FLOOD FORECASTING AND WARNING IN THE PHILIPPINES

Initial Planning Meeting on the Establishment of a Flash Flood Guidance System (FFGS) for Southeast Asia-Oceana Region

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Presented by :
ENG'R. MAXIMO F. PERALTA
Assistant Weather Services Chief, HMD
Philippine Atmospheric Geophysical Astronomical Services Administration

Outline of Presentation :

- 1. Background
- 2. Extreme flood events
- 3. Types and causes of flooding & flood mitigation measures
- 4. Flood forecasting and warning system
- 5. Other Activities

1. BACKGROUND:

2. EXTREME FLOOD EVENTS IN THE PHILIPPINES

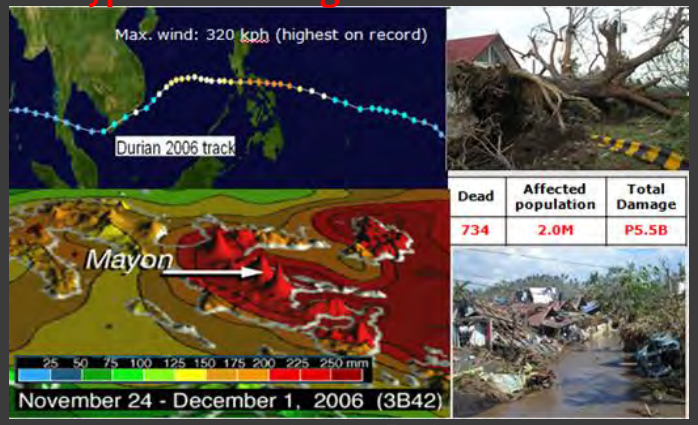
2004

Flashfloods in Quezon in December 2004

TY Unding (MUIFA) - 14-25 November
TS Violeta (MERBOK) - 22-23 November
TD Winnie – 26-30 November
TY Yoyong (NANMADOL) - 1- 4 December

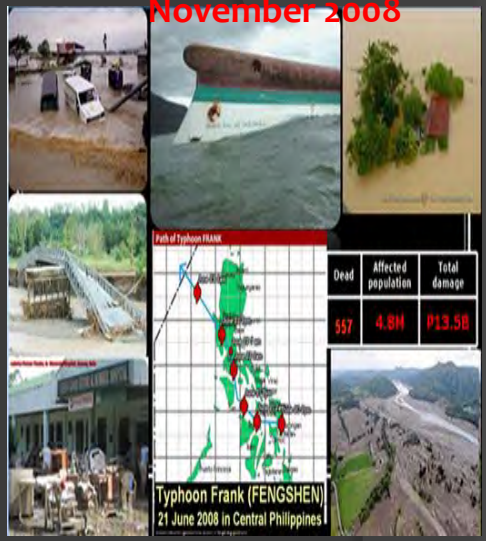
2006

Typhoon Reming in November 2006



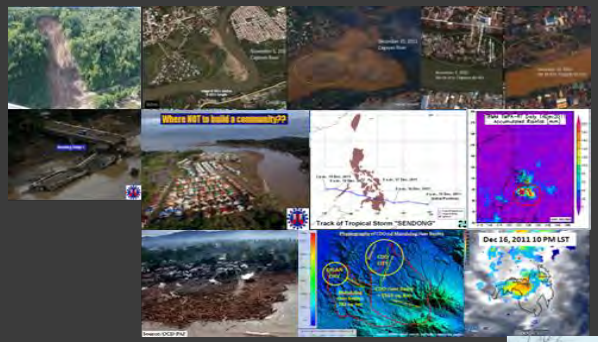
2008

Typhoon Frank (Fengshen) in November 2008



2012

Typhoon Pablo (Bopha) in December 2012



2009

Tropical Storm Ondoy (Ketsana) and Pepeng (Parma) September-October 2009

2013

S. Typhoon Yolanda (Haiyan) in November 2013

A man walks past debris of destroyed houses in Tacloban City on Nov 10, 2013

Impacts of Hydromet hazards in PH

- More extreme weather events are expected.
- More and more people are affected by hydromet-related hazards.
- Frequency, duration and intensity of rainfall events have changed.

Date	Daily Rainfall mm	Mo Normal Rainfall, mm	Station
26 Sep 2009	455.0	504.2 (90.24%)	Sci. Garden Quezon City
6-7 Aug 2012	714.8	504.2 (144%)	Sci. Garden Quezon City
18-19 Aug 2013	801.4	457.2	Sangley, Cavite
22-23 Sep 2013	503.3	695.8	Cubi Point, Zambales

Impacts of STY Yolanda

A view of the Tacloban airport (REUTERS/Romeo Ranoco

An airport lies in ruins in the city of Tacloban in the Philippines. CNN

Overturned vehicles are seen at a ricefield in Tacloban City. (REUTERS/Raul Banias

A survivor in Tacloban City holds the statue of Jesus Christ. (REUTERS/Raul Banias)

http://news.yahoo.com/hurricane-cyclone-typhoon-heres-difference-203732059.html

Impacts of STY Yolanda

http://edition.cnn.com/2013/11/09/world/asia/philippines-tacloban/

A man walks past debris of destroyed houses in Tacloban City on Nov 10, 2013.

Houses are destroyed by the strong winds caused by the typhoon in Tacloban City.

Devastation is everywhere in Iloilo in the aftermath of the typhoon.

An aerial view shows the damaged houses in Iloilo province. (REUTERS/Raul Banias

3a. TYPES OF FLOODING:

A. Based on location or place of occurrence:

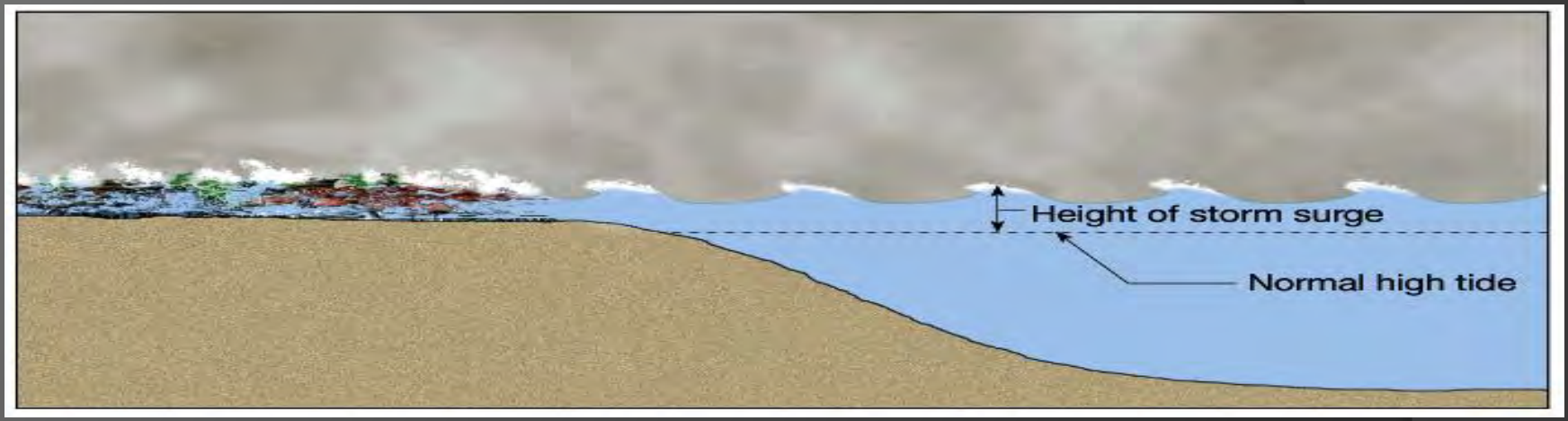
A.1 River flooding occurs when a large amount of rain falls in river system(s) with tributaries that drain large areas containing many independent river basins and inundates the adjacent low lying areas. They may last a few hours or many days depending on the intensity, amount and the distribution of the rainfall.

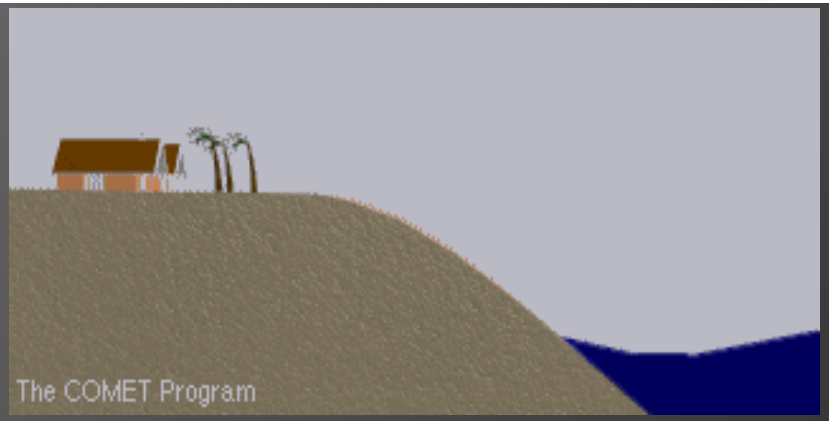
Marikina River, Typhoon Ondoy, Sept. 2009

Agno River, Pangasinan, Typhoon Pepeng, October 2009

Source of photos: various internet sites

A.2 Coastal flooding may occur due to storm surges, high tide and tsunamis (waves produced by earthquakes at sea).





Communities with a steeper continental will not see as much surge inundation.

A shallow slope off the coast will allow a greater surge to inundate coastal communities.

A.3 Urban flooding occurs in an area where roads are usually paved. During rainy episodes, water cannot infiltrate the ground and is normally retained in the surface. This type of flooding is often associated with the limited capacity of the sewerage system to drain the heavy rains that are falling.

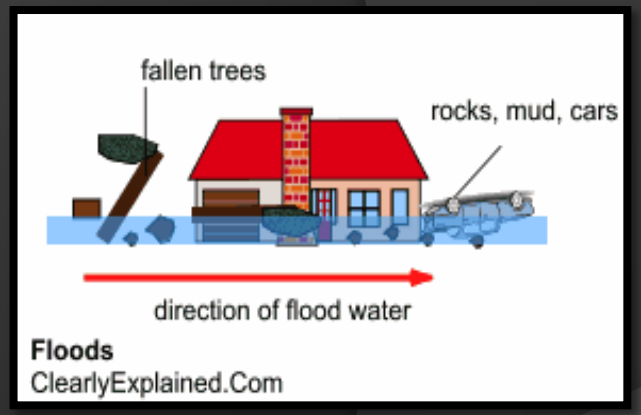
Source of photos: from different internet sites

B. Based on duration of occurrence:

B.1 Flash Flooding is the result of heavy rainfall or cloudburst over a relatively small drainage area. Flash floods carry highly destructive flood waves and are most common in mountainous areas or in steep places that have streams flowing though narrow canyons. It happens quickly and move with little warning.

Flashfloods are common in river basin with circular shape.

Pinut-an, Panaon Island, Southern Leyte, December 2003
(Photo courtesy of Mines and Geosciences Bureau)



B.2 Sheet Flooding is caused by comparatively shallow water flowing over a wide area and is very common in the flood plain area which is normally flat. Sheet flooding may also result when water from a river channel with insufficient carrying capacity overtop its bank, inundating the adjacent areas.

