-13	0900		0.000		12.58	13.11
	1000		0.000	0.0	12.57	13.11
	1100	T	1.524	1.0	12.57	13.11
	1200	1.2	0.000	0.0	12.58	13.11
	1300	0.6	1.016		12.60	13.11
	1400	9.2	9.398	8.5	12.72	13.11
	1500	2.0	2.032	2.0	12.87	13.11
	1600	0.2	0.000		12.97	13.11
	1700	1.2	0.762	0.5	13.05	13.11
	1800	0.1	0.254		13.10	13.11
	1900	0.2	0.000	0.0	13.14	13.11
	2000	0.1	0.000	0.0	13.17	13.15
	2100	T	0.000	0.0	13.19	13.17
	2200	T	0.000	0.0	13.19	13.17
	2300	T	0.254		13.20	13.18
	0000	T	0.254	0.5	13.23	13.21
	0100	T	0.508		13.25	13.23
	0200	0.6	0.000		13.27	13.25
	0300		0.000		13.27	13.25
	0400		0.000		13.27	13.24
	0500	3.1	3.556	3.5	13.25	13.23
	0600	1.1	0.254	0.0	13.28	13.26
	0700	T	0.254	0.5	13.32	13.30
	0800	0.6	0.000	0.0	13.36	13.34
	TOTAL	20.2	20.066	16.5		
18-Aug-13	0900	T	0.000	0.0	13.40	13.38
	1000	9.0	8.636	7.5	13.53	13.52
	1100	0.2	0.508	0.5	13.63	13.61
	1200	2.6	1.778	1.5	13.72	13.70
	1300	1.8	2.540		13.90	13.89
	1400	1.0	1.270	1.5	13.92	13.89
	1500	1.6	1.016	1.0		14.90
	1600	7.4	8.382	7.5	14.01	14.01
	1700	3.6	4.064	3.5	14.30	14.28
	1800	2.6	5.588		14.44	14.40
	1900	23.7	27.178	27.0	14.89	15.84
	2000	19.6	21.082	20.5	15.38	15.29
	2100	9.5	9.398	9.5	15.55	15.45
	2200	34.7	33.020	31.0	15.85	16.72
	2300	4.0	3.810	4.0		16.92
	0000	4.0	4.318	4.0	16.16	15.98
	0100	5.0	4.572	4.5	16.20	16.06
	0200	3.4	8.382	8.5	16.21	16.05
	0300	11.0	11.684	11.5	16.23	16.08
	0400	10.0	10.414	10.5	16.18	16.04
	0500	8.8	4.572	4.5	16.12	15.97
	0600	3.0	2.540		16.00	15.85
	0700	3.8	3.810	4.0	15.83	15.63
	0800	4.0	4.318	4.0	15.66	15.52
	TOTAL	174.3	182.880	166.5		
19-Aug-13	0900	2.6	1.524	1.5	15.49	15.37
	1000	0.2	0.762	1.0	15.31	15.19
	1100	1.0	1.524	1.0	15.16	15.03
	1200	3.1	2.794	2.5	15.04	15.93
	1300	3.7	3.048	3.5	14.93	15.84
	1400	0.8	0.254	0.5	14.83	14.80
	1500	0.2	0.254	0.0	14.67	14.60
	1600	T	0.000	0.0	14.55	14.46
	1700	0.8	0.508	0.5	14.43	14.36
	1800	0.3	0.254	0.5	14.33	14.27
	1900	T	0.000	0.0	14.23	14.17
	2000	4.0	4.826	4.5	14.15	14.11
	2100	2.1	1.778	2.0	14.12	14.08
	2200	0.5	1.016	0.5	14.11	14.08
	2300	11.6	11.430	12.0	14.19	14.16
	0000	4.0	4.318	4.0	14.16	14.12
	0100	5.0	5.334	5.5	14.09	14.06
	0200	5.4	2.540	3.0	14.07	14.05
	0300	1.0	1.016	1.0	14.04	14.01
	0400	1.0	2.032	4.0	14.01	13.98
	0500	4.0	3.048	3.0	14.23	14.21
	0600	4.0	3.556	3.5	14.28	14.26
	0700	26.0	26.670	29.0	14.59	14.58
	0800	24.2	17.526	18.5	14.93	15.90
	TOTAL	105.5	96.012	101.5		

Source:
[1] PRSD Science Garden Complex
[2] PAGASA METTSS/ ETSP
[3] KOICA Database
[4] EFCOS Database

