

National Report of the Philippines
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Oceanography Division
Coast and Geodetic Survey Department
National Mapping and Resource Information Authority
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I. Introduction

The Oceanography Division of the Coast and Geodetic Survey Department of NAMRIA 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 observation 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 tidal 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, the processes of tidal analysis and prediction use modern PCs and software programs used in Australia, Japan and the US. The Philippine tide stations has remained the same in terms of setup, structure, and instrumentation and still continue to yield good data results.

III. 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 each of the tide stations 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.

IV. Related issues on Sea-Level Scenarios

Among the 10 primary tide stations in the Philippines, only the Legaspi Tide Station is equipped with telemetry capability, which monitors tidal measurement in real-time mode. In collaboration with the Pacific Tsunami Warning Center (PTWC), based in Hawaii, the telemetry system was installed sometime in 1993 at the station. A special coupling device was attached to the tide gauge of NAMRIA to translate the tidal measurement to the telemetry system, which then transmits the data to PTWC. Locally, personnel from the Philippine Institute of Volcanology and Seismology (PHIVOLCS) closely collaborate with the tide observer of NAMRIA for tidal observation and monitor the operation of the telemetry. PTWC personnel supervise the maintenance of the telemetry instrumentation setup.

There are four Philippine tide stations that are registered in the network of tide stations under the Global Ocean Sea Level System for worldwide tidal scientific studies. These four Philippine tide stations registered with GLOSS are the Manila, Cebu, Legaspi and Davao tide stations. Being a member of the International Oceanographic Commission, the Philippines send yearly tidal data to this program as part of the country's commitment to various oceanographic surveying activities.

Mode of Data Acquisition and Transfer from Tidal Stations

Tidal data in the Philippines, in the case of analogue 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. As of this time, Philippine tidal data retrieval uses this procedure in the monitoring and transfer of data from tidal stations to the main office. The Philippines has not yet acquired equipment and instruments that can facilitate a faster mode of data transfer.

List and features of the present GLOSS primary tide stations of the Philippines

Tide Station Location – Original Year Established	Present Type of Tide Gauge	Type of Tide – Mean Tide Range	Highest Tide Observed – Date Recorded All Heights: Above Zero Tide Staff	Lowest Tide Observed – Date Recorded All Heights Above Zero Tide Staff
1. South Harbor, Manila 1947 14 35 N, 120 58 E	Analog tide gauge (AOTT model - operational	Mixed diurnal and semi-diurnal – 0.758 meter	4.0 meters – 04 July 2000	1.16 meters – 26 January 1952
2. Cebu City – 1935 10 18 N, 123 55 E	Analog tide gauge (AOTT model) - operational	Mixed diurnal and semi-diurnal with diurnal dominance – 1.023 meters	3.25 meters – 13 July 1987	0.36 meter – 29 January 1983
3. Sasa Wharf, Davao City – 1947 07 05 N, 125 38 E	(Temporary) Portable digital tide gauge (WTG model) - operational	Semi – diurnal – 1.305 meters	3.47 meters – 27 September 1988	0.40 meter – 13 December 1958
4. Legaspi Pier in Legaspi City, Albay – 1947 13 09 N, 123 45 E	Analog tide gauge (AOTT model) - operational	Semi – diurnal 1.156 meters	2.92 meters – 26 September 1988	0.15 meter – 19 January 1969

V. Philippine Tide Station Characteristics

There are 10 primary tide stations established and maintained in the different coastal areas of the country. Each 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. This type usually houses the analog type of tide gauge due to the numerous mechanisms and setup features of the equipment. Some digital-type tide gauges such as the Aanderaa pressure sensor type are housed in small boxes attached to existing pier structures. 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. Three tide stations to date are equipped with digital tide gauges, six stations with analog-type tide gauges, and one station with both digital-and-analog-type tide gauges.

Figure 1. *Types of tide gauges currently in use in the different tide stations in the Philippines*



Leupold & Stevens chart recording recorder Model



A.O.T.T. float type Marigram



WTG-904 series 3, wave and tide Gauge, InterOcean

Tide observers who are hired in the local area for advantageous reasons oversee maintenance, operation, housekeeping, security of the station, as well as monitoring of data acquisition. They are also responsible for sending the data on a monthly basis.

VI. Future Locations of Additional Tide Stations

The Philippines being an archipelago, the present number of tide stations in the country is not sufficient to provide adequate tidal information for its entire coastline. The densification of our tide station network is therefore greatly required, considering the varied tidal behavior of our waters that should be fully understood.

The need for the densification of the Philippine tide gauge network in the near future would suggest the establishment of additional tide stations in many coastal areas such as the following which are initial priorities; Eastern Mindanao, Eastern Samar, Masbate coast, Northeastern Luzon, Northwestern Luzon, Southwestern Negros, West Coast of Zambales, Western Palawan, and Zamboanga. The above locations are deemed necessary since most part of the country lack tidal information, especially within the internal waters, which are largely used for navigation. The outer coastlines are likewise very long and the existing tide stations may not define tidal characteristics very well as they are spaced too far apart from one another.

