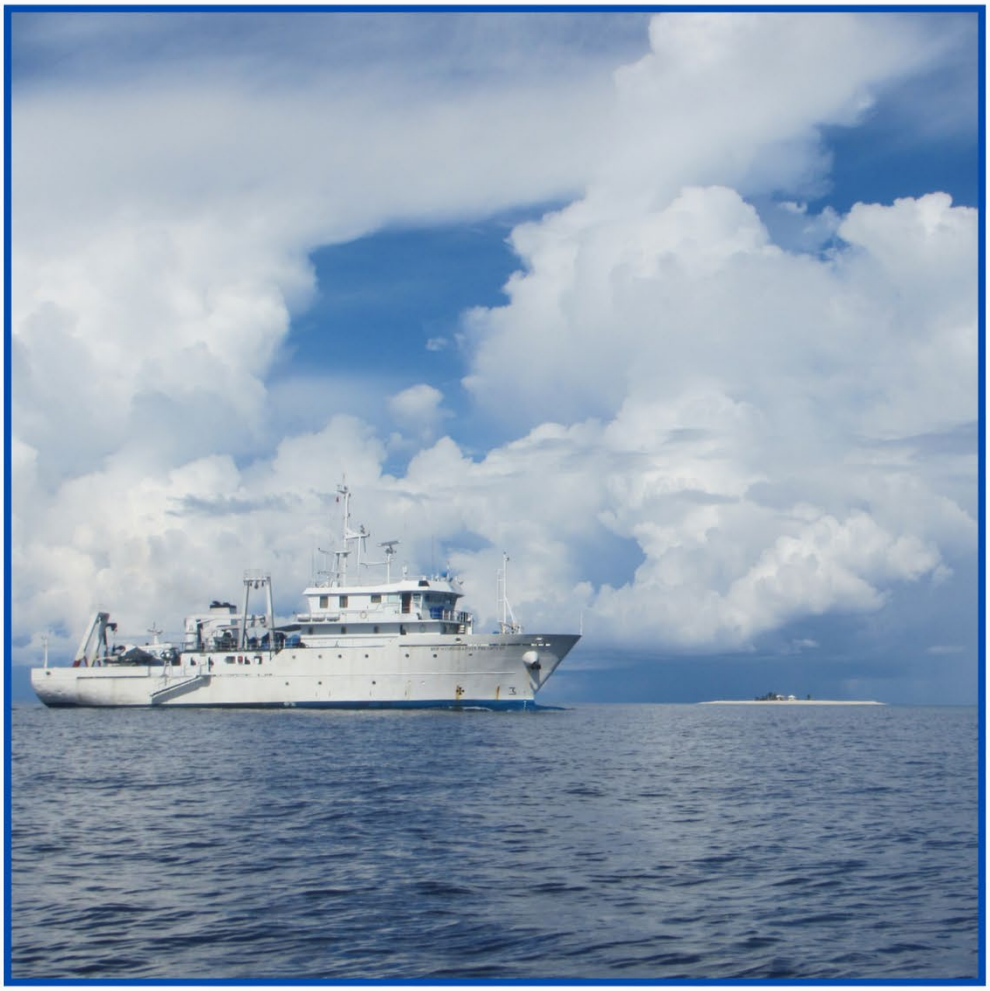
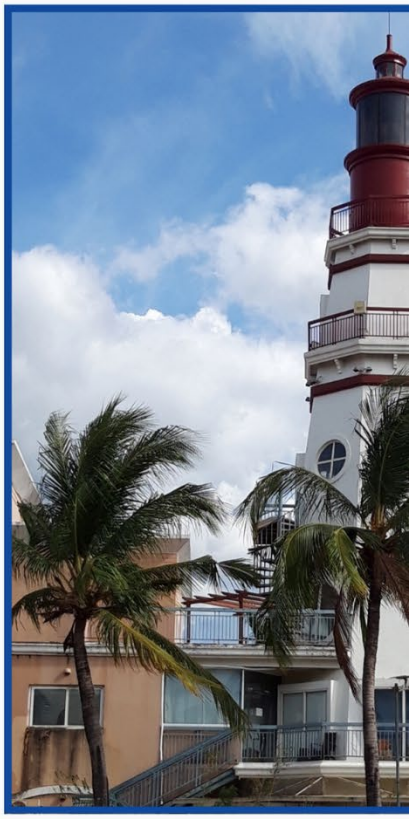
# NAMRIA STANDARDS FOR HYDROGRAPHIC SURVEYS