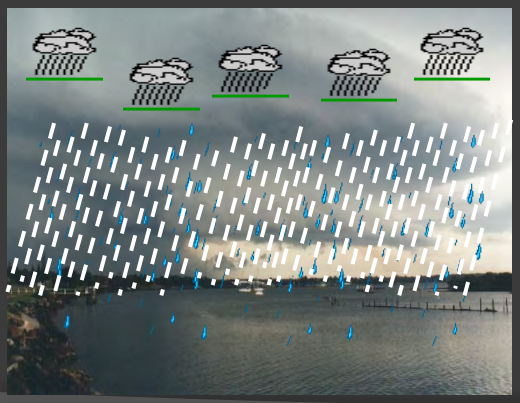
Flooding in Poblacion Mainit, Surigao Del Norte, January 2011

Rosales, Pangasinan, Typhoon Pepeng, October 2009

Source of photos: from different internet sites

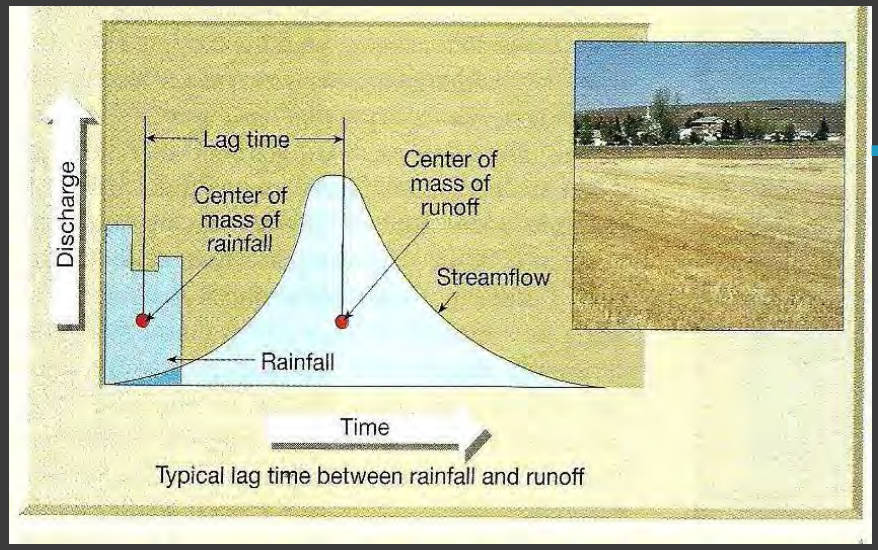
3b. CAUSES OF FLOODING:

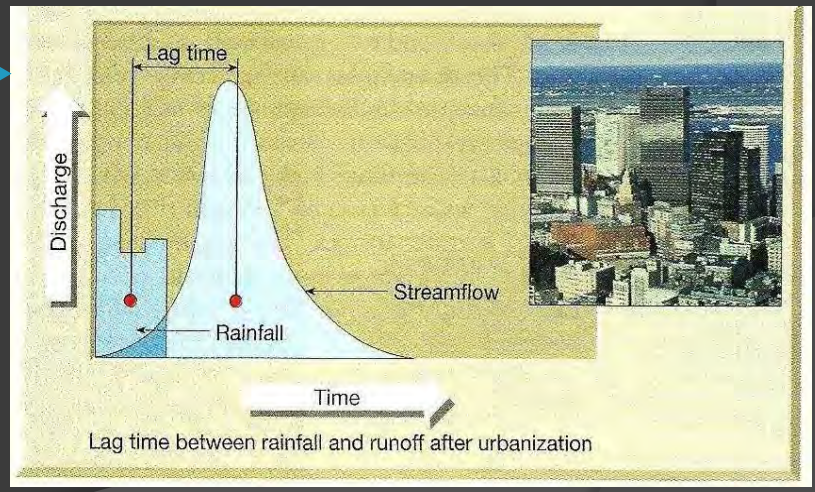
1. Heavy, continuous rains that persist for days or ceases only briefly.
2. Heavy siltation of the river system which decreases the carrying capacity of the river.
3. Timeliness of dam spilling
4. Over tapping of dikes and levees
5. Insufficient Carrying Capacity of drainage system



Aggravating Factors :

1. Influence of Urbanization - Small streams in urban areas can also rise quickly after heavy rain due to higher run-off generated and the smaller time of concentration .





Aggravating Factors :

2. Improper waste disposal and encroachment along the river channel which constricts the pathway of floodwaters.

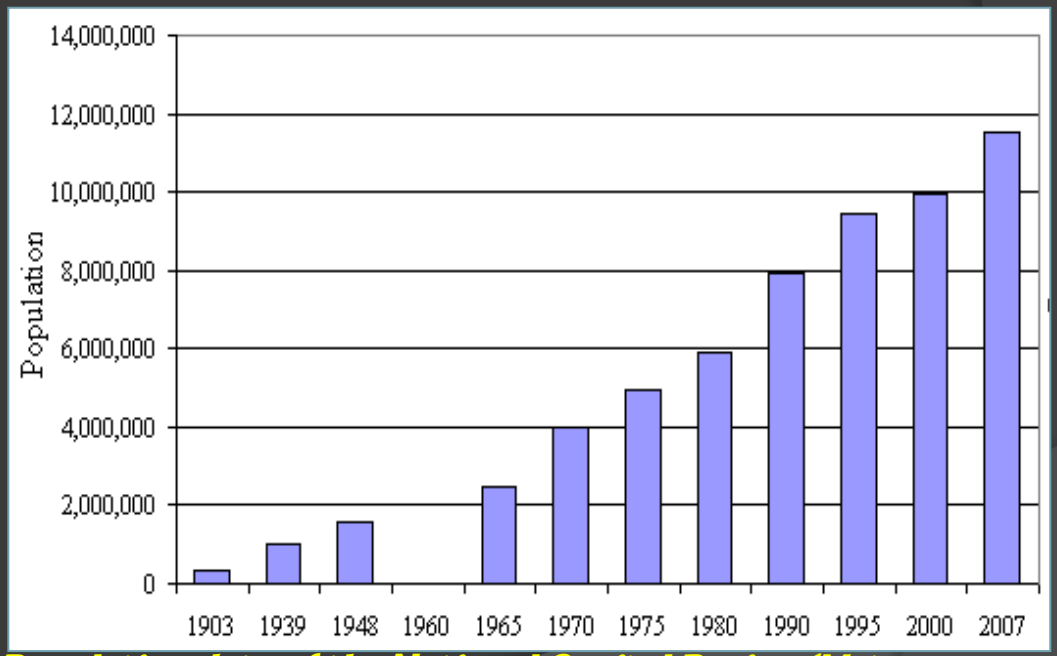
Aggravating Factors :

3. Population size, growth rate and distribution have influence shaping the environment of a region.

Philippines stats:
2000 Population: 76.0 M
10-year Avg. Annual Pop. Growth: 2.2%
GDP: 2000$310.0 billion
GDP per capita: $4,079
GDP growth: 3.6%
GNI per capita2000: $1,040
World Bank Classification Lower Mid. Inc Population
Below Poverty Line: 25.5 M

Ave. Population density:
1903 – 517
1960 – 3,872
2000 – 16,495

Distribution among cities/ municipalities as of 2000:
e.g. Navotas – 88,617
Pateros – 5,520
Growth rate: 2000 to 2007 = 2.11%



Population data of the National Capital Region (Metro Manila)

Other factors: Cultural & religious attitudes

Certain cultural and religious attitudes to disasters may also need to be overcome.

According to Oxfam, an assessment of participatory capacities and vulnerabilities found that disasters "were perceived as "God's punishment" or a "fact of life".

Since a disaster was considered to be a "natural phenomenon", many people expressed doubts that they can actually do something about it.

This fatalistic attitude is also reinforced by strong religious beliefs. "Bahala na ang Diyos" ("God will take care of everything") is the usual prayer in the face of an impending disaster in the community. – Oxfam, 2001:66

3c. COMPREHENSIVE FLOOD MITIGATION AND MANAGEMENT MEASURES

Structural Measures

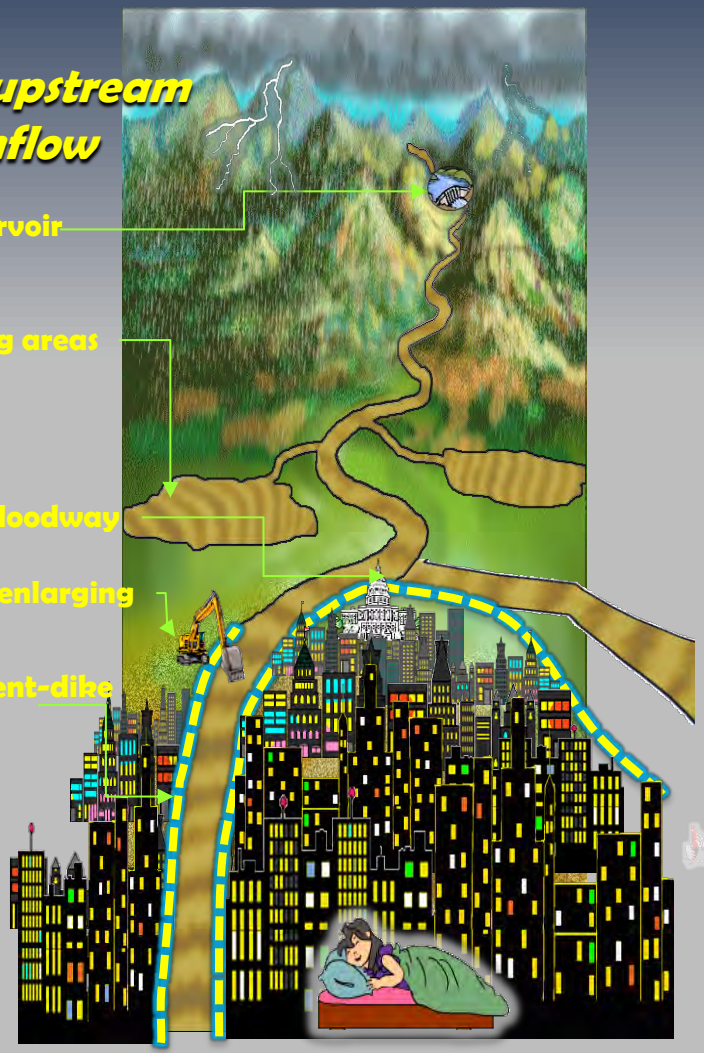
- ✓ River Improvement
  - Dikes and Flood Walls
  - Channel Improvements
  - Flood Diversion/ Floodway
- ✓ Retention/ Retardation of Runoff
  - Reservoirs, Retarding Ponds
  - Rainfall Retention Facilities
  - Conservation of Upper Watershed thru Regulations on Development and Afforestation

Non-structural Measures

- ✓ Flood Plain Management
  - Land use regulation
  - Flood proofing of facilities
  - Flood insurance
- ✓ Flood warning and evacuation
  - Flood forecasting and warning system (FFWS)
  - Information and education campaign (IEC)
  - Flood hazard map
  - Flood fighting
  - Flood rescue & disaster relief

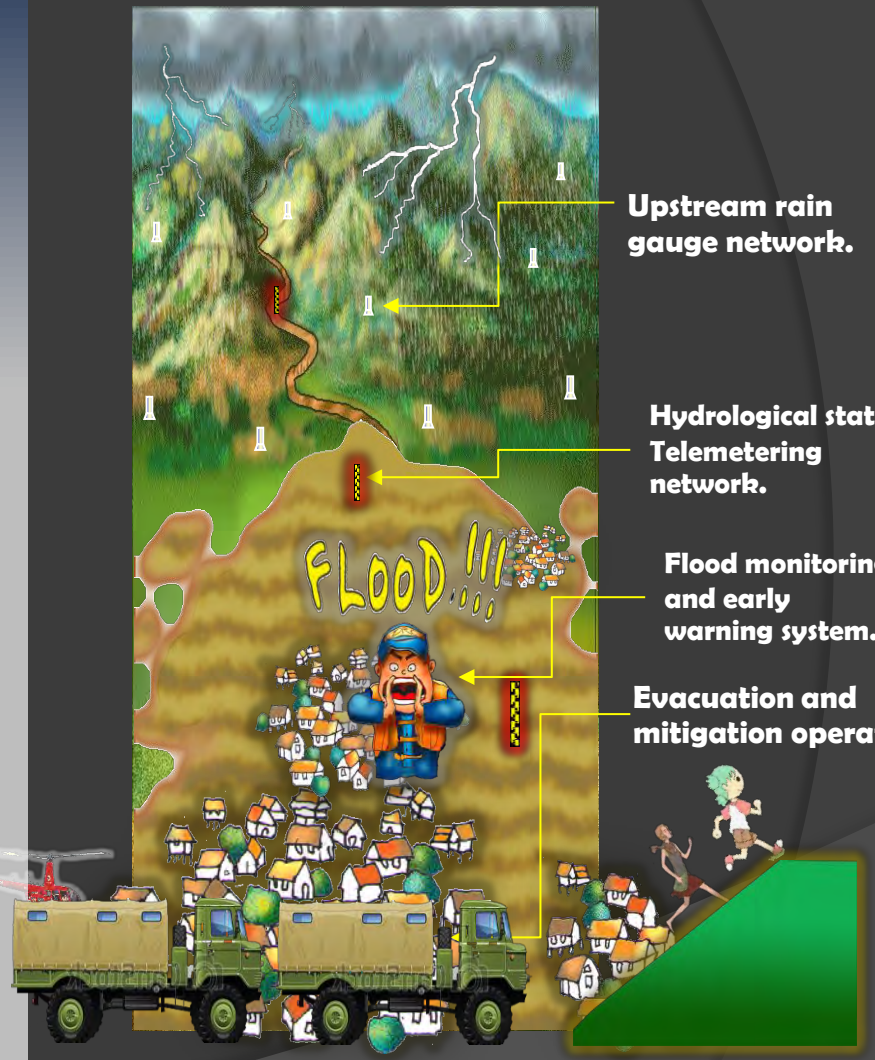
WATER-RELATED DISASTER MITIGATION MEASURES

STRUCTURAL MEASURES



MOVE THE WATER AWAY FROM THE PEOPLE...!!