Philippine organization involved in sea-level measurements:

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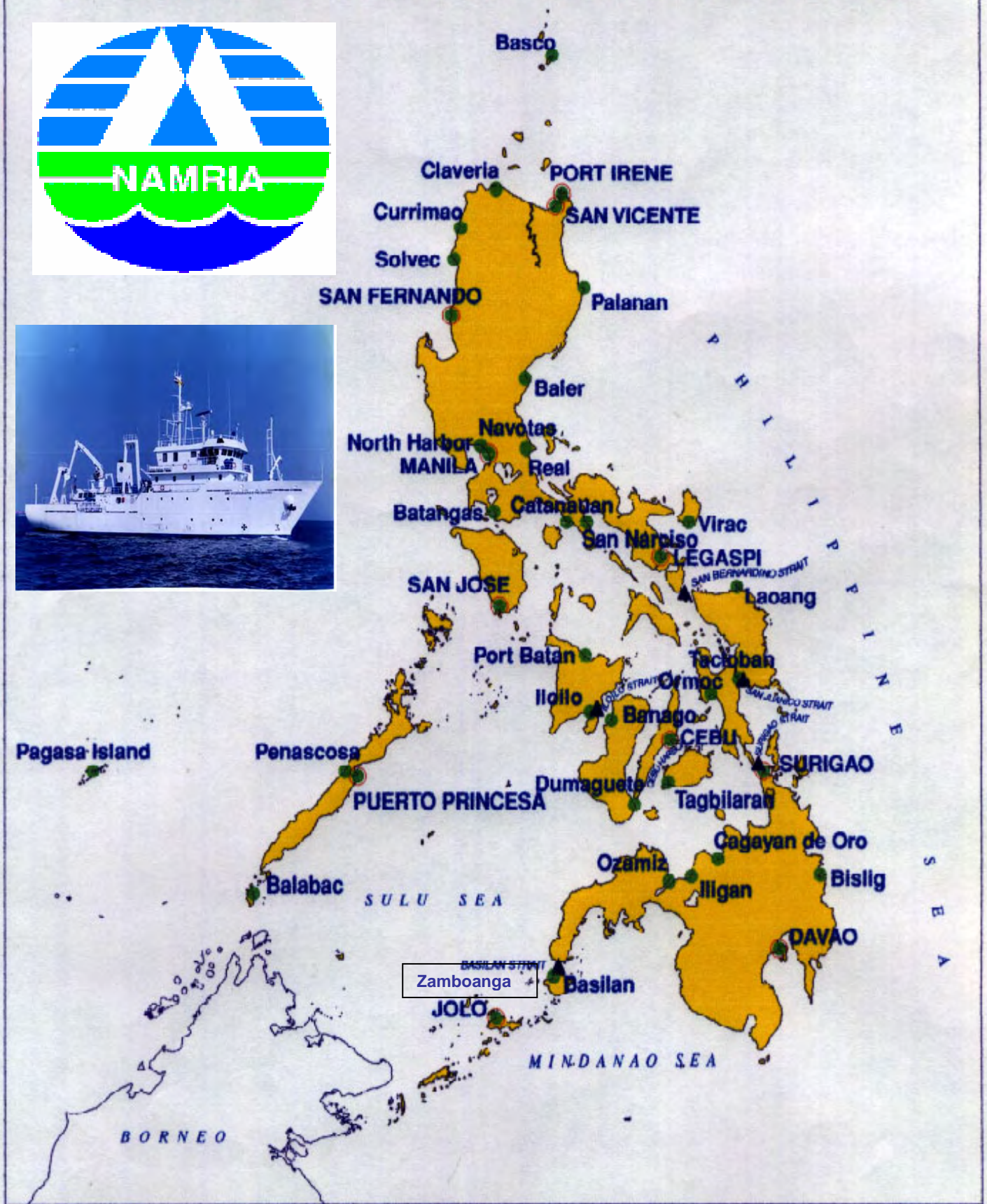
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LOCATION OF TIDE AND CURRENT STATIONS



VII. Developments in Philippine Sea-Level Observations

Recent events in March and April 2006 saw the upgrading and installation of new and modern tide gauges in the Manila and Legaspi tide stations. In cooperation with GLOSS and University of Hawaii Sea-Level Center, the Manila and Legaspi tide station was provided with a radar sensor, GPS receivers, satellite capable tide gauges. Mr. Nikolai Turetsky of the University of Hawaii installed the tide gauges in the named locations.

There are also plans to upgrade the tide gauges in Davao in the near future, with the same set of equipment and instruments sponsored again by GLOSS and the UHSLC.

Subic bay was also surveyed by a different funding agency namely the Asian Disaster Prevention center (ADCP) and they plan to install the equipment in the near future. It is mainly in relation with the Tsunami Warning System and in collaboration with the Philippine Institute of Seismology and Volcanology.

VIII. Conclusion

The Philippines continuous to improve and develop its tidal data acquisition and dissemination. Providing accurate tidal data to local and international users is the main objective of NAMRIA particularly its Oceanography Division. Our country is keen on continuing our participation in international organizations involving oceanographic information gathering. With our commitment to this endeavor, we continue to exert efforts in joining IOC/GLOSS and other agencies that has the same interest in this field of study.

The support of these international organizations particularly IOC/GLOSS is greatly appreciated by our country. In this manner we seek to further develop our capabilities with the help of IOC/GLOSS's technical expertise to further enhance and upgrade our equipment and train our personnel. We are also calling upon these international organizations to assists us in whatever form in establishing more tide stations for the densification of the Philippine tide gauge network. In the long run we look forward to a more wholesome relationship with GLOSS and other countries in terms of oceanographic data sharing.

Photos of the newly installed GLOSS/UHSLC tide gauge system at the Manila Tide Station