3RD EDITION, JANUARY 2025

NATIONAL MAPPING AND RESOURCE INFORMATION AUTHORITY
HYDROGRAPHY BRANCH

# NAMRIA STANDARDS FOR HYDROGRAPHIC SURVEYS

2025

THIRD EDITION

Hydrography Branch

National Mapping and Resource Information Authority

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# GLOSSARY

**A priori uncertainty**: The theoretical value calculated before the conduct of the survey , on account of all estimated uncertainties of factors affecting the measurements in a hydrographic survey.

**C-Check:** a field procedure to check the calibration of the leveling instrument, by determining the combined effects of instrument misalignment from the horizontal plane and atmospheric refraction.

**Confidence Level or Confidence Interval**: The probability that the actual value of a measurement will lie within the specified uncertainty. For the purposes of the NSHS, the default confidence level or interval is 95%.

**Error:** The difference between the measured value and actual value of collected data.

**Geodetic Control Points (GCPs)** - ground markers or control points whose coordinates are established by geodetic surveying methodology with information such as gravity value, geographic position, and elevation used in determining the gravity field, location, and elevation of other points.

**Hydrographic Descriptive Report (HDR)**: A document detailing the processes involved in the collection of hydrographic data, the instruments and software used, the accuracy of the survey, and the results.

M**ean Lower Low Water (MLLW):** the water level datum resulting from averaging the lower of the two low tides per day over an extended period of time, or an epoch.

**Tide Reducers or Water Level Reducers:** Corrections or adjustments to the water level, so that the depths will be referenced to the chart datum, which in our case is MLLW (i.e., "reducing" the soundings to MLLW).

**Tidal Zoning:** An interpolation method in reducing sounding data to chart datum (e.g., MLLW) using water level data from multiple tide stations.

**Total horizontal uncertainty (THU):** A two-dimensional quantity that includes all contributing horizontal measurement uncertainties; The horizontal component of the total propagated uncertainty (TPU).

**Total propagated uncertainty (TPU):** A three-dimensional uncertainty measure wherein all sources of errors or uncertainties are taken into account.

**Total vertical uncertainty (TVU):** A one-dimensional quantity that includes all contributing vertical measurement uncertainties; The vertical component of the total propagated uncertainty (TPU).

**Uncertainty:** A range of values within which the true value of a measurement lies within a specified confidence interval.

# 1 INTRODUCTION

The purpose of this document is to detail the technical specifications and requirements for the conduct of hydrographic surveys to be undertaken by the Hydrography Branch of the National Mapping and Resource Information Authority (NAMRIA). This manual may also be used as standard by other agencies or private companies in their survey operations.

The specifications described in this document are largely based on the International Hydrographic Organization's (IHO) Standards for Hydrographic Surveys – Special Publication No. 44 (IHO S-44), 6th Edition (October 2020). The references for this document also include the hydrographic survey standards of various international hydrographic organizations.

It shall also be noted that the provisions of this document do not discredit or invalidate the previous hydrographic surveys or nautical charts, but rather seek to improve the conduct of future hydrographic surveys. This document also seeks to respond to the advancement and progress of technology and principles associated with hydrographic surveying.

The NAMRIA Hydrographic Survey Standards shall be reviewed annually by the Technical Working Group and shall be revised if necessary. For suggestions, comments or questions related to the NSHS, please contact the Hydrographic and Geomagnetic Data Management Section, Survey Support Division thru or email nshs@namria.gov.ph.

For the purpose of this document, these words shall be defined as follows:

"**Shall**" or "**must**" indicates a mandatory requirement;

"**Should**" indicates a recommendation;

"**may**" indicates an optional requirement.