NON-STRUCTURAL MEASURES

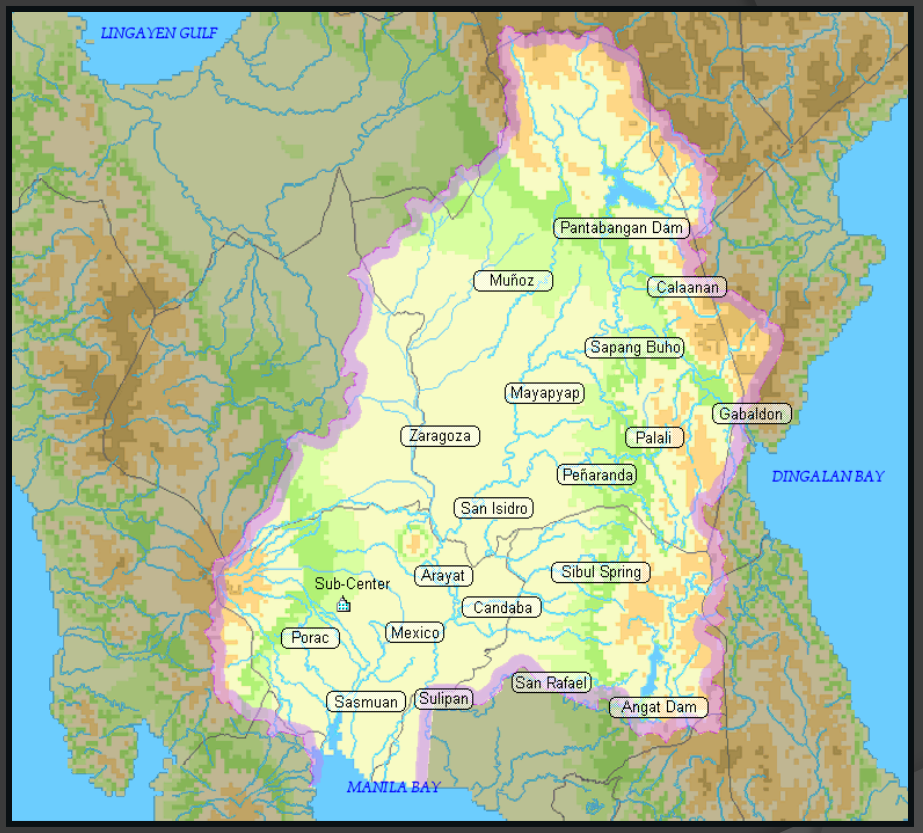


MOVE THE PEOPLE AWAY FROM THE WATER ...!!

Flood Forecasting and Warning is giving advance notice that a flood is imminent or is in progress at a certain location or in a certain river basin.

-Accuracy
- Timeliness

Flood Forecasting and warning can only be done if a river system or watershed is equipped with a monitoring facilities, i.e. rainfall and water level monitoring facilities and a good communication system.



Network of rainfall & water level stations for flood forecasting & warning system in the Pampanga river basin

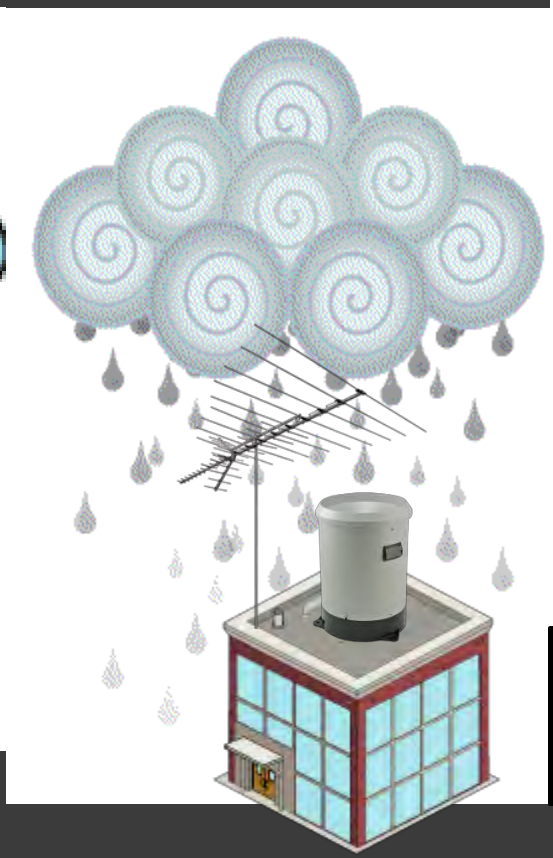
Objectives of flood forecasting & warning system

- to forewarn the people living in the low-lying areas of the increase in water level of the river and the expected flood situation;
- to forewarn people living in the target area of the dam on the present and expected flood situation; and
- to alert the agencies concerned with flood control and /or flood fighting activities in the event of the occurrence of flood.

Awareness

Rainfall observation of **15 mm** in **1-hour duration**

Preparedness



Rainfall observation is **60 to 80 mm** for the **past 3 hrs**

Response

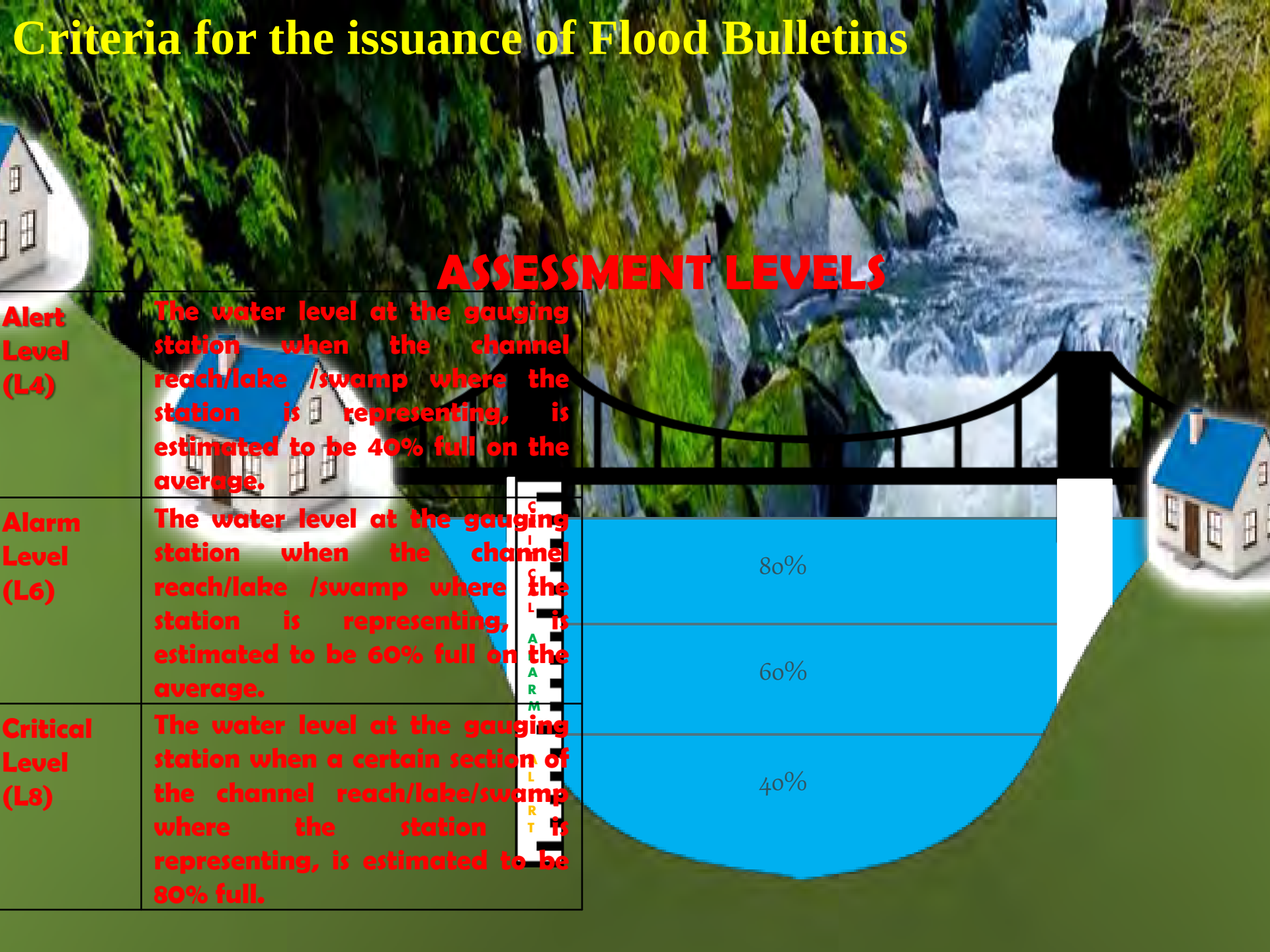
Continuous rain of **more than 80 mm** for the **past 3 hours and 3 hourly rainfall**

THRESH HOLD VALUES OF RAINFALL INTENSITY

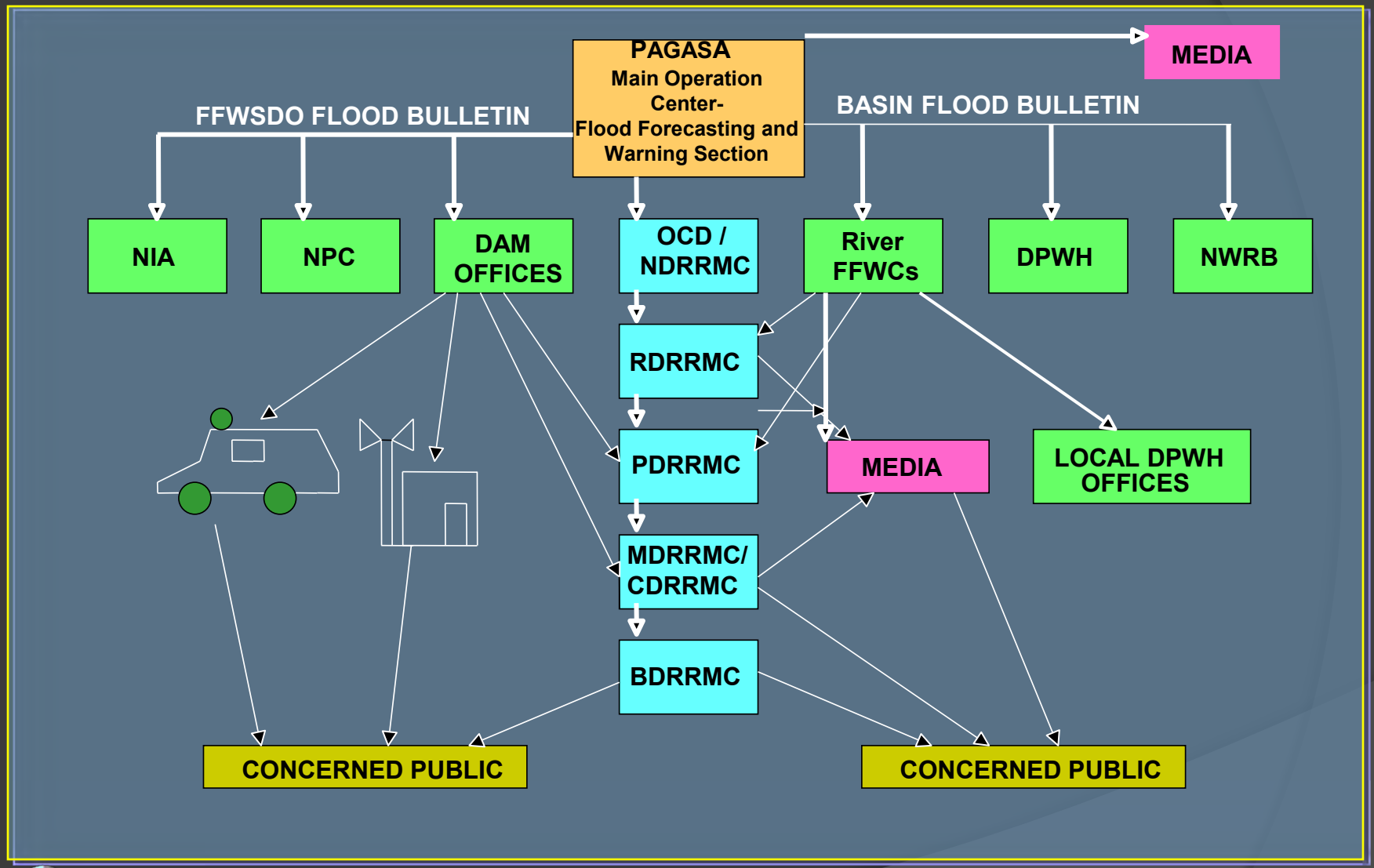
Criteria for the issuance of Flood Bulletins