Rainfall and Water Level Data				(20 to 22 August 2013)		PAGE 2
		1. RAINFALL: Science Garden			2. WATER LEVEL: Sto. Niño	
Date	Time	1.1 Synoptic [1] (mm)	1.2 ASTI AWS [2] (mm)	1.3 KOICA DPAWS [2] (mm)	2.1 KOICA [3] (m)	2.2 EFCOS [4] (m)
20-Aug-13	0900	23.0	20.828	21.5	15.33	15.28
	1000	21.0	28.956	26.5	15.64	15.57
	1100	42.3	29.210	32.5	16.20	16.10
	1200	21.0	21.844	22.5	16.74	16.59
	1300	10.6	5.842	6.0	17.08	17.90
	1400	23.9	12.954	13.0	17.53	17.35
	1500	1.1	0.254		18.15	18.03
	1600	4.9	6.858		18.64	18.41
	1700	4.8	2.286	2.5	18.92	18.72
	1800	2.5	3.556	2.5	19.03	18.77
	1900	4.5	3.302	4.0	18.99	18.75
	2000	0.9	0.762	0.5	18.83	18.59
	2100	1.4	1.270	1.5	18.55	18.31
	2200	1.1	1.270	1.0	18.19	17.96
	2300	0.5	0.000		17.78	17.55
	0000	T	0.000		17.36	17.13
	0100	1.0	1.524		16.94	16.79
	0200	11.4	12.700		16.59	16.47
	0300	6.0	8.128	6.5		16.34
	0400	8.0	4.064		16.47	16.28
	0500	-	0.000	0.0	16.30	16.19
	0600	1.0	3.302		16.22	16.11
	0700	19.4	12.192		16.43	16.26
	0800	15.4	14.224	14.0	16.60	16.35
	TOTAL	225.7	195.326	154.5		
21-Aug-13	0900	3.2	2.794	2.5	16.75	16.52
	1000	4.4	3.810	4.5	16.74	16.48
	1100	7.8	7.366		16.79	16.54
	1200	8.4	8.636	8.5	16.80	16.57
	1300	0.7	0.000	0.5	16.78	16.50
	1400	0.4	0.508		16.72	16.44
	1500	1.6	1.270	1.0	16.76	16.50
	1600	1.6	1.270		16.86	16.56
	1700	0.6	0.508	0.5	16.93	16.60
	1800	T	5.080	4.5	16.94	16.63
	1900	12.7	7.366	8.0	16.97	16.68
	2000	3.8	0.508	0.0	16.88	16.58
	2100	7.5	7.366	7.5	16.78	16.52
	2200	3.5	3.302	3.0		16.41
	2300	1.4	0.762		16.55	16.30
	0000	65.0	19.812	17.5	16.42	16.20
	0100	24.5	21.590	23.0	16.64	16.41
	0200	4.0	4.826	4.5	16.73	16.47
	0300	6.5	8.128		16.68	16.44
	0400	0.5	0.000		16.66	16.41
	0500	1.0	0.254		16.64	16.39
	0600	T	0.000		16.64	16.38
	0700	3.0	3.048	3.0	16.59	16.34
	0800	4.0	4.318	4.5	16.49	16.23
	TOTAL	166.1	112.522	93.0		
22-Aug-13	0900	8.4	7.874	8.0	16.41	16.19
	1000	6.0	5.080	5.0	16.38	16.18
	1100	0.3	0.000	0.0	16.35	16.14
	1200	1.1	1.016		16.30	16.09
	1300	0.2	0.000		16.23	15.99
	1400	0.0	0.000	0.0	16.12	15.88
	1500	0.3	0.762	0.5	15.99	15.78
	1600	0.3	0.000	0.0	15.83	15.64
	1700	T	0.000	0.0	15.67	15.50
	1800		0.000		15.51	15.36
	1900		0.000	0.0	15.37	15.23
	2000		0.000		15.21	15.06
	2100		0.000	0.0	15.08	15.94
	2200		0.000	0.0	15.04	15.90
	2300		0.000	0.0	15.00	14.89
	0000		0.000	0.0	14.93	15.80
	0100		0.000	0.0	14.83	**.**
	0200		0.000	0.0	14.71	14.60
	0300		0.000		14.62	14.51
	0400		0.000	0.0	14.54	14.45
	0500		0.000	0.0	14.45	14.35
	0600		0.000		14.37	14.28
	0700		0.000		14.30	14.22
	0800		0.000	0.0	14.24	14.17
	TOTAL	16.6	14.732	13.5		

Source:
[1] PRSD Science Garden Complex
[2] PAGASA METTSS/ ETSP
[3] KOICA Database
[4] EFCOS Database