## 1.1 LIST OF MAJOR CHANGES FROM DECEMBER 2021

Listed below are several important changes which have been made in the 2021 Edition of this document:

### Glossary

- Glossary – the addition of the term "Geodetic Control Points (GCPs)" to the list of described terms.

## Chapter 2: Reference Datums

- Section 2.3 titled "Vertical Datum" – the addition of the delineation of Mean High Water Line per NAMRIA Administrative Order no. 2023-002.

## Chapter 3: Hydrographic Positioning

- Section 3.1 titled "Horizontal Control" – additional requirement to use the post-processed coordinates with the least horizontal uncertainty; additional requirement for the use of either 24-hour static or two 5-hour static observations if online GNSS processing service will be used; additional requirement of ensuring each observation falls within a single UTC Day; addition of option to use NAMRIA's AGS observations provided the same reference frame was used.

## Chapter 4: Tides and Water Levels Requirements

- Section 4.5.1 titled "Tide Station Requirements" - added emphasis on 10-minute interval tide recording

- Section 4.5.6 titled "Leveling" – addition of the use of Third Order geodetic control, increasing in order as the vertical uncertainty requirement increases.

## Chapter 5: Depth Sounding

- Addition of new Section 5.1.1 titled "Confidence Level" that defines the calculation of the confidence level for one-dimensional (1D) as 1.96 x standard deviation, and for two-dimensional (2D) quantities as 2.45 x standard deviation.

- Addition of new Section 5.2.2 titled "Sounding Density" that requires a minimum of three (3) soundings per cell for at least 90% of the cells if feature detection is required in a survey area.

- Addition of new Section 5.2.3 titled "Holiday" to define a holiday as a collinear contiguous length of at least three (3) matrix cells.

- Addition of new Section 5.3.5 titled "Corrections for Grid Convergence" to account for the grid convergence angle during patch test to enable its correction during data processing.

- Transfer of previous Section 5.3.5 titled "Uncertainty Analysis for Depths" to Section 5.3.6 and a change in its title to "A-posteriori Uncertainty Determination and Management".

- Addition of spatio-temporal sound speed distribution error in the errors considered in Section 5.3.6 titled "A-posteriori Uncertainty Determination and Management".

- Section 5.4.1 titled “Multibeam Sonar Calibration” – addition of consideration for grid convergence which may be mitigated by conducting the patch test on the center of the survey area.

- Section 5.4.2 titled “Cross Check Analysis” – addition of the inability of cross-check analysis to estimate the Total Horizontal Uncertainty (THU), thus opening the use of other methods for THU estimation.

- Addition of new Section 5.4.3 titled “A-posteriori Uncertainty Analysis” to emphasize the use of uncertainty profiles and allow CUBE processing and filtering to generate CUBE-filtered soundings, as well as allow additional THU and TVU analysis; added the requirement to generate BAG files from CUBE-derived surfaces.

## Chapter 6: Features

- Section 6.1.6 titled “Shoreline Construction” – addition of list of required attributes to be identified: Category of Shoreline Construction, Water Level Effect, Nature of Construction, Status or Condition, Color and/or Color Pattern, and Other Relevant Characteristics Observed.

- Section 6.1.8 titled “Elevations and Clearances” – addition of Mean Higher High Water Height (MHHW) tidal datum for clearances above navigable waters.

- Addition of new Section 6.1.9 titled “Topographic Information” to specify the coastal topographic survey requirements and required attributes to be identified for topographic features.

# 2 REFERENCE DATUMS

Datums are numerical or geometrical set of quantities that specify references from which measurements can be made. It can be an actual physical or invisible point, line, or plane positioned by the statistical treatment of a particular natural phenomenon.

For hydrographic surveys, a horizontal datum is used in the positioning of points on the earth while elevations or depth are referred to a vertical datum.

## 2.1 TIME

Coordinated Universal Time (UTC) shall be used as the reference time for all data collection, including water level data. Any observation or data collection conducted using other reference time shall be converted to UTC when merged to other hydrographic survey data.