ASSESSMENT LEVELS

Alert Level (L4)	The water level at the gauging station when the channel reach/lake /swamp where the station is representing, is estimated to be 40% full on the average.
Alarm Level (L6)	The water level at the gauging station when the channel reach/lake /swamp where the station is representing, is estimated to be 60% full on the average.
Critical Level (L8)	The water level at the gauging station when a certain section of the channel reach/lake/swamp where the station is representing, is estimated to be 80% full.

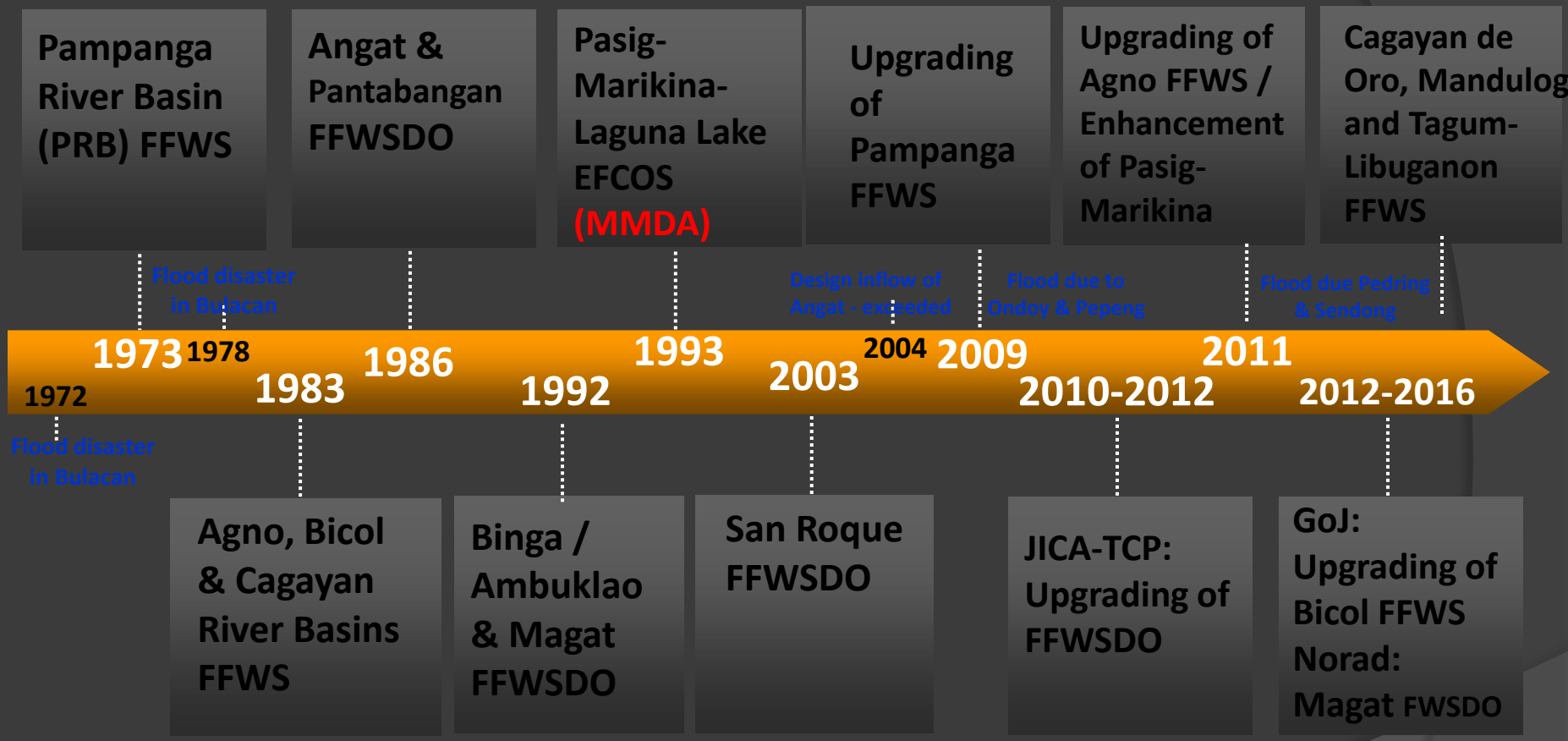


Existing dissemination scheme for basin and dam bulletin



"tracking the sky…helping the country"

4. Evolution of FFWS and FFWSDO in the PH



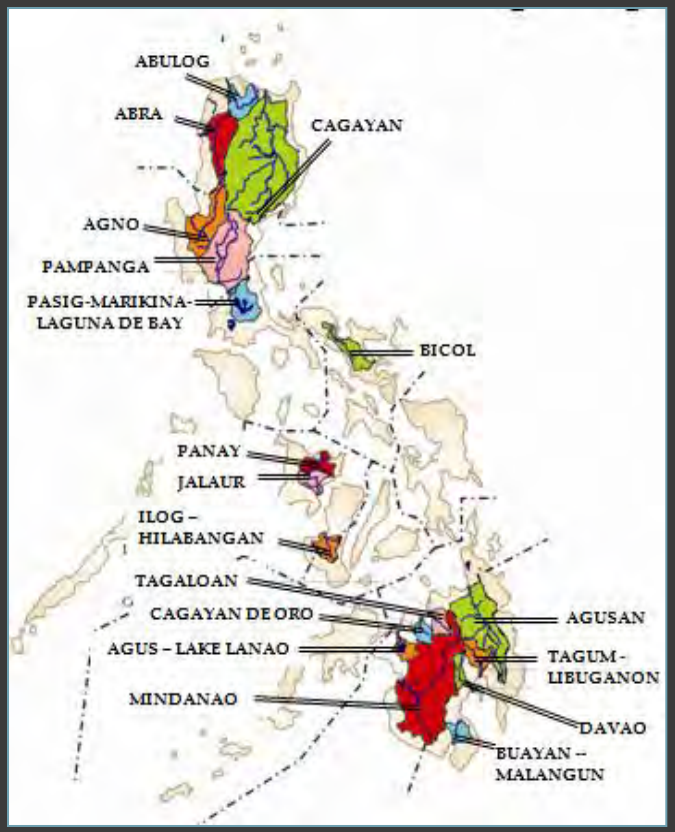
EO 2011 – Ipo telemetered FFWSDO - operational

2012 – Caliraya FFWSDO will be operational

"tracking the sky…helping the country"

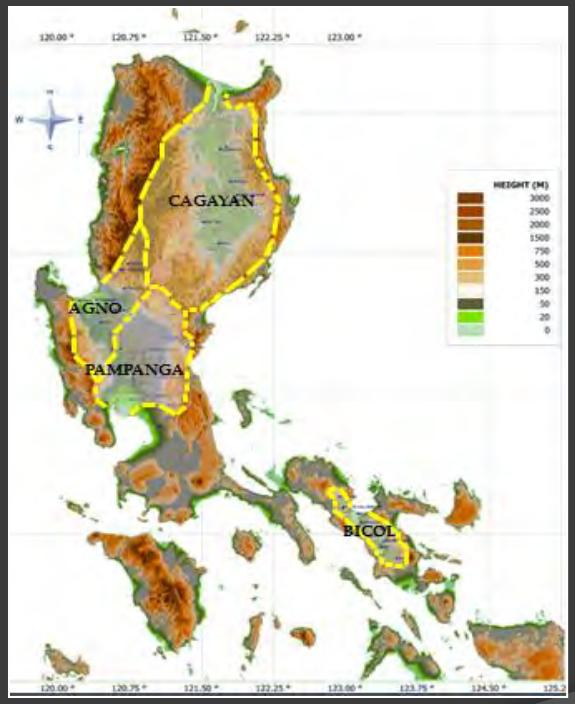
NETWORK of Existing PAGASA HYDROLOGICAL Stations (Telemetered major river basins and dams)

Major River Basins => 1,400 sq. km.

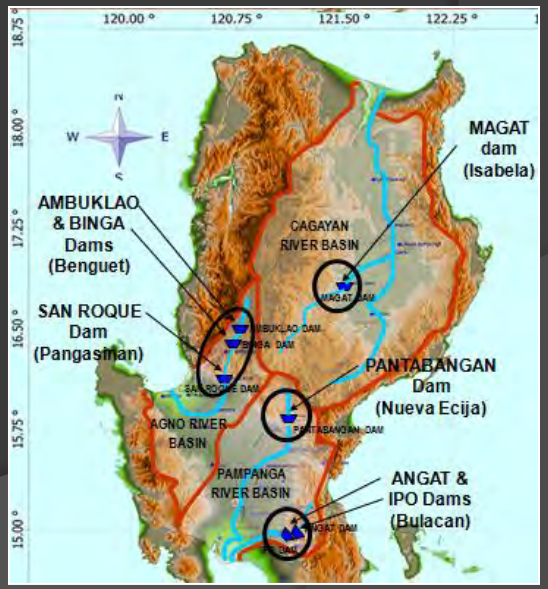


Major river basins (18)

Monitored telemetered major river basins (5+3)

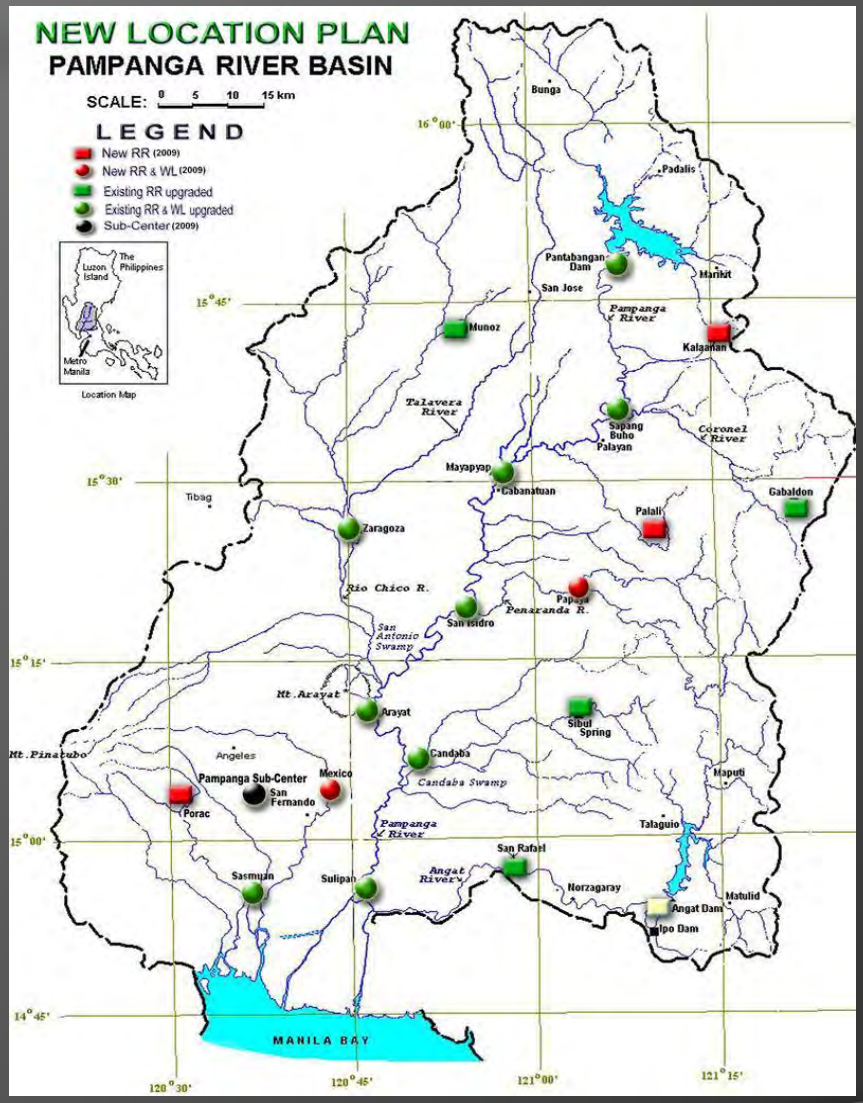


Monitored dams (6)