Rainfall and Water Level Data			(23 August 2013)			PAGE 3
		1. RAINFALL: Science Garden			2. WATER LEVEL: Sto. Niño	
Date	Time	1.1 Synoptic [1] (mm)	1.2 ASTI AWS [2] (mm)	1.3 KOICA DPAWS [2] (mm)	2.1 KOICA [3] (m)	2.2 EFCOS [4] (m)
23-Aug-13	0900		0.000	0.0	14.21	14.15
	1000		0.000	0.0	14.20	14.14
	1100		0.000	0.0	14.16	14.10
	1200		0.000		14.10	14.05
	1300		0.000	0.0	14.05	14.00
	1400		0.000	0.0	14.00	13.95
	1500		0.000	0.0	13.95	14.90
	1600	T	1.016		13.90	13.86
	1700	1.4	0.508	1.0	13.91	13.89
	1800	T	0.000	0.0	13.98	13.95
	1900		0.000	0.0	13.98	13.96
	2000		0.000		13.96	14.93
	2100		0.000	0.0	13.93	14.90
	2200		0.000	0.0		13.88
	2300		0.000	0.0	13.90	13.87
	0000		0.000	0.0	13.88	13.86
	0100		0.000	0.0	13.87	13.86
	0200		0.000	0.0	13.88	13.86
	0300		0.000		13.88	13.86
	0400		0.254		13.86	14.84
	0500		0.000		13.83	14.81
	0600		0.000	0.0	13.79	13.77
	0700		0.000		13.74	
	0800		0.000		13.70	13.68
	TOTAL	1.4	1.778	1.0		
	TOTAL					
	TOTAL					

Source:
[1] PRSD Science Garden Complex
[2] PAGASA METTSS/ ETSP
[3] KOICA Database
[4] EFCOS Database

Appendix J

Current Status of FFWS/FFWSDO Equipment as of September 2013

Appendix J, Current Status of Equipment as of September 2013

1 Current Status of PAGASA's FFWS

Components of PAGASA's FFWS are summarized as follows:

(1) FFWS in Pampanga River

Rainfall and water level stations in the Pampanga River which have improved in 2009 (there are two repeater stations: San Rafael and Cabanatuan)

Rainfall and Water Level Stations in Pampanga River

Rainfall Gauging Station	Rainfall/ Water Level Gauging Station	Water Level Sensor Type
Muñoz	Sapang Buho	Pressure Type
Calaanan (new)	Peñaranda (new) *1	Pressure Type
Gabaldon	Mayapyap; Not Operational *2	Pressure Type
Palali (new)	Zaragoza	Pressure Type
San Rafael (new)	San Isidro	Pressure Type
Sibul Spring	Sulipan	Pressure Type
Porac (new)	Sasmuan	Pressure Type
	Mexico (new)	Pressure Type
	Candaba	Pressure Type
	Arayat	Pressure Type
*1: Water level data was missing from 23:00, August 10, 2012 to 15:00, August 14, 2012 because the signal cable was cut by a rat. *2: Only water level data was stopped from July 20, 2013 due to vandalism.		

Source: Study Team

(2) FFWS in Agno River

Rainfall and water level stations in the Agno River which have improved in 2011 (there are two repeater stations: Mt. Ampucao and Rosales)

Rainfall and Water Level Stations in Agno River

Rainfall Gauging Station	**Rainfall/ Water Level Gauging Station**	**Water Level Sensor Type**
Camp O'Donnel (new)	Sta. Maria (new)	Pressure Type
Maasin (new)	Binalonan (new)	Pressure Type
Mt. Ampucao NIA (new)	Tibag	Pressure Type
	Carmen	Pressure Type
	Bugallon	Pressure Type
	Sta. Barbara	Pressure Type
	San Vicente (near old Wawa)	Pressure Type
	Mapandan (new)	Pressure Type

Source: Study Team

(3) Microwave radio telecommunication networks

Microwave radio telecommunication networks have improved in 2009 and 2011 as follows:

Microwave Radio Telecommunication Networks

Link No.		Description
1		7.5 GHz microwave radio
	(1)	Science Garden – San Rafael (new)
	(2)	San Rafael (new) – Pampanga Sub-center (San Fernando)
	(3)	San Rafael (new) – Gapan
	(4)	Gapan – Cabanatuan
	(5)	Cabanatuan – Pantabangan Radio Station
	(6)	Cabanatuan – Mt. Cuyapo
	(7)	Mt. Cuyapo – Agno Sub-Center (Rosales)
2		18 GHz microwave radio
	(1)	Science Garden – NIA Central Office
	(2)	OCD – Rosario (EFCOS): transferred from NIA – OCD in August 2012
3		26 GHz FWA
	(1)	Binga FFWSDO office – Binga Power Station

Source: Study Team

The components for the PAGASA FFWS improvement project have been implemented without major trouble except for the following items:

- Cut of the optic fiber between the Science Garden and WFFC on 4 November 2012, because of the new road construction works after the dismantling of houses of the informal settlers; Wipass system (26 GHz wireless radio) has been installed as a temporary connection on 6 November 2012.
- Disconnection of NPC/ NGCP network at the beginning of November 2012 (no telemetry data monitoring for Ambuklao and Binga dams); the telemetry equipment situated at both dams are operational.

(4) FFWS in Cagayan River

The expected useful lives of equipment in the rainfall and water level stations of the Cagayan River (there is one repeater station in Ilagan) have already been exceeded.