## 2.2 HORIZONTAL DATUM

All horizontal positions shall be referenced to the World Geodetic System of 1984 (WGS84) realization G1762 or later. This datum must be used for every geographic position throughout the survey project. When the Universal Transverse Mercator (UTM) projection is being used, the data coverage shall be defined under the appropriate zoning definition (Zone 50 to 52) in the Northern Hemisphere.

## 2.3 VERTICAL DATUM

With some limited exceptions, the sounding data in tidal bodies of water shall be referenced to Mean Lower Low Water (MLLW). The heights of bridges and overhead cables shall be referenced to Mean Higher High Water (MHHW). The coastline, for purposes other than charting, shall be referenced to MHWL as described in AO No. 2023-002 - Manual on the Delineation of Mean High Water Line (MHWL).

On other inland bodies of water such as lakes and rivers (i.e., non-tidal bodies of water), the soundings shall be referenced to the designated vertical datum for that lake or river, if such a "Special Datum" exists.

The reduction of sounding data to MLLW is optional in hydrographic surveys of the EEZ (exclusive economic zone) and AW (archipelagic waters) with depths deeper than 200 meters.

# 3 HYDROGRAPHIC POSITIONING

The position accuracy refers to the proximity of the measured feature or sounding to its exact position within the reference frame. All positions shall be referenced to WGS84 (G1762).

The general misconception is that the accuracy of the positioning equipment alone is equivalent to the position accuracy. Position of reduced sounding or feature is affected by various parameters, e.g. water level, draft, water refraction, horizontal offset, attitude, etc. All contributions of such parameters to the total uncertainty should be accounted for.

A statistical method to determine combined uncertainty from all sources must be adopted. A 95% confidence level should be followed when reporting the total position uncertainty.

## 3.1 HORIZONTAL CONTROL

The uncertainty of the geodetic control used in the positioning of soundings and features during hydrographic survey contributes to the total horizontal uncertainty which should not exceed the values shown in *Table 1*.

Primary shore control points established by ground survey method to a relative accuracy of 1 part in 100,000 shall be used. The error shall not exceed 10 cm at 95% confidence level when such points are established using GNSS.

Secondary shore control points may be located for local positioning but not to be used to extend controls. Such points shall have a relative accuracy of 1 part in 10,000 if established by ground survey method, and shall not exceed 50 cm at 95% confidence level using GNSS.

These Primary and Secondary controls correspond to NAMRIA's First Order and Fourth Order Geodetic Controls, respectively. NAMRIA-established geodetic controls—Zero Order, First Order, Second Order, Third Order, and Fourth Order—can be used in hydrographic surveys, provided that the positions of these controls are referenced to WGS84(G1762) or later. Only controls with at least Third Order accuracy can be used to establish new control points, and these new controls should only be established using static GNSS observation.

In cases when a WGS84(G1762)-referenced control is not available, the horizontal control must be established using static GNSS observation and post-processed via PPP (precise point positioning) or double-difference strategy using multiple online GNSS processing service such as AUSPOS or CSRS-PPP. The processed coordinates with the least horizontal positioning uncertainty shall be used as the final coordinates. A continuous 24-hour static observation or two 5-hour static observations should be conducted if an online GNSS processing service is to be used. Each observation must fall within a single UTC Day to ensure that the observation data will not be split.

Survey teams may optionally post-process static GNSS observations using the NAMRIA Active Geodetic Network (AGN) provided the same reference frame was used in the collection of AGN data.

Survey teams shall coordinate with the Mapping and Geodesy Branch of NAMRIA for the updated list and coordinates of geodetic controls in the project area. Survey teams shall refer to NAMRIA Quality Management and Operations Manual on Procedures and Instructions on establishment and maintenance of geodetic controls (*Doc No QMOM-PGRSDM: EMGCP*).

### 3.1.1 Position Accuracy

Horizontal position of soundings and features must satisfy accuracy requirements in *Table 1*. The survey party shall undertake *a priori* calculations of the total propagated uncertainty (TPU) to ensure that the planned survey will meet the standards for horizontal control. The *a priori* uncertainties shall be detailed in the Hydrographic Descriptive Report (HDR).

