National Report of the Philippines

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Physical Oceanography Division

Hydrography Branch

National Mapping and Resource Information Authority (NAMRIA)

I. Introduction

The Physical Oceanography Division of the NAMRIA's Hydrography Branch is focused on the collection of physical oceanographic data that dwell mainly on ocean parameters such as tides, currents, temperature, salinity and depth. Data collection likewise explores other marine-related data in the course of combined hydrographic and oceanographic surveying operation.

Primary tide stations, where continuous tidal observations are conducted, are mostly located in strategic coastal areas. These areas are scattered in the different seaports of industrial and economic convergence such as Manila, Cebu, Davao, and Legaspi. To date there are 10 primary tide stations in the Philippines with existing tide house structure and tide gauge equipment. Mean values of datum planes are derived from the operation of these primary tide stations. They likewise serve as references for analyzing data from secondary and subordinate locations where short-period tidal observation exists.

II. History of the Establishment of Tidal Stations in the Philippines

Tidal observation in the Philippines began in 1901 with the establishment of the Manila Field Station by the United States Coast and Geodetic Survey (USC&S). In 1902, the first primary tide station was established in Manila with the first observation records mainly kept in the archives of the then USC&S. Tidal observation continued to be conducted across the country with the establishment of a tide gauge in Iloilo, Panay in 1903. The Cebu primary tide station was set up in 1903. In 1952, the office then called the Bureau of Coast and Geodetic Survey (BCGS) acquired a tide-predicting machine from Liverpool, England, which could take into account 32 tidal components. Six tidal stations were being maintained and these were located in Manila, Cebu, Davao, Legaspi, San Fernando and Jolo. The first *Tide and Current Tables* was published in 1953 under Filipino leadership. Prior to this preparation and printing were done in Washington D.C. USA.

In 1969, computer-aided tidal predictions (IBM 360/06) replaced the use of the 32-component predicting machine. By 1972, additional computers such as the FACOM 230/20 were being used for all predictions including manuscript preparation. In 1986, under Phase I of the ASEAN-Australia Marine Project (Tides and Tidal Phenomena-Regional Ocean Dynamics), BCGS started to use the digital type of tide gauges with models such as EMS 16 (cartridge type) and ENDECO pressure sensor type. The office also undertook the establishment of more tide stations. Nearing completion of Phase II of the project in 1990, four additional tide stations were already in existence, three of which became primary stations in the same year, namely, Surigao, San Jose in Mindoro, and Port Irene in Cagayan. In 1994, the Puerto Princesa tide station became a primary tide station. The year 1996 the Jolo station was dismantled due to security reasons and was transferred to Zamboanga City in 2002. In 2001, the tide station in Real, Quezon became a primary tide station.

To date, a total of forty-seven (47) tide stations (*see Figure 1 and Table 1*) are operating all over the country. The Philippine tide stations have remained the same in terms of setup, structure, and instrumentation and still continue to yield good data results. The process of tidal analysis and prediction use modern computers and software programs similar to Australia, Japan, United Kingdom and the US.

III. Philippine Tide Station Characteristics

At present, each tide station consists of a simple tide house structure of concrete and wooden materials measuring about 1.5 meters square in floor area and about 2.5 meters in height (*see Figure 2*). This station houses analog and digital tide gauges such as the OTT Strip Chart and Thalimedes Data Logger, Stevens Chart Recorder with AXSYS Digital Data Logger and the Sutron Satlink Logger (*see Figure 3*). Other digital-type tide gauges such as the wave and tide gauge (WTG) models are just fastened to pier piles below the surface of the water and do not require casings.

IV. Mode of Data Acquisition and Transfer from Tide Stations

Tidal data in the Philippines, in the case of analog tide gauges using paper chart recorders or marigrams, follows a procedure wherein three months of continuous observation is obtained before data is retrieved and sent to the office for analysis and processing. In stations utilizing digital tide gauges, the mode of data transfer follows the same time interval of three months and to some stations, a period of six months observation before data is retrieved, downloaded and sent for processing.