Rainfall and Water Level Stations in Cagayan River

Rainfall/ Water Level Gauging Station	Water Level Sensor Type	Status
Maris Dam	Pressure sensor	Operational
Gamu	Pressure sensor	Operational
Pangat	Pressure sensor	Operational
Tumauini	Pressure sensor	WL: Non-operational
Tuguegarao (Bunton)	Sensing pole	WL: Non-operational due to vandalism on the sensor cable

Source: Study Team

The following 800 MHz and 2 GHz radio links have not been operational due to the radio interference from cellular phone networks:

- Cauayan and Ilagan repeater stations (no dedicated wireless communication link between PAGASA sub-center and Magat Dam office)
- Magat Dam office and Cauayan repeater station (no dedicated wireless communication link between PAGASA WFFC and Magat Dam office)

- Cauayan and Mt. Ampucao repeater stations (NIA)
- Mt. Ampucao and Tarlac repeater stations
- Tarlac and Cabanatuan repeater stations

(5) FFWS in Bicol River

The expected useful lives of equipment in the rainfall and water level stations in the Bicol River (there are two repeater stations: Sipocot Hill and Iriga) have already been exceeded.

Rainfall and Water Level Stations in Bicol River

Rainfall Gauging Station	Status	
Napolidan	Non-operational since 1995 due to vandalism	
Ocampo	Operational	
Ligao	Operational	
Rainfall/Water Level Gauging Station	Water Level Sensor Type	Status
Sipocot	Sensing pole	WL: Non-operational
Balongay	Sensing pole	WL: Non-operational
Camaligan	Floating	Operational
Ombao	Floating	Operational
Bato	Sensing pole	WL: Non-operational
Buhi	Sensing pole	WL: Non-operational

Source: Study Team

The following 800 MHz and 2 GHz radio links have not operated due to the radio interference from cellular phone networks:

- Naga sub-center and Gapas repeater station
- Gapas and Tanay repeater stations

The 7 GHz radio equipment between the Science Garden and Tanay repeater station via Tanay reflector station has not been in operation since the lifetime of the equipment has already passed.

2 Components of NIA's Magat FFWSDO

Components of NIA's Magat FFWSDO are summarized as follows:

(1) Rainfall and Water Level Stations through VHF radio

The expected useful lives of equipment in the rainfall and water level stations in the Magat dam catchment area via VHF radio, which has been constructed in 1986 through funding aid from the OECF, have already been exceeded.

Rainfall and Water Level Stations in the Magat Dam Catchment Area

Rainfall Gauging Station	Status	Water Level Gauging Station	Water Level Sensor Type	Status
Sto. Domingo	Operational	Sto. Domingo	Sensing pole	Non-operational
Dumayap	Operational	Magat Dam	Pressure	Operational *
Buyuc	Non-operational			
Dantor	Non-operational			
Halong	Operational			
Magat Dam	Operational			
* Renovated by TCP in 2011, but the decoder has damaged by lightning on August 2013.				

Source: Study Team

(2) Rainfall and Water Level Stations through satellite

Rainfall and water level stations in the Magat Dam catchment area via satellite communication have been established in 2010 through funding from NIA as follows:

Rainfall and Water Level Stations in the Magat Dam Catchment Area via Satellite

Rainfall Gauging Station	Status	Water Level Gauging Station	Water Level Sensor Type	Status
Buyuc	Operational	Barelbet	Pressure	Operational
Halong	Operational	Ibulao	Pressure	Operational
Kiangan	Operational			
Imugan	Operational			
Dupax del Norte	Operational			
Banaue	Operational			

Source: Study Team

(1) Water level through SMS

Water level stations in the Magat River via SMS communication have been established in 2012 through funding from NIA.

Water Level Stations in Magat River via SMS communication

Water Level Gauging Station	Water Level Sensor Type	Status
Laiog 2	Ultrasound	Operational
Bagong Sikat	Ultrasound	Operational

Source: Study Team

(2) Warning Stations

(a) Warning equipment through VHF radio

The expected useful lives of equipment in the warning stations at the Magat River, which have been constructed in 1986 through funding aid from the OECF, have already been exceeded.

Warning Stations at Magat River

Warning Station (Type A)	Status	Warning Station (Type B)	Status
Ramon	Non-operational	Sinamar Norte	Manual Operation
San Mateo	Manual Operation	Centro-II	Manual Operation
Cabatuan	Manual Operation	Rang-Ay	Manual Operation
Aurora	Manual Operation	San Andres	Non-operational
Luna	Manual Operation	Lalog-I	Manual Operation
Renia Mercedes	Non-operational	Banguero	Manual Operation
Nagulian	Manual Operation	Burgos	Non-operational
Gamu	Manual Operation		
Type A consists of speaker and radio telephone set. Type B consists of speaker only.			