Evidence of quality monitoring of survey operations, such as DOP and RMS values, should also be documented and discussed in the Descriptive Report.

## 3.2 VERTICAL CONTROL

Total Vertical Uncertainty (TVU) is more stringent than THU. Likewise, all contributors to the TVU when reducing soundings and height to vertical datum must be considered, and detailed in the HDR.

All soundings and drying heights of rocks and islets must be referred to Mean Lower Low Water (MLLW). Heights and clearances of overhead features must be referred to Mean Higher High Water (MHHW).

### 3.2.1 Survey Order Pre-Qualification

The survey team should make efforts to estimate the entire survey platform's capability to comply with the required survey order of the project. This can be done by estimating the (1) expected horizontal and vertical uncertainties' contribution of each equipment to be used as well as the datum transformation model/s and geodetic control points to be used, and (2) feature detection capability (in terms of cubic features) of the sonar to be used at the expected depths of the survey area. Manufacturer-specified tolerances may be used for this exercise, but if available, calibration or field-testing data is preferred though not mandatory.

# 4 TIDES AND WATER LEVELS REQUIREMENTS

## 4.1 OBJECTIVES

The tides and water level requirements as described here apply in hydrographic surveys of ports and harbors, as well as other related hydrographic surveys. The first objective is to produce water level time series and associated water level or tidal reducers that will be used in sounding corrections and water level validation in the hydrographic survey. The second objective is to recover and/or establish tidal benchmarks, to obtain the difference in elevation compared to the tidal datum in the area which can be used in future hydrographic survey activities.

## 4.2 PRE-SURVEY PLANNING

The Physical Oceanography Division (POD) is in charge of managing and maintaining the NAMRIA tide station network in support of hydrographic survey activities. The POD calculates and generates tide reducers to be used by hydrographers in reducing hydrographic survey data to the required vertical reference datum. The POD shall also identify previously occupied subordinate tide stations near the area and provide the hydrographers with information such as datum and benchmark information for possible recovery and reoccupation. If there is no tide station or previously occupied subordinate tide station available in the area, the hydrographer shall establish a new temporary subordinate tide station. The hydrographer shall ensure that the tide stations to be used to determine tide reducers in the area are in operational status prior to start of survey operations.

## 4.3 GENERAL DATA AND REFERENCE DATUM REQUIREMENTS

The present NAMRIA Chart Reference Datum is the Mean Lower Low Water (MLLW) for hydrographic surveys and Mean High Water (MHW) for shoreline mapping surveys. Hourly heights and high and low predictions in the Tide and Current Tables shall be referred to MLLW. Subordinate tidal observations shall be compared and matched with the primary station having the same tidal characteristics in order to compute the final tidal datum for the subordinate station.

## 4.4 ERROR BUDGET CONSIDERATIONS

Tide reducers are very important to reduce soundings to chart datum especially in shallow areas with relatively high tidal range. Uncertainties associated with tidal data may come from leveling error, measurement/instrument error, data processing error, datum error and zoning error. As much as possible, the effects of these errors must be minimized by proper planning of tidal observation, by using tidal zoning and prescription of subordinate stations with

sufficient length of observation. The allowable error contribution of tides and water levels to the overall hydrographic survey error budget should fall between 0.10 m and 0.45 m at 95% confidence level.

## 4.5 TIDAL DATA COLLECTION

### 4.5.1 Tide Station Requirements

Data from NAMRIA tide stations will be used for reducing hydrographic survey data to the required vertical datum which is MLLW. The Survey Support Division (SSD) may require the hydrographer to set up subordinate tide stations in a project area. This shall be specified in the Field Project Instructions (FPI). The data will be used in the computation of final tide reducers, tidal datum calculations, and harmonic analysis for tide prediction.