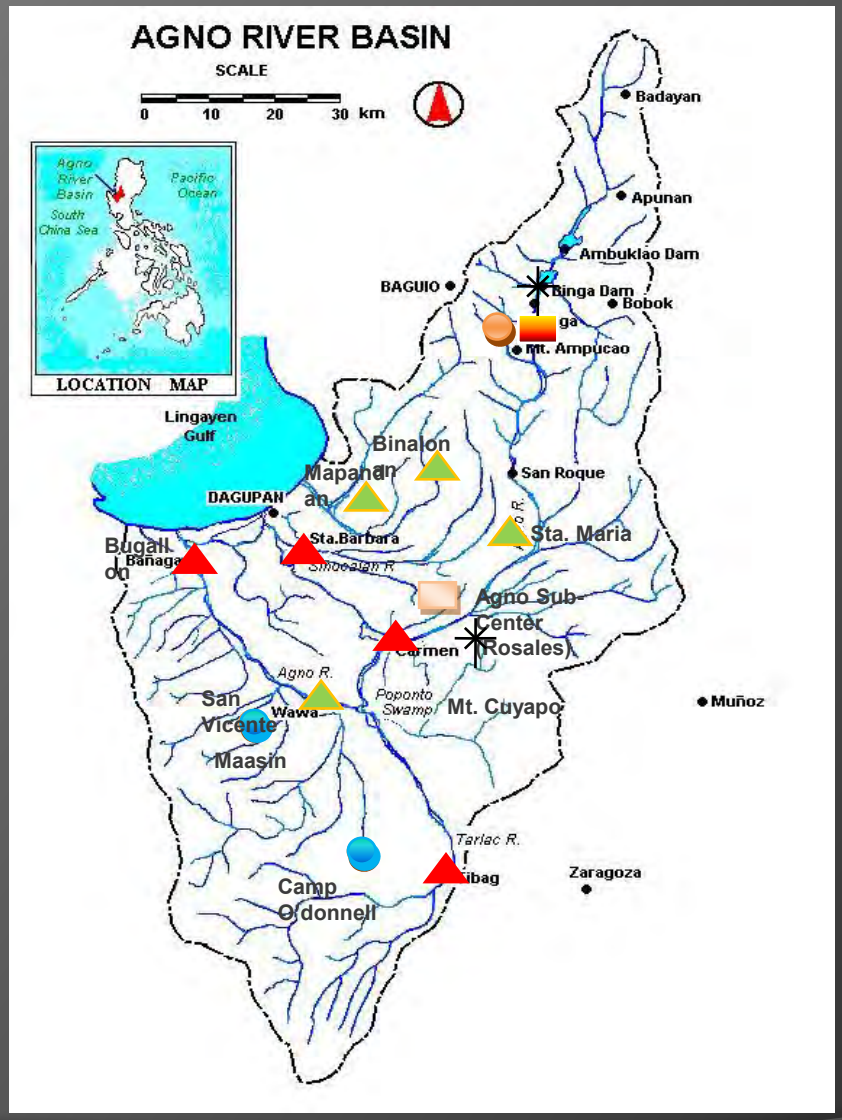


"tracking the sky…helping the country"

REHABILITATED PAMPANGA RIVER BASIN FLOOD FORECASTING AND WARNING SYSTEM

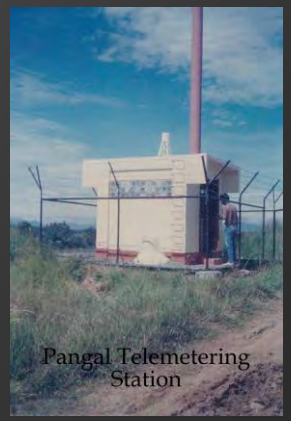


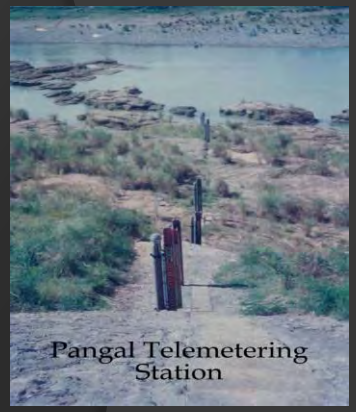
Rehabilitated Agno River Basin Flood Forecasting and Warning System



Cagayan River Basin Flood Forecasting and Warning System (CRBFFWS)

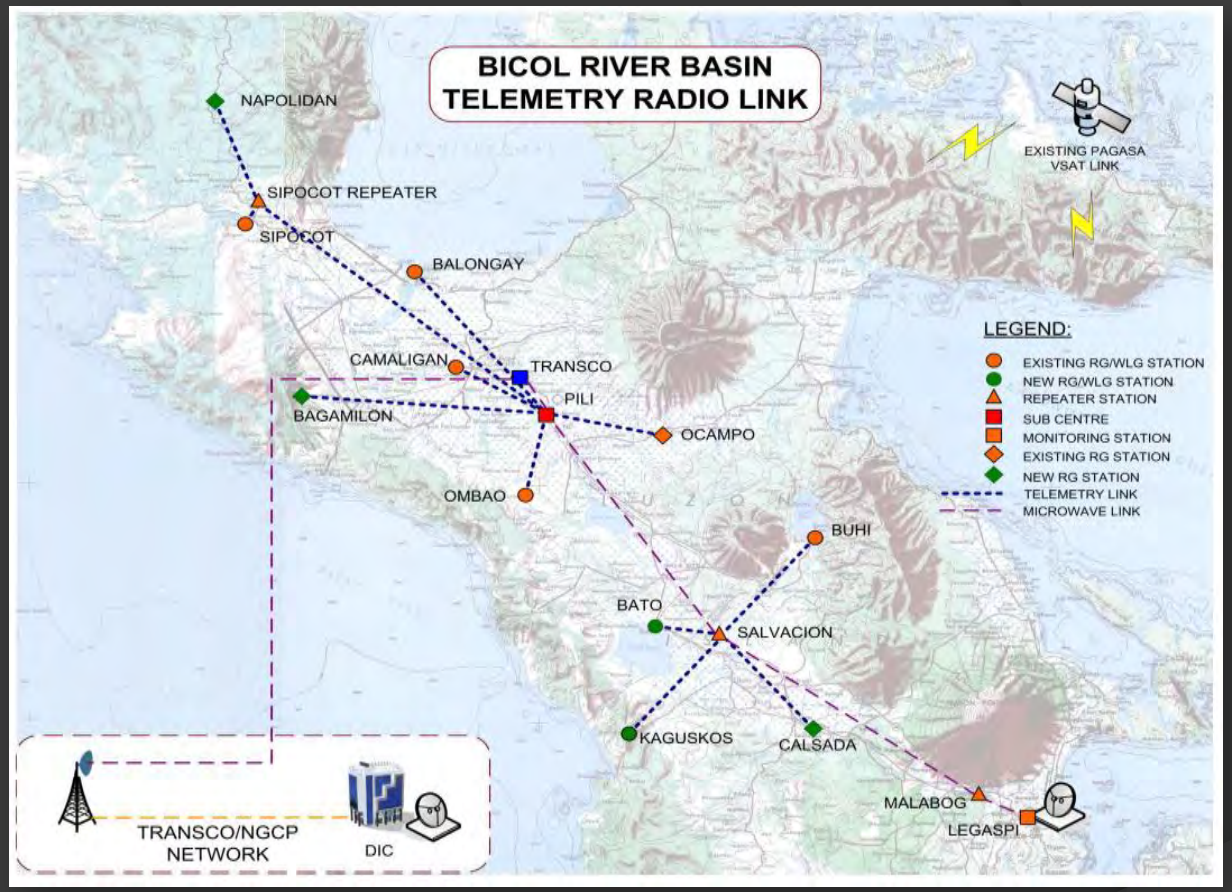
- ✓ Cagayan River Basin Flood Forecasting and Warning Center (CRBFFWC)
- ✓ Five (5) rainfall and water level gauging stations (Pangal, Maris Dam, Gamu, Tumauini and Buntun
- ✓ Repeater Station





Bicol river basin FFWS

Drainage area:
3771 sq. km.
FFWS established:
1983

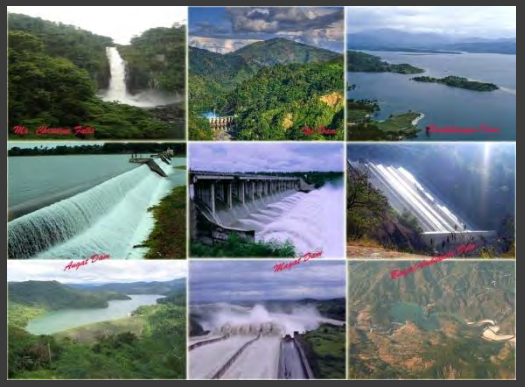


Upgrading of the Bicol River Basin - component in the project “Improvement of Capabilities to cope with Natural Disasters caused by Climate Change”, Non-Project Grant Aid (NPGA) Program of the Government of Japan.

Project Implementation: 2015

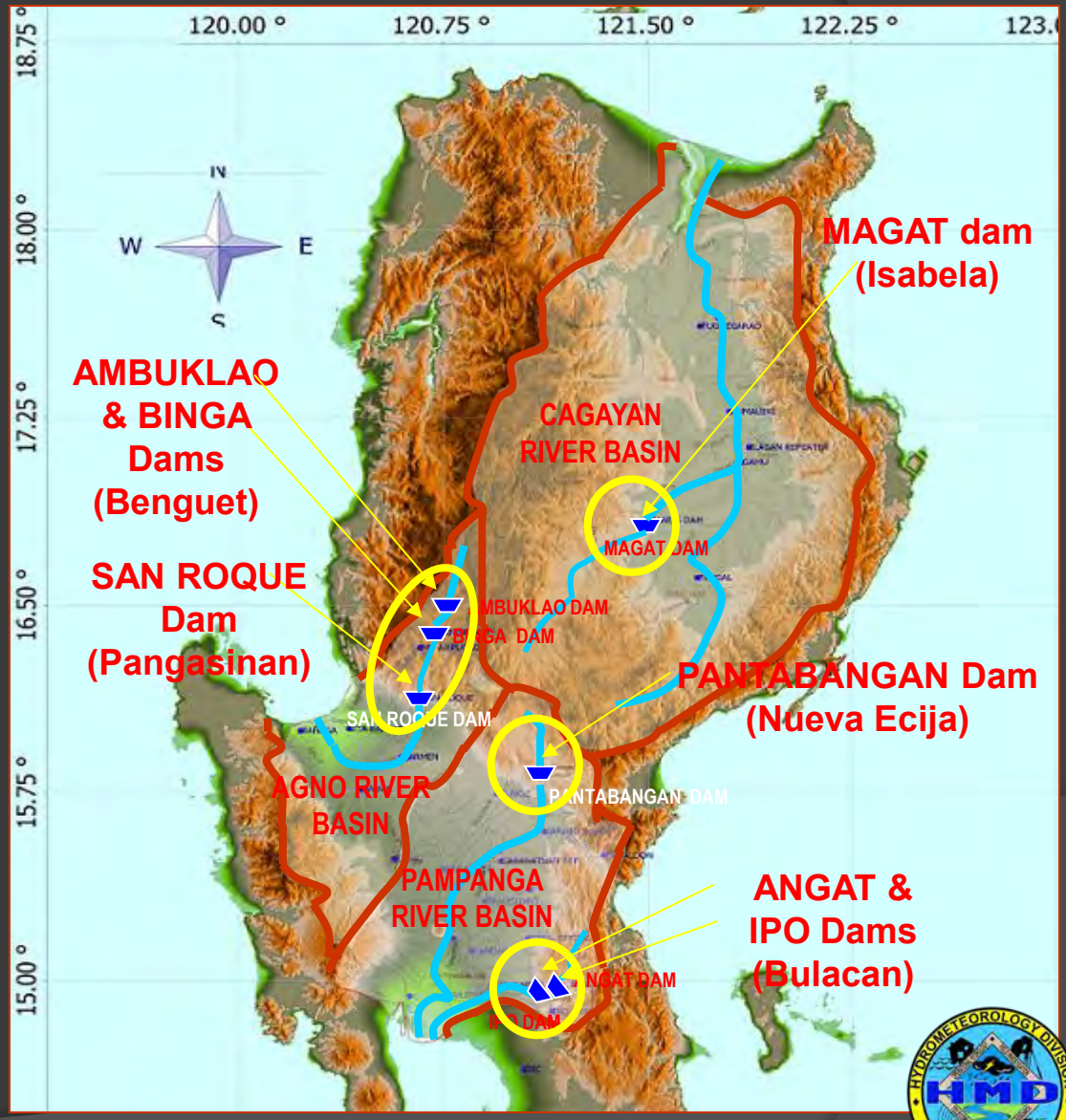
Flood Forecasting & Warning System for Dam Operation
FFWSDO