Source: Study Team

(b) Public Warning Stations

Public warning stations at the Magat River which have been renovated in 2010 through funding from NIA

Public Warning Stations at the Magat River

Warning Station	Status
Magat Central Office	Operational
San Mateo	Operational
Banquero	Operational
Sinamar	Operational
Gamu	Operational
Cabatuan	Operational

Source: Study Team

3 Components of NIA's Pantabangan FFWSDO

Components of NIA's Pantabangan FFWSDO are summarized as follows:

(1) Rainfall and Water Level Stations through VHF radio

The expected useful lives of equipment in the rainfall and water level stations in the Pantabangan Dam catchment area via VHF radio, which have been constructed in 1986 through funding aid from OECF, have been rehabilitated in 2009 by fund of NIA.

Rainfall and Water Level Stations in the Pantabangan Dam Catchment Area

Rainfall Gauging Station	Status	Water Level Gauging Station	Water Level Sensor Type	Status
Bunga	Operational	Pantabangan Dam crest	Pressure	Operational *1
Padaris	Operational	Masiway Dam	Pressure	Non-operational *2
Marikit	Operational			
Conversion (new)	Operational			
Pantabangan dam office	Operational			
*1: Renovated by TCP in 2011. *2: The water level sensor was washed out by the typhoon "Pepeng" in 2009.				

Source: Study Team

(2) Warning Stations

The useful lives of equipment in the warning stations at the Pampanga River, which have been constructed in 1986 through funding aid from the OECF, have already been exceeded.

Warning Stations at Pampanga River

Warning Station (Type A)	Status	Warning Station (Type B)	Status
Rizal	Manual Operation	Paco Roman	Manual Operation
Bongabon	Manual Operation	Vega Grande	Manual Operation
Gen. Natividad	Manual Operation	Sapang Buho	Manual Operation
Palayan	Manual Operation	Talabutab Sur	Manual Operation
Cabanatuan	Non-operational	Atate Dam	Manual Operation
Santa Rosa	Manual Operation	Platero	Manual Operation
		Calawagan	Manual Operation
		Balite	Manual Operation
		Mayapyap	Manual Operation
		Pagas	Non-operational
		Aduas	Manual Operation
		Bonifacio	Manual Operation
		San Gregorio	Manual Operation

Source: Study Team

4 Components of NPC's Binga/Ambuklao FFWSDO

Components of NPC's Binga/Ambuklao FFWSDO are summarized as follows:

(1) Rainfall and Water Level Stations through VHF radio

The useful lives of equipment at the rainfall and water level stations in Ambuklao and Binga dam catchment areas via VHF radio, which have been constructed in 1994 through funding aid from the OECF (there is one repeater station: Mt. Toyangan), have already been exceeded.

Rainfall and Water Level Stations in Ambuklao and Binga Dam Catchment Areas

Rainfall Gauging Station	Status	Water Level Gauging Station	Water Level Sensor Type	Status
Badyan	Operational	Ambklao dam	Pressure	Operational *
Apunan	Operational	Binga dam	Pressure	Operational *
Bobok	Operational			
Ambuklao Dam	Operational			
Binga Dam	Operational			
* Renovated by TCP in 2011, but the decoder has damaged by lightning on August 2013.				

Source: Study Team

(2) Rainfall and Water Level Stations through VHF radio in San Roque Dam

Rainfall and water level stations in the San Roque Dam catchment area via VHF radio have been constructed in 2004 through funding aid from the OECF (there is one repeater station: Mt. Ampacao NPC).

Rainfall and Water Level Stations in the San Roque Dam Catchment Area

Rainfall Gauging Station	Status	Water Level Gauging Station	Water Level Sensor Type	Status
Baloy	Non-operational	Pitican	Ultrasound	Non-operational

Source: Study Team

(3) Warning Stations

The useful lives of equipment in the warning stations at the Agno River, which have been constructed in 1994 through funding aid from the OECF, have already been exceeded.

Warning Stations at the Agno River

Warning Station (Type A)	Status	Warning Station (Type B)	Status
San Nicolas	Operational	San Roque	Operational
San Manuel	Operational	Sto.Tomas	Operational
Tayug	Operational	San Vincente West	Operational
Asingan	Operational	Sta.Ana	Operational
Sta.Maria	Operational	Bantog	Operational
Rosales	Operational	Carosucan	Operational
Asingan	Operational	Cal-Litang	Operational
		Pias	Operational
		San Blas	Operational
		Rosales PAGASA	Non-operational
		Carmen	Non-operational
Type A consists of speaker and radio telephone set. Type B consists of speaker only.			

Source: Study Team

5 Components of NPC's Angat FFWSDO

Components of NPC's Angat FFWSDO are summarized as follows:

(1) Rainfall and Water Level Stations through VHF radio

The useful lives of equipment in the rainfall and water level stations in the Angat Dam catchment area via VHF radio, which have been constructed in 1986 through funding aid from the OECF, have already been exceeded.