The tidal observation shall not be less than 30 days at a maximum sampling interval of (10) minutes with recording every 10-minute mark (:00, :10, :20, etc.) and shall start at least three (3) hours before starting hydrographic survey operations to three (3) hours after ending the hydrographic survey. Tidal leveling shall be conducted as soon as installation is finished and shall be repeated before dismantling of the station.

For permanent tide stations, site selection is very important to maximize the usability of the tidal data. Areas with local tidal characteristics due to underwater topography, nearness to inlets and rivers should be avoided.

### 4.5.2 Tide Gauge

The tide gauge's measurement range shall be greater than or equal to five (5) meters. The sensor must be able to measure tide level at a resolution of at least 1 cm. Calibration/Verification must be done before deployment and in accordance with the instrument's manual and/or existing NAMRIA procedures.

### 4.5.3 Station Installation

The field survey party shall secure permission before installation of the tide gauge and tide staff, establishment of benchmarks and conduct of leveling with concerned authorities where the tide station shall be installed.

The choice of site of installation shall be carefully studied. The installation shall be on a stable ground; far from river, estuaries and sharp headlands; away from the occurrence of impounded water during extreme low tide, turbulence, currents; and far from berthing space of ships to avoid collision.

The installation of the tidal sensors should be done in accordance with the manual of the said instrument. Photos of the tide station shall be submitted together with the report. If possible, the GNSS coordinates of the tide station should also be recorded.

The field survey party must ensure that all components of the tide station are safe and secure throughout the whole length of observation. Components of the tide station shall include the tide gauge attached, a tide staff and at least five (5) benchmarks.

The field survey party shall inspect the tide station and should download tidal data at least once a week to ensure that it is operational and in good working condition.

### 4.5.4 Tide Staff

The field survey party shall install a tide staff together with the tide gauge. The staff shall be plumb and shall have graduation marks every 1 cm. The tide staff should be mounted on a separate piling independent of the water level sensor in order to maintain the independent stability of the staff and sensor.

A series of staff observations shall be conducted initially after installation, during deployment and before removal of the tide station. The staff observations after installation and before removal shall be performed coinciding with the specified tide gauge sampling interval for at least three (3) hours. Staff observations shall also be required at least twice a week coinciding with the specified tide gauge sampling interval for at least one (1) hour. If tide staff observations cannot be performed twice a week, an alternative would be to conduct tide staff observations at least four times in a month with at least 2 hours of observation. The tide staff observations shall be conducted to compute the difference between the tide staff and tide gauge. The tide staff to tide gauge differences shall be averaged and shall be applied to the elevation of the Primary Benchmark for the computation of the tidal datum.

### 4.5.5 Benchmarks

Benchmarks are permanent markers established in the vicinity of a tide station whose elevation above the tidal datum is known. Benchmarks can be used to monitor stability and can be used in retrieval of tidal datum. The field survey party shall consult with the POD regarding the existence of previously observed subordinate tide stations in the vicinity of the survey project. If a subordinate tide station was previously installed in the vicinity, the party shall recover previously used benchmarks and use the elevation data of the said benchmarks for retrieval of the tidal datum. At least two (2) previously established benchmarks should be recovered and shall be checked if not disturbed and still suitable for tidal datum recovery. A tide station can then be installed in the area and leveling shall be conducted to determine the difference in elevation between benchmarks, water level sensor and tide staff.

A minimum of five (5) benchmarks shall be established in the vicinity of the tide station. It is recommended that all benchmarks are within a few hundred meters or at most one (1) kilometer from the tide gauge. Benchmarks shall be described according to the type of mark used, inscription, access, and location relative to at least two prominent landmarks in the vicinity. If possible, the GNSS position of the mark (in degrees, minutes, and seconds) should also be determined for easier recovery in the future. Sketch map, description, and photographs of benchmarks shall be submitted together with the leveling book and/or report. The minimum distance of separation between each benchmark must be 60 meters.

Each tide station shall have a designated Primary Benchmark (PBM). The PBM is typically the most stable mark in close proximity to the water level station. In recovery of tidal datums of previously occupied subordinate tide stations, the elevation of the PBM above tidal datum shall be used. If the PBM is found to be disturbed or unstable, another benchmark from the five (5) previously established BMs shall be used. The newly designated PBM shall then be related to the tidal datum by determining its previous elevation compared to the original PBM. This process shall be well documented and submitted to POD for updating of records.