Out of the total 47 tide stations, fifteen (15) stations are telemetry-equipped or have the capability of providing near real-time data. Six (6) of these telemetry stations (Manila, Legaspi, Davao, Subic, Lubang and Currimao) are linked to international organizations such as the Intergovernmental Oceanographic Commission (IOC), Global Sea Level Observing System (GLOSS), University of Hawaii Sea Level Center (UHSLC), and the Regional Integrated Multi-hazard

Early Warning System for Africa and Asia (RIMES). The other nine (9) stations (Cagayan de Oro, General Santos, Puerto Princesa, Zamboanga, Balanacan, Real, San Vicente, Guiuan, and Tandag) provide near real-time data but are only accessible to NAMRIA.

V. Tidal Leveling

Tide stations are annually inspected and checked for proper equipment operation and data accuracy. During annual inspection, tidal leveling is conducted to determine water level datum shift with regard to land elevations. Tidal leveling is then carried out to connect the benchmarks to a water-level datum plane. These measurements are then connected to the zero datum of the tide gauge referred to a mean water-level reference to define the elevations of points on the ground.

Through these measurements, shifts in water-level datum or ground-level change can be determined which could be analyzed as either sea-level rise or ground subsidence. The present datum of each of the tide stations is referred to a fixed zero level of a tide staff, which was initially determined when the station was first established. These are only arbitrary levels that vary for each tide station depending on how the tide staff was set up. The following lists the original years of establishment of the zero-level tide staff in determining the datum planes of references; Manila – 1901; Cebu – 1935; Davao, Legaspi, Jolo, San Fernando – 1947; Surigao, Port Irene, San Jose – 1986; Palawan – 1990; and Real – 1995.

Levels of the current tide staff in each of the tide stations may differ during the annual inspection and re-leveling from the original setup but the discrepancy is always connected to refer back to the original zero level. These corrections are to maintain the fixed reference level for the analysis of the observed tidal data for quality control and more importantly in monitoring the datum planes for control references.

VI. International Links

There are currently three (3) operating Philippine tide stations that are registered under the Global Sea Level Observing System (GLOSS). These are the Manila, Legaspi and Davao Tide Stations. GLOSS aims to establish high quality global and regional sea level networks for use in climate, oceanographic and coastal sea level research. The abovementioned tide stations as well as the other three (3) located in Subic, Currimao and Lubang are also associated with the Sea Level Station Monitoring Facility of the IOC. Said facility streams near real-time data of each tide station registered in its global network of sea level stations. The same six (6) tide stations are also linked to the Pacific Tsunami Warning Center (PTWC) and RIMES with the objective of providing early and reliable tsunami warnings.

Sea level data from twenty-four (24) tide stations are also provided to the UK-based Permanent Service for Mean Sea Level (PSMSL). PSMSL is responsible for the collection, publication, analysis and interpretation of sea level data from the global network of tide gauges

VII. Conclusion

The Philippines, being an archipelago, is determined to further enhance its tidal data acquisition and dissemination by establishing additional tide stations within its internal waters and outer coastlines and upgrading their data transmission through telemetry installation. The country, through NAMRIA, is keen on providing accurate tidal data to local and foreign users and participating in international organizations involved in oceanographic information gathering. With this commitment in sight, rest assured that NAMRIA would continue its active involvement in the international community especially to the IOC and GLOSS.