Rainfall and Water Level Stations in Angat Dam Catchment Area

Rainfall Gauging Station	Status	Water Level Gauging Station	Water Level Sensor Type	Status
Maputi	Non-operational	Norzagaray	Sensing Pole	Non-operational

Talaguio	Operational	Bustos Dam	Pressure Type	Non-operational
Matulid	Operational	Angat Dam	Pressure Type	Operational *
Angat Dam	Operational			
* Renovated by TCP in 2011				

Source: Study Team

(2) Warning Stations

The useful lives of equipment in the warning stations at the Angat River, which have been constructed in 1986 through funding aid from the OECF, have already been exceeded.

Warning Stations at the Angat River

Warning Station (Type A)	Status	Warning Station (Type B)	Status
Norzagaray	Operational	Padling	Operational
Angat	Operational	Matictic	Operational
San Rafael	Operational	Binagbag	Operational
Bustos	Operational	Maronquilio	Operational
Baliuag	Operational	Donacion	Operational
Plaridel	Operational	Bonga Mayor	Operational
Pulilan	Operational	Sabang	Operational
		Sta.Barbara	Operational
		Bintog	Operational
		Tibag	Operational
Type A consists of speaker and radio telephone set.			
Type B consists of speaker only.			

Source: Study Team

6 Components of EFCOS Phase II

Components of MMDA's EFCOS are summarized as follows:

(1) Rainfall and water level stations in Marikina-Pasig river basin via VHF radio

There are two (2) repeater stations: Antipolo and Science Garden.

Rainfall and Water Level Stations in Marikina-Pasig River Basin

Rainfall Gauging Station	Status	Water Level Gauging Station	Water Level Sensor Type	Status
Boso-Boso	Operational	Montalban	Floating	Operational
Mt. Oro	Operational	Sto. Nino	Floating	Operational
Aries	Operational	Rosario JS	Crystal Quartz	Operational
Mt. Campana	*	Rosario LS	Crystal Quartz	*
Science Garden	*	Pandacan	Floating	Operational
Nangka	Operational	Fort Santiago	Floating	Operational
Napidan JS/LS	*	Angono	Floating	Operational
		San Juan	Floating	Operational
		Nangka	Floating	Operational
		Napidan JS	Crystal Quartz	*
		Napidan LS	Crystal Quartz	*
* Not monitored in PAGASA WFFC				

Source: Study Team

(2) Warning posts at Marikina-Pasig river basin

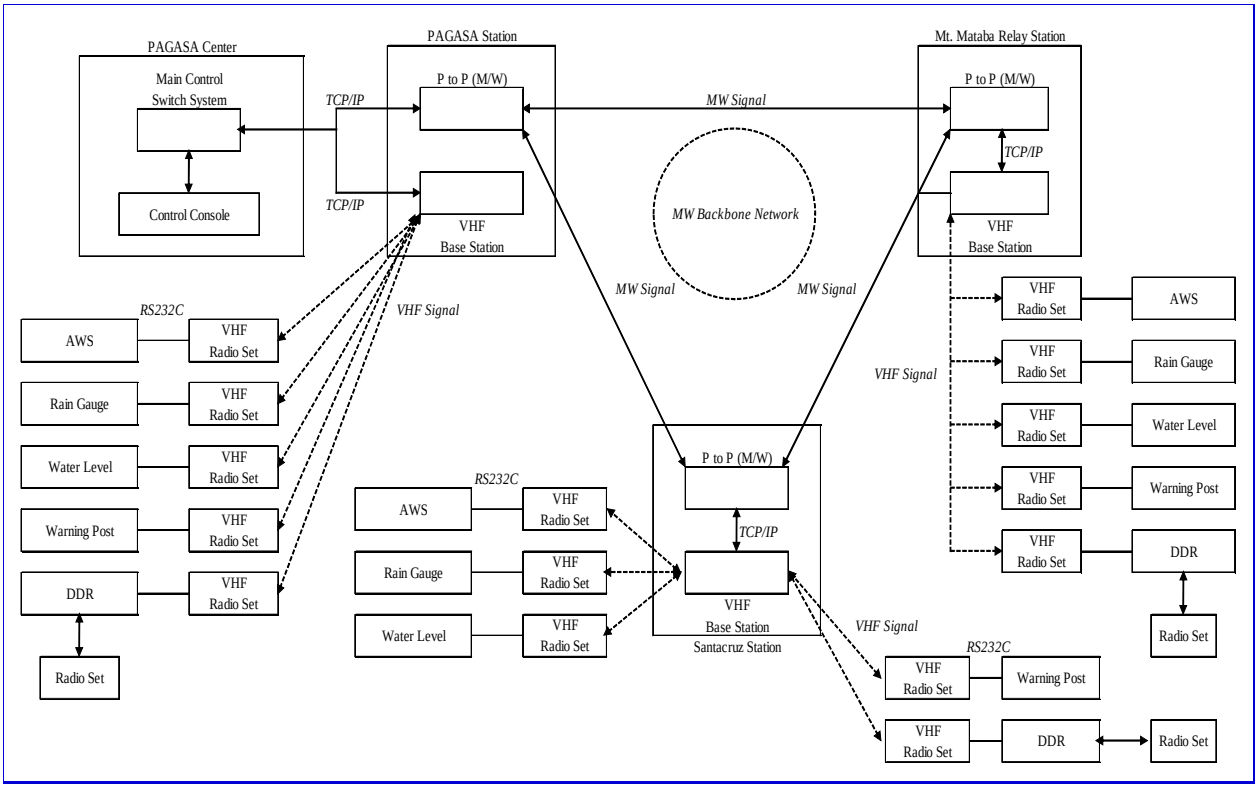
Warning Posts at Marikina-Pasig River Basin