FFWSDO - Inter-agency undertaking: PAGASA, NPC, NIA, OCD, DPWH, NWRB, MWSS



Protocols:

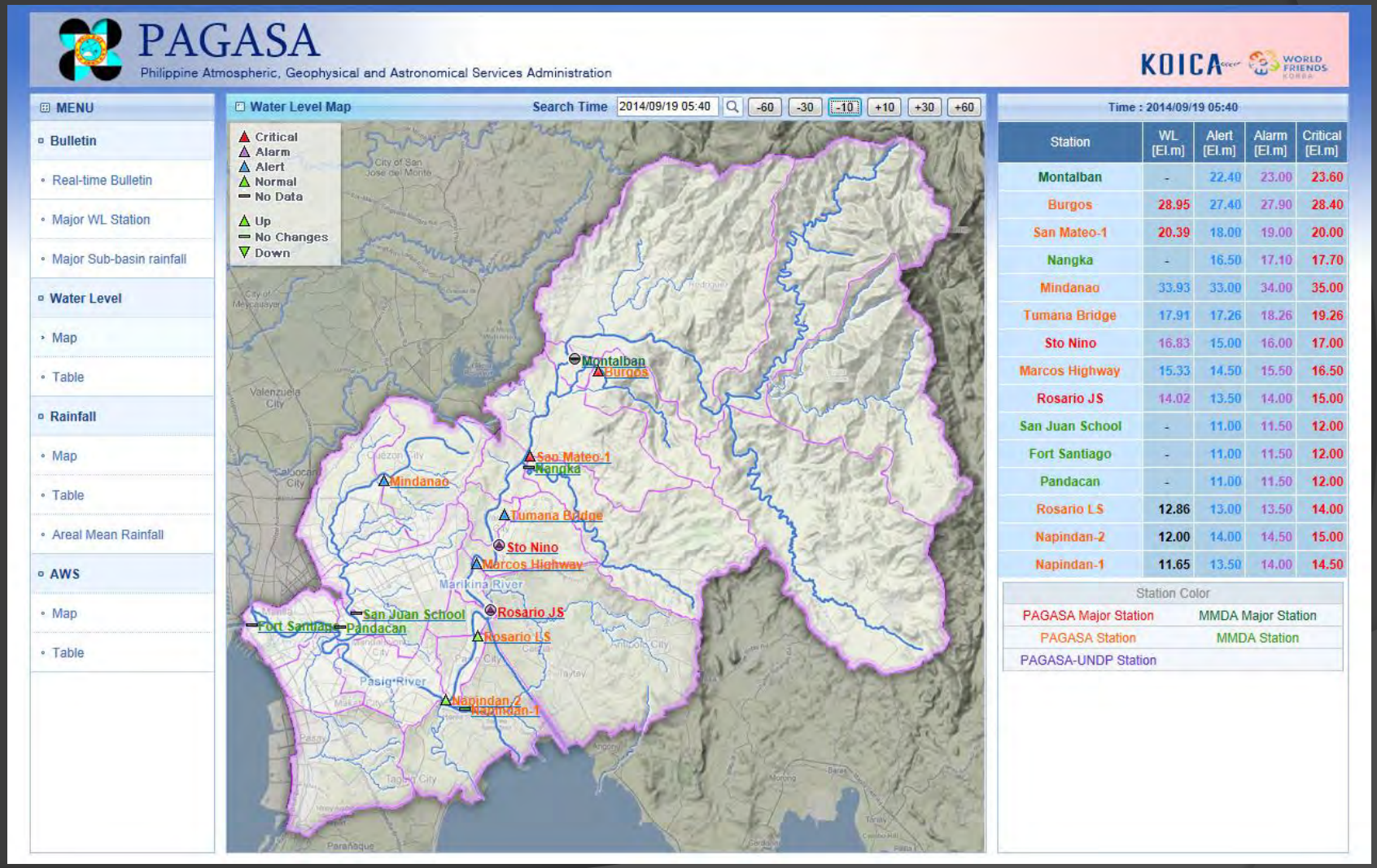
1. Flood Operation Rule
2. Dam Discharge Warning
3. Flood Forecasting & Warning



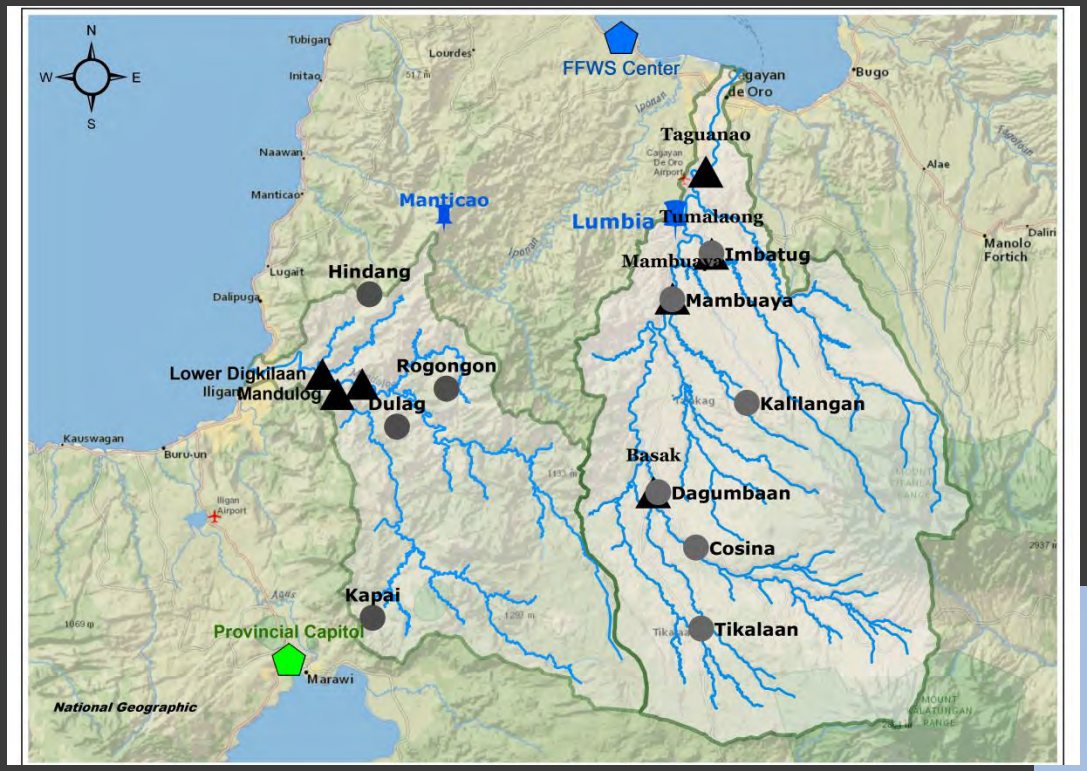
Pasig Marikina River FFWS Monitoring Equipment 1/2

Pasig Marikina River FFWS Monitoring Equipment 2/2

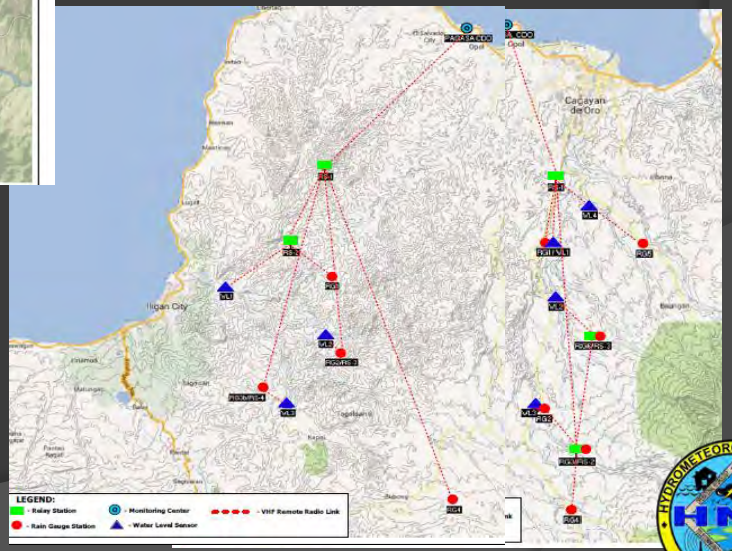
STATUS OF WATERLEVEL of PMRB
as of 5:40 AM September 19, 2014



Cagayan de Oro & Mandulog river basins FFWS

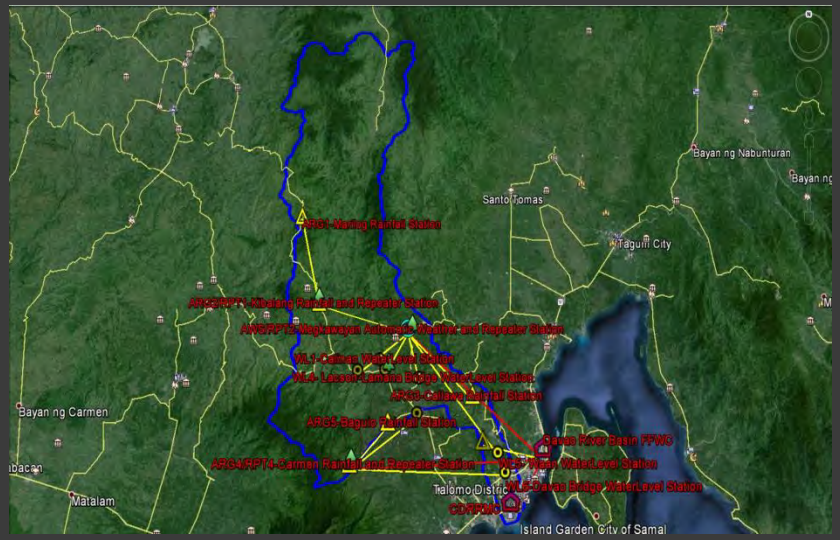


Operational FFWS (2015) - established with funding under the TWIN PHOENIX Project (AusAID/ UNDP) and GoP.