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Table and Figures

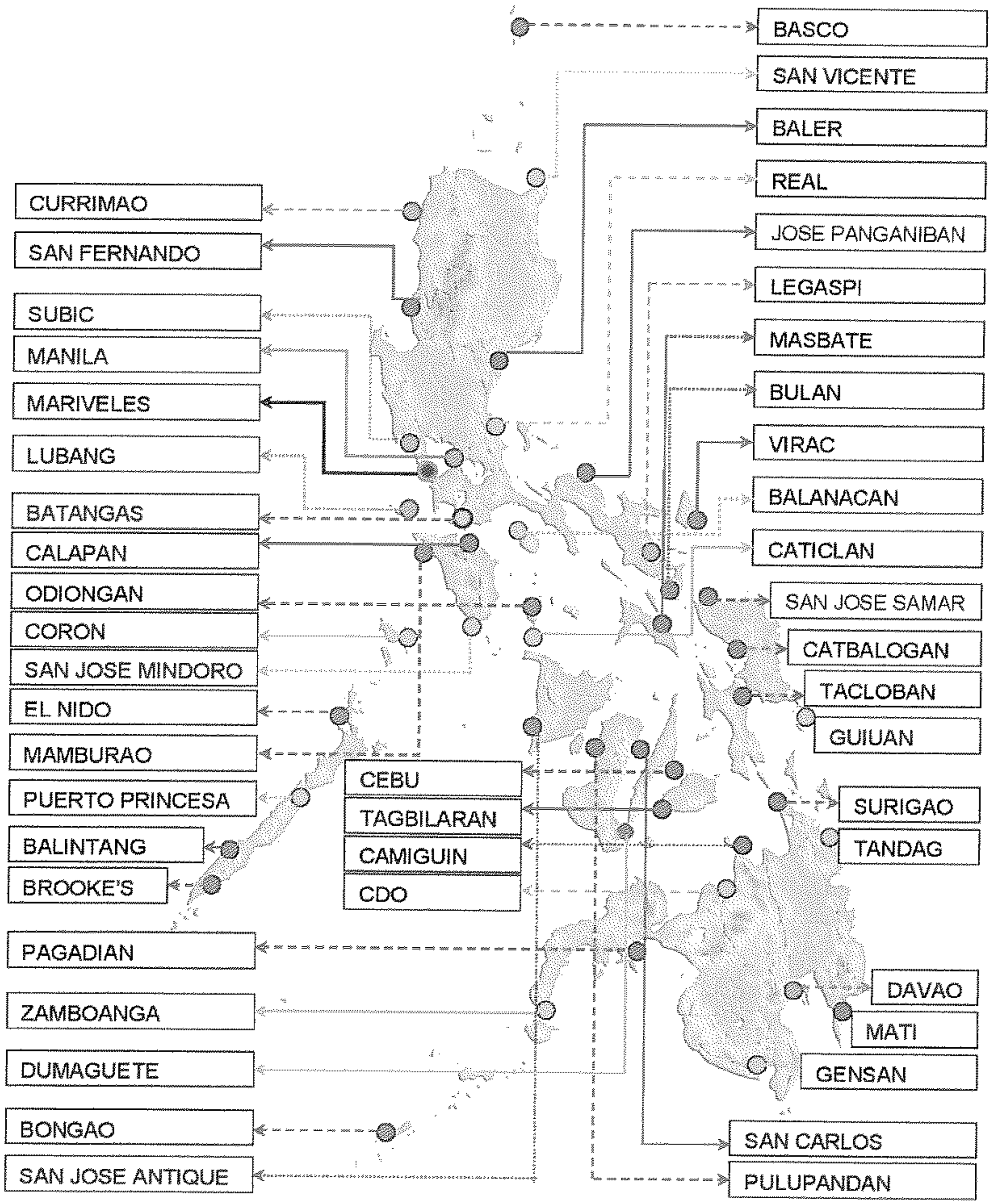

Figure 1. *Map of the Philippines showing the location of the 47 tide stations.*

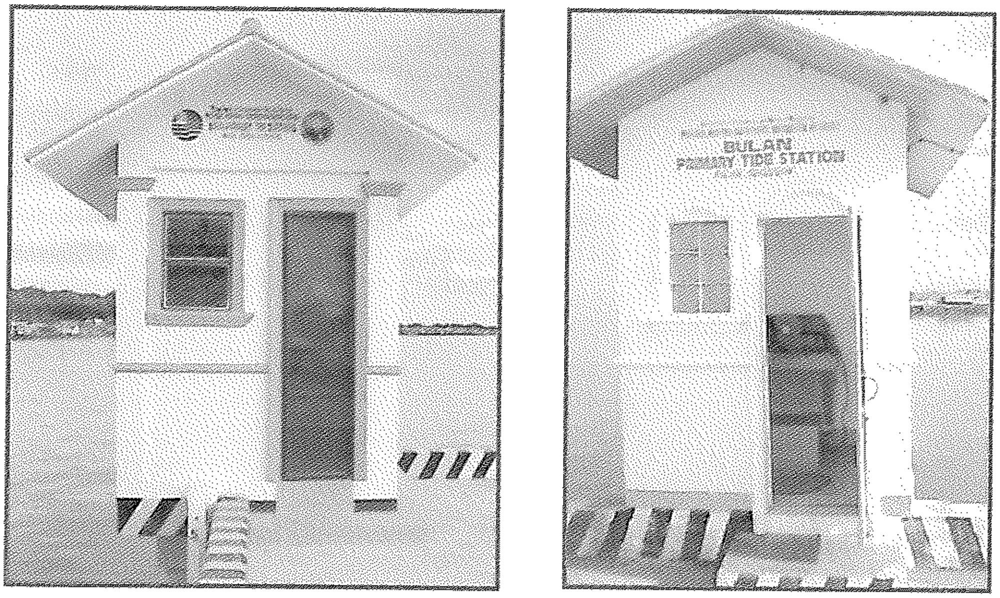

Figure 2. *Typical Philippine Tide Stations.*