Warning Post	Status
No. 1 at Rosario Master Control Station	Operational
Nos. 2 to 9 at the east and west main dikes of Mangahan flood way	Operational

Source: Study Team

7 Components of KOICA-II

Outline of KOICA-II is shown in the following figure below.



Source: KOICA Report

Outline of KOICA-II System

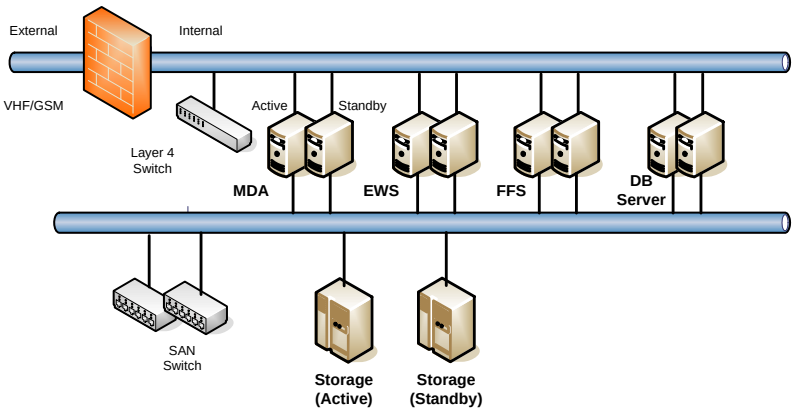
The KOICA-II system is called "Early Warning and Monitoring System for Disaster Mitigation in Metro Manila" which consists of the following three components: 1) Servers, 2) Base Stations, and 3) Posts as per the document prepared by KOICA.

(i) Servers gather information such as data of each post or information of stations.

(ii) Base stations connect the weather survey server with the posts using Ethernet and RF signal with VHF radio set.

(iii) Posts monitor the water level, rain gauge, and AWS.

Hardware configurations of the servers, in which the OS' are operated by Linux Clustering (iLO), are shown in the subsequent figure and table.



Source: KOICA Report

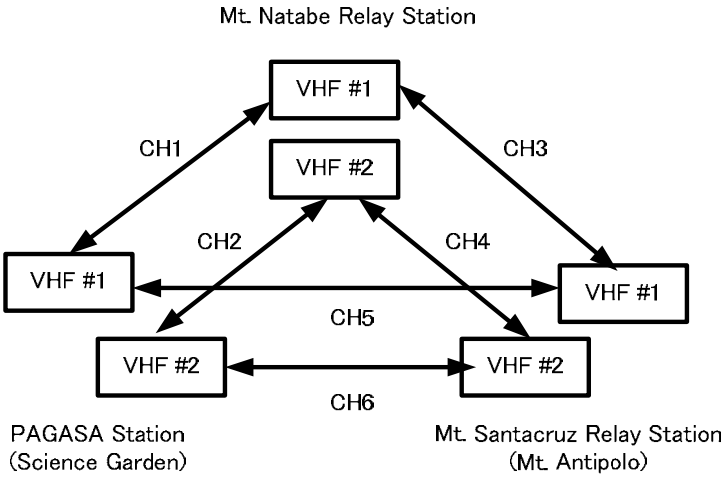
Hardware Configurations of the Servers

Hardware Name (Active and Standby)	Application
Measured Data Acquisition (MDA)	NLB, Windows 2008
Early Warning System (EWS)	H.A Solution ReadHat Linux WAS
Flood Forecast System (FFS)	H.A Solution ReadHat Linux WAS
Data Base Server (DB)	H.A Solution ReadHat Linux MySQL

Source: KOICA Report

The hardware configuration of the base stations consists of VHF radio/ SMS equipment which collects data measurements from the post and microwave radio equipment (5 GHz wireless LAN) transmitting the data to the servers at PAGASA WFFC through the Science Garden.