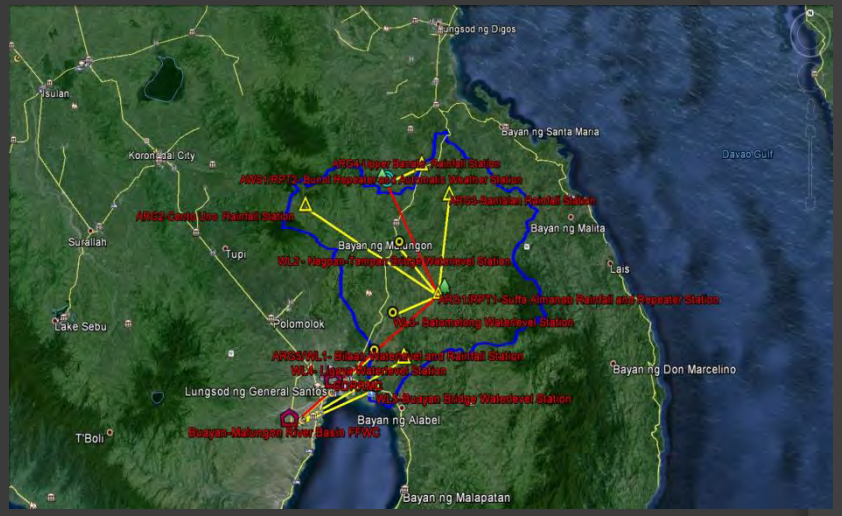


Future Projects :
River basins FFWS under NPGA (GoJ)

Davao FFWS

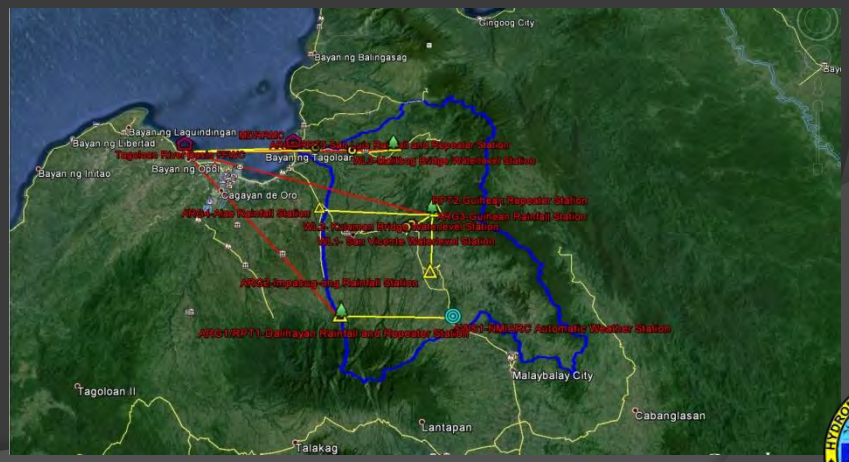


Buayan-Malungun FFWS



The Non-Project Grant Agreement (NPGA-GoJ) will provide 36 monitoring instruments (3 AWS, ARGs and WLGs) – to be implemented in 2015, while installation will be undertaken by the GoP.

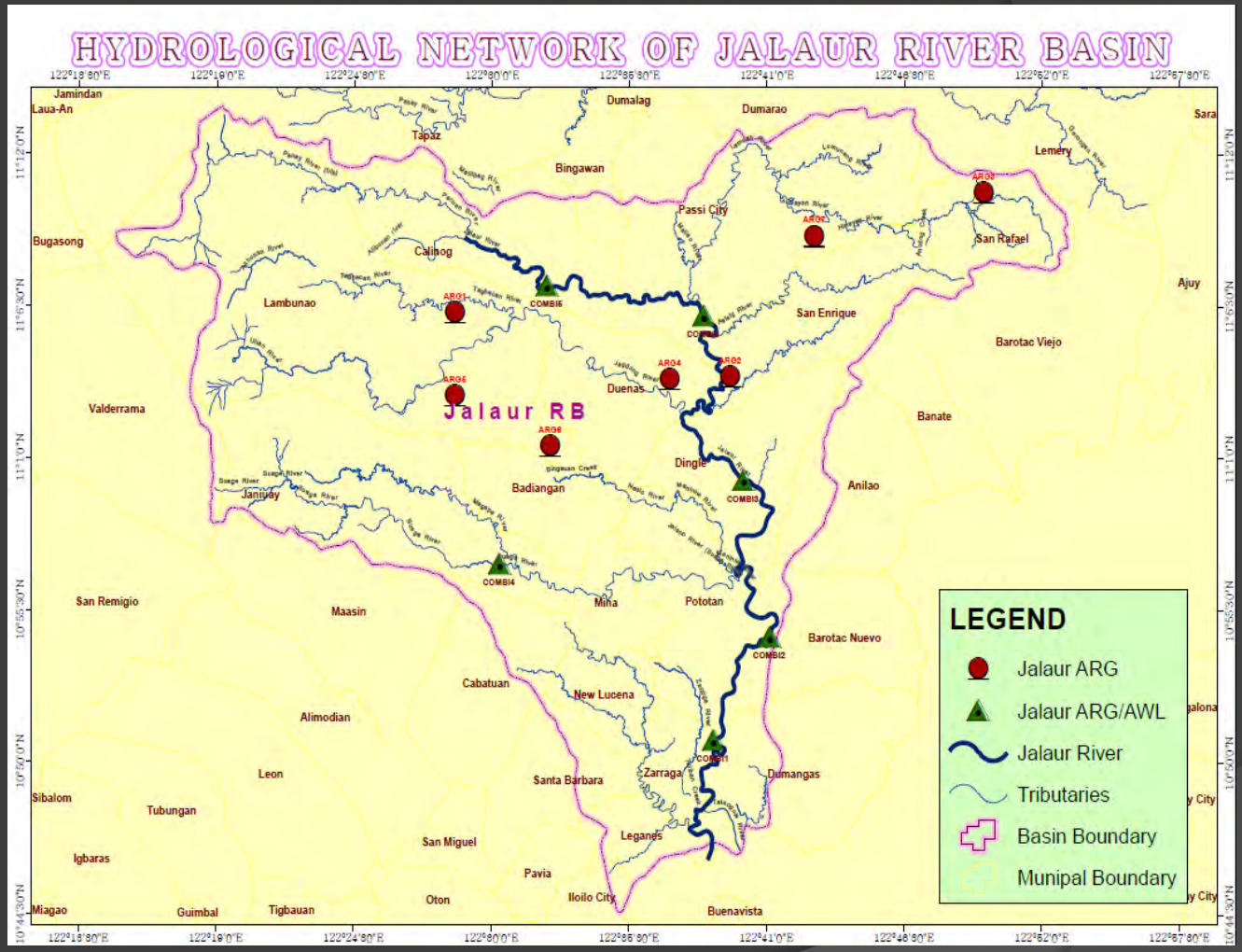
Tagaloan FFWS



Equipments are all ready for installation (2015).

Major river basins in the Visayas

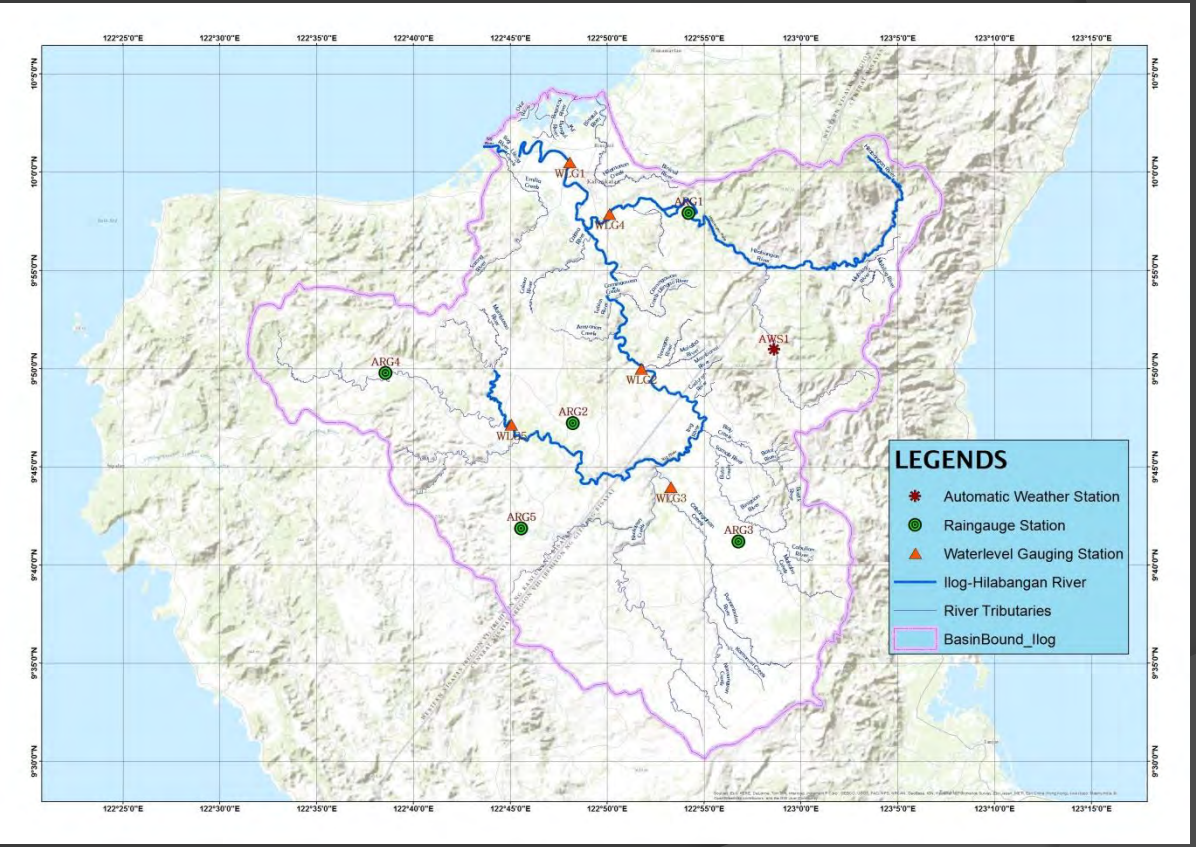
FFWS (2014) – will be established with funding under the Government of India thru RIMES



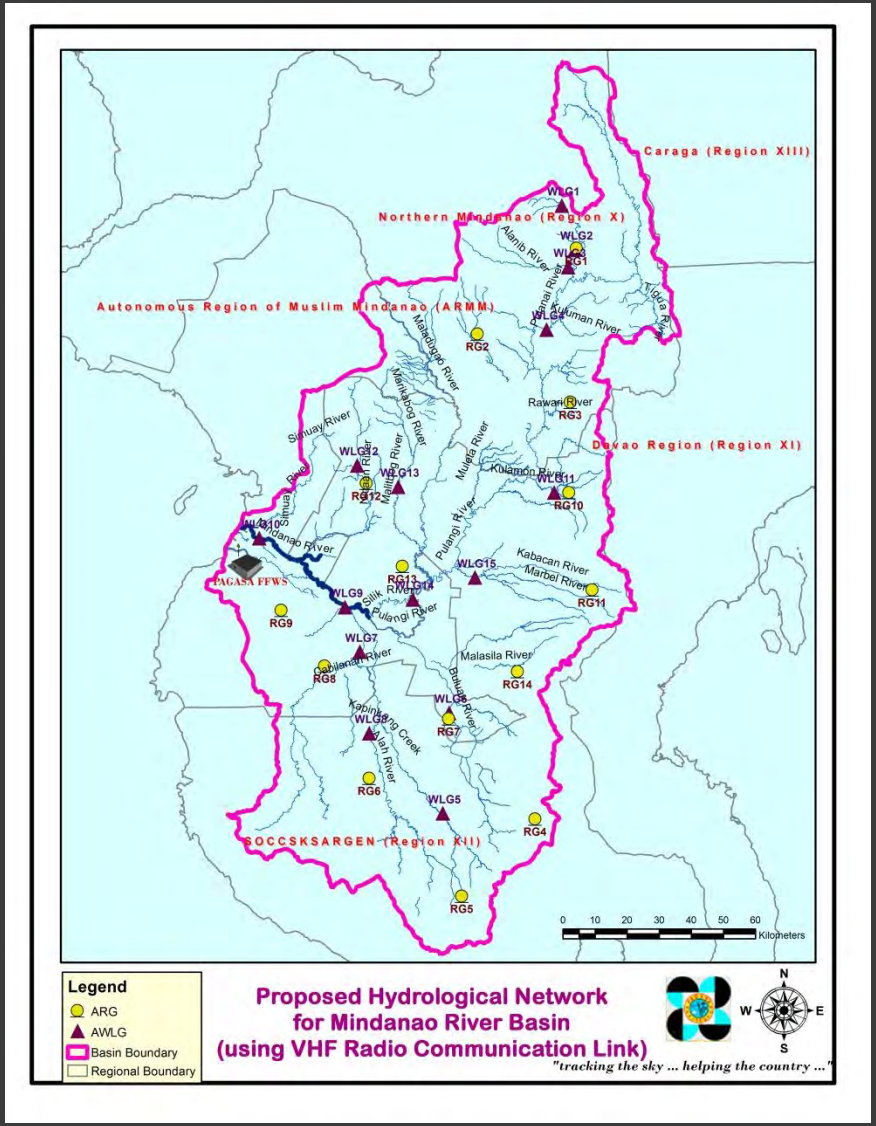
Ilog Hilabangan River Basin (Visayas)

FFWS will be establish with funding under PAGASA budget (GoP).