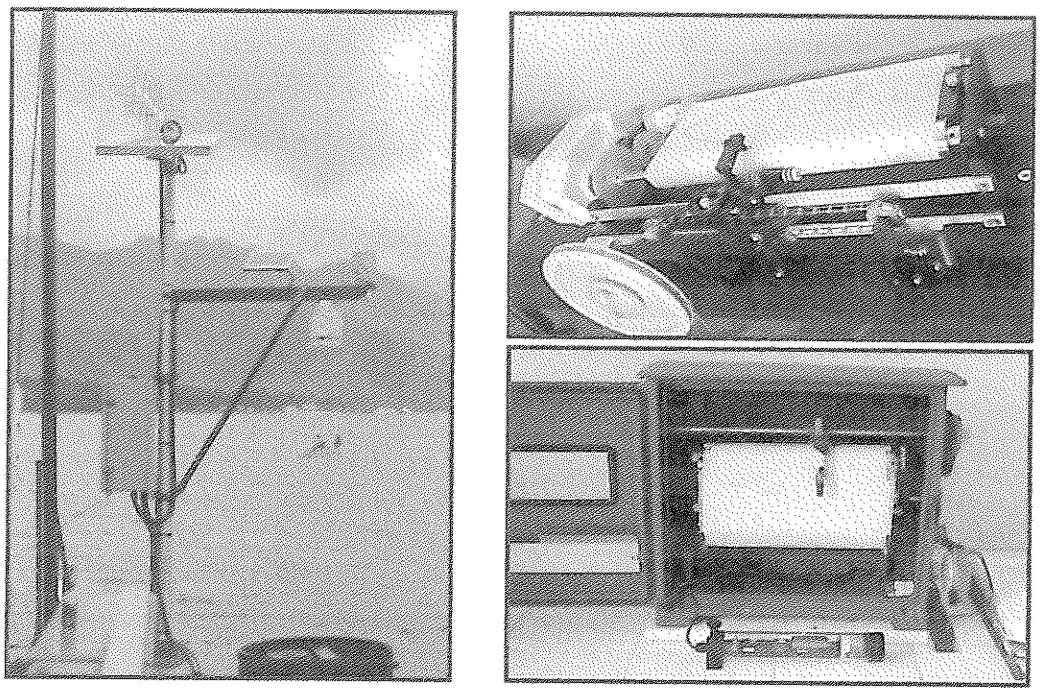

Figure 3. *Types of tide gauges used installed in the Philippine tide stations: Sutron Satlink Logger (left), Stevens Chart Recorder with Axsys Digital Data Logger (upper right), and OTT Strip Chart Water Level Recorder with OTT Thalimedes Digital Data Logger (bottom right)*