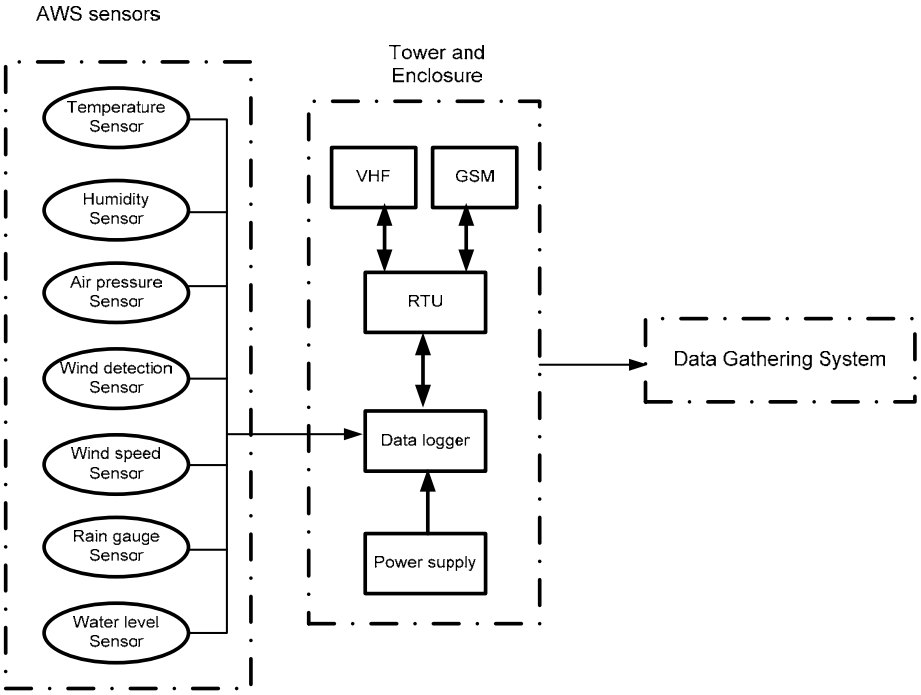
Each of the three (3) base stations is equipped with two (2) VHR radio sets, i.e., a total of six (6) channels. If data cannot be transmitted through radio, it can be sent through SMS as back-up function



Source: KOICA Report

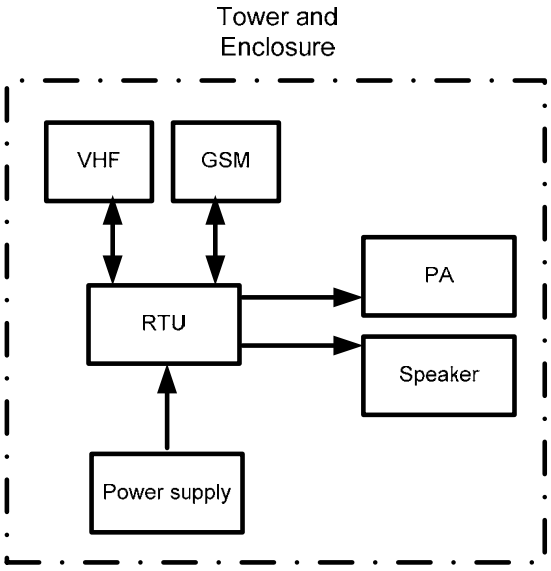
VHF Radio Configuration

The hardware configurations of the posts are shown in the subsequent tables below:



Source: KOICA Report

Hardware Configuration of the Post (AWS)



Source: KOICA Report

Hardware Configuration of the Post (Warning)

ARG and Water Level Stations in the Marikina-Pasig River Basin (KOICA-II)

ARG	Status	Water Level Gauging Station	Water Level Sensor Type	Status
La Mesa Dam	Operational	Burgos	Radar Pulse	Operational
Guadanoville	Operational	San Mateo-1	Radar Pulse	Operational
Markia (Youth Comap)	Operational	Mindanao	Radar Pulse	Operational
Antipolo	Operational	Tumana Bridge	Radar Pulse	Operational
Cainta	Operational	Sto. Nino	Radar Pulse	Operational
Pasig City Hall	Operational	Marcos Highway	Radar Pulse	Operational
Napolidan-2	Operational	Rosario JS	Radar Pulse	Operational
Fort Area Synop	Operational	Rosario LS	Radar Pulse	Operational

Airport	Operational	Napidan-1	Radar Pulse	Operational
		Napidan-2	Radar Pulse	Operational

Source: KOICA Report

AWS in the Marikina-Pasig River Basin (KOICA-II)

AWS	Status
Antipolo	Operational
Fort Area Synop	Operational
La Mesa Dam	Operational
Pasig City Hall	Operational

Source: KOICA Report