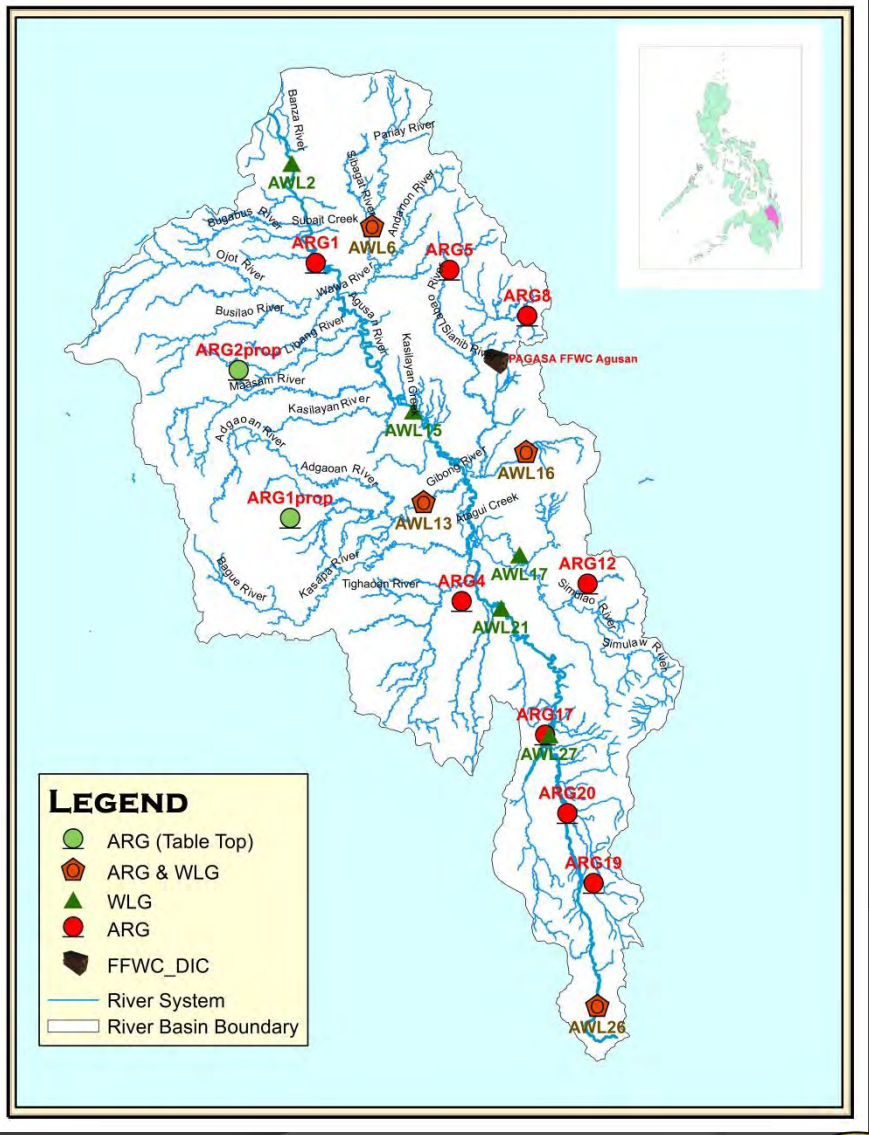
- NTP was served to the winning bidder for the Installation of the monitoring equipment within the basin.



Other river basins in Mindanao



Cotabato FFWS



Agusan FFWS

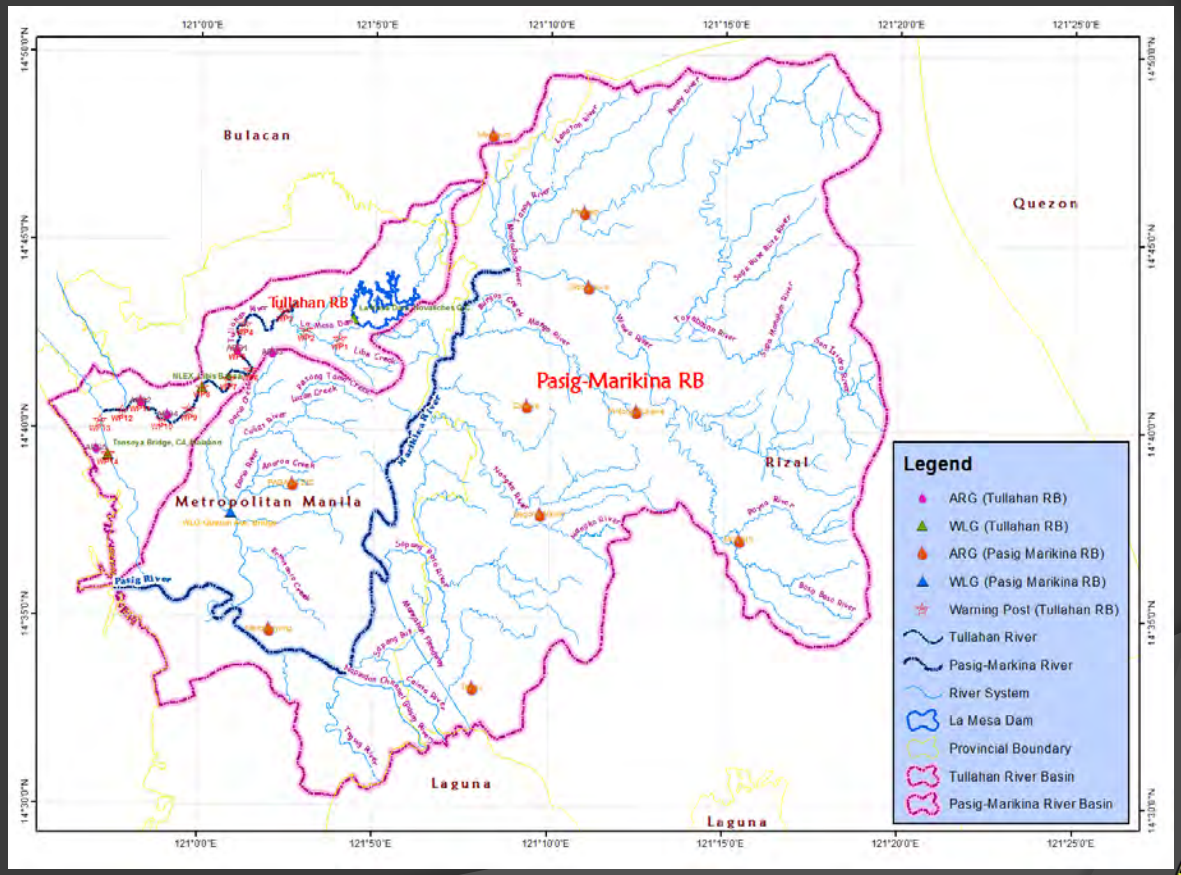
KOICA 3

Proposed project: Automation of Flood Early Warning System for Disaster Mitigation in Greater Metro Manila

Project cost: USD7,102,767.40

FFWS for Pasig Marikina River and Tullahan river

NCR PAGASA Flood Information Command Control Center display and data archiving system



Telemetered- CBFEWS

for Laguna, Cavite, Rizal and Bulacan

GMMA-READY COMMUNITY-BASED FLOOD EARLY WARNING SYSTEM (CBFEWS)

Actions | View | Audio/Video | File transfer | Extras | Remote update

Data Panel | Charts | Database | Map & Station Data | Station Setup

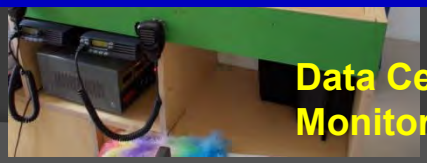
GMMA READY PROJECT - LAGUNA COMMUNITY-BASED FLOOD EARLY WARNING SYSTEM (CBFEWS)

DATA PANEL - LAGUNA

RAIN GAUGE STATION	DATE & TIME	10-MIN	1-HR	24-HR
RG_CUEVA	2016-01-27 08:21:11	0	0	0
RG_KATAYPUANAN	2016-01-27 08:21:31	0	0	0
RG_KAPATALAN	2016-01-27 08:21:51	0	0	0
RG_MATALINGTING	2016-01-27 08:22:11	0	0	0

WATER-LEVEL STATION	DATE & TIME	WLmsl	ALERT	ALARM	CRITICAL
WL_POBLACION	2016-01-27 08:20:11	5.07	8.7	9.5	9.95
WL_CORALAN	2016-01-27 08:20:31	16.94	18.85	20	21.15
WL_NUMERO	2016-01-27 08:20:51	30.49	31.9	32.5	33.15
WL_LLAVAK	2016-01-27 08:22:31	2.15	3.65	4.45	5.2
WL_KATAYPUANAN	2016-01-27 08:21:31	42.95	42.6	42.9	43.2

TeamViewer



Data Center Monitor

Communication scheme for CBFEWS

¿¿ RR Observers

Data/Rainfall Observation

Weather Update/Info

Weather Update/Info

Data/Rainfall Observation

¿¿ Water Level Observers

Disaster Operation Center (DOC) Provincial Hall

Warning Phase
1 - READY
2 - Get SET
3 - GO

Flood Advisory

Communication of Warning
1 - MDCC
2 – BDCC
3 – Local Volunteers

Bandillo Megaphone w/siren Church Bells

Batingaw Sitio/Purok Leaders

Target Community

Evacuation Center

Data / Flood Advisory / Warning

Weather Update / Info

River Observation
1 – Color
2 – Speed of Flow
3- Sound
4 – Presence of Debris

PAGASA

Flood info

NDRRMC

Weather Update / Info

PAGASA- Field Station ?

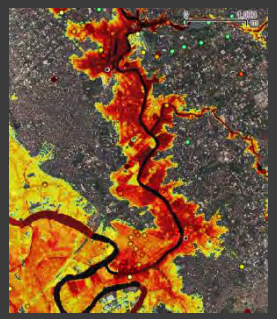
Legend: ? Information starts here in case of large-scale system (Ex. typhoon and monsoon).

¿¿ Information starts here in case of local/ small-scale system (Ex. Thunderstorm and ITCZ).

"tracking the sky…helping the country"

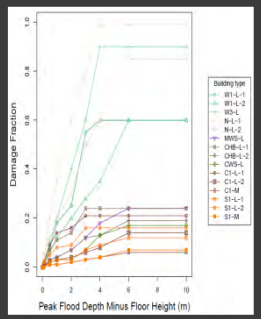
OTHERS...

- Implementation of other foreign projects (JICA, JICA-LLDA, KOICA, AusAID, NZAP, UNDP, ADB, WFP, GIZ, non-government organizations (NGOs), etc.)
- Application of remote sensing data
- Flood hazard mapping to risk mapping
- Recruitment of young engineers
- Continuous training of technical personnel



HAZARD

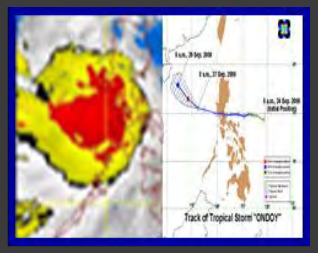
EXPOSURE



VULNERABILITY

RISK

Risk Analysis Project (RAP): UNDP/AusAID/GA



THANK FOR YOUR ATTENTION !

www.pagasa.dost.gov.ph

Main Operation Center-Flood Forecasting and Warning Section
(MOC-FFWS)

Hydrometeorology Division

02.929.40.65/02.928.27.54/02.920.40.52/02.926.6970 or
you can e-mail us at hmd.ffws@gmail.com
WFFC Bldg., BIR Road, Diliman, Quezon City

Like us on Facebook, follow us on Twitter