	STATION	LATITUDE	LONGITUDE	TIDE GAUGE
1	BALANACAN	13-32-01N	121-51-55E	OTT THALIMEDES
2	BALER	15-45-23N	121-35-26E	AXSYS MPU / STEVENS ANALOG
3	BALINTANG	9-20-52N	118-07-30E	AXSYS MPU / STEVENS ANALOG
4	BASCO	20-27N	121-58E	AXSYS MPU / STEVENS ANALOG
5	BATANGAS	13-45-26N	121-02-26E	STS DLN70
6	BONGAO	5-02-04N	119-46-29E	AXSYS MPU / STEVENS ANALOG
7	BROOKE'S POINT	8-46-17N	117-49-42E	AXSYS MPU / STEVENS ANALOG
8	BULAN	12-39-53N	123-52-16E	AXSYS MPU / STEVENS ANALOG
9	CAGAYAN DE ORO	08-30-04N	124-39-51E	OTT THALIMEDES
10	CALAPAN	13-25-40N	121-11-41E	AXSYS MPU / STEVENS ANALOG
11	CAMIGUIN	09-14-37N	124-44-15E	STEVENS ANALOG
12	CATBALOGAN	11-47N	124-53E	AXSYS MPU / STEVENS ANALOG
13	CATICLAN	11-56N	121-57E	OTT THALIMEDES
14	CEBU	10-17-35N	123-54-29E	AXSYS MPU / STEVENS ANALOG
15	CORON	11-59-27N	120-12-41E	OTT THALIMEDES
16	CURRIMAO	17-59-16N	120-29-16E	SUTRON
17	DAVAO	07-07-18N	125-39-46E	SUTRON
18	DUMAGUETE	09-18N	123-19E	AXSYS MPU / STEVENS ANALOG
19	EL NIDO	11-10-52N	119-23-12E	AXSYS MPU / STEVENS ANALOG
20	GENERAL SANTOS	06-05-30N	125-09-15E	OTT THALIMEDES
21	GUIUAN	11-02N	125-43E	OTT THALIMEDES
22	JOSE PANGANIBAN	14-18-52N	122-40-28E	AXSYS MPU / STEVENS ANALOG
23	LEGASPI	13-08-46N	123-45-29E	SUTRON
24	LUBANG	13-49-03N	120-12-11E	SUTRON
25	MAMBURAO	13-13-39N	120-34-03E	AXSYS MPU / STEVENS ANALOG
26	MANILA	14-35-07N	120-58-03E	SUTRON
27	MARIVELES	14-26-12N	120-30-28E	GLOBAL WATER
28	MASBATE	12-22-12N	123-36-56E	AXSYS MPU / STEVENS ANALOG
29	MATI	06-57N	128-13E	AXSYS MPU / STEVENS ANALOG
30	PAGADIAN	07-49-05N	123-26-21E	AXSYS MPU / STEVENS ANALOG
31	PUERTO PRINCESA	09-44-37N	118-43-41E	OTT THALIMEDES
32	PULUPANDAN	10-31N	122-48E	AXSYS MPU / STEVENS ANALOG
33	REAL	14-40-17N	121-36-49E	OTT THALIMEDES
34	ROMBLON	12-24-08N	121-58-50E	AXSYS MPU / STEVENS ANALOG
35	SAN CARLOS	10-28-40N	123-25-23E	STEVENS ANALOG
36	SAN FERNANDO	16-36-21N	120-17-30E	AXSYS MPU / STEVENS ANALOG
37	SAN JOSE, OCC. MINDORO	12-19-50N	121-05-20E	OTT THALIMEDES
38	SAN JOSE, SAMAR	12-31-58N	124-29-12E	AXSYS MPU / STEVENS ANALOG
39	SAN JOSE, ANTIQUE	10-44-13N	121-56-17E	AXSYS MPU / STEVENS ANALOG
40	SAN VICENTE	18-30-24N	122-08-49E	OTT THALIMEDES
41	SUBIC	14-45-56N	120-15-03E	SUTRON
42	SURIGAO	09-47-26N	125-29-49E	AXSYS MPU / STEVENS ANALOG
43	TACLOBAN	11-15-08N	125-00-10E	AXSYS MPU / STEVENS ANALOG
44	TAGBILARAN	09-39N	123-51E	AXSYS MPU / STEVENS ANALOG
45	TANDAG	09-05-05N	126-11-49E	OTT THALIMEDES
46	VIRAC	13-34-54N	124-14-04E	AXSYS MPU / STEVENS ANALOG
47	ZAMBOANGA	06-54-55N	122-02-17E	OTT THALIMEDES

Table 1. *List of Philippine Tide Stations.*