Any deviations by the field party from these requirements shall be subject to approval by the CSSD.

### 4.5.6 Leveling

Leveling of the tide station, tide staff, and the five (5) benchmarks shall be conducted after installation and before dismantling of tide station, after station modification and at least every six (6) months during operation. Electronic digital/barcode level systems are preferred. The leveling shall pass at least second order accuracy for geodetic leveling.

Before the conduct of leveling, the instrument must first pass the collimation test or C-Check. The resulting collimation error or C-factor must be less than ±0.004.

Stability of the tide station and benchmarks shall be determined after every leveling activity. Movement of tide gauge or tide staff relative to PBM compared to previous leveling of more than 1 cm shall be verified by re-run of leveling between tide staff or tide gauge to PBM. The findings of the said activity shall be reported to POD.

It is recommended to tie the tidal benchmarks to the nearest geodetic control point and periodically check with respect to the national vertical network. The geodetic control point to be used should at least be a Third Order, increasing in order of accuracy as the vertical uncertainty requirement increases.

## 4.6 TIDAL DATA PROCESSING

### 4.6.1 Quality Control

Quality control of data shall be done by POD. The acquired tidal data shall be compared with predicted tide or data from nearby stations. Data editing and gap filling shall be done and documented according to established guidelines of the POD. All changes in the gauge record such as vertical movement of the tide gauge, staff or benchmarks shall be well documented.

### 4.6.2 Data Processing

POD shall perform the tidal data processing. Tidal data that have undergone quality check shall be used to compute for different tidal datums and generate hourly, maximum, and minimum water height referred to MLLW.

## 4.7 COMPUTATION OF TIDAL DATUMS

### 4.7.1 Datum Computation

Tidal datums are computed from continuous tidal observations of at least thirty (30) days. The tidal data shall be quality controlled by filling gaps and shall be processed by tabulating the high and low tides and hourly heights. Tidal parameters shall then be computed by taking the mean of the tabulated values. Tidal datums are then computed by taking the mean of the tidal parameters over a 19-year period or one tidal epoch. For subordinate tide stations with less than 19 years of observation, tidal datums shall be computed by comparison of data with an appropriate primary tide station. After computation of the tidal datums, they can then be transferred to benchmarks through leveling.

### 4.7.2 Tidal Datum Recovery

In the recovery of tidal datum at previously observed subordinate tide stations, at least two (2) benchmarks must be recovered. If a tide station is to be installed, tidal leveling shall be conducted to determine the differences of elevation between the newly installed tide gauge and the recovered benchmarks. The previously determined MLLW can then be transferred to the new tide gauge and can be used again in the computation of tide reducers.

### 4.7.3 Quality Control

Leveling must be done according to Section 4.5.6 to ensure stability of the time series and minimize errors in the computation of the tidal datum. New leveling results must be compared with the previous leveling data by comparing the differences in elevations between benchmarks. Significant change in the differences in elevation of the benchmarks must be reported to POD for investigation and checking. The data from the subordinate substation should be compared to a primary tide station of same tidal characteristics. After reoccupation and re-observation of subordinate tide stations, the new tidal datums (from the new tidal data) shall be compared with the previously determined tidal datums for verification and updating. It can be noted that the longer the duration of tidal observation, the more accurate are the resulting tidal datums.

## 4.8 ZONING AND TIDE REDUCERS

Data relative to MLLW from subordinate tide stations shall be applied to soundings to reduce them to chart datum. Tidal series data relative to MLLW and applied to hydrographic soundings are called tide reducers.

Tidal zoning is the direct or indirect correction technique of reducing sounding data to chart datum. Discrete tidal zoning may be used to interpolate or extrapolate tide level variations from the closest tide station to a survey area. Several subordinate tide stations can be installed at strategic sites in the survey area. The survey area can then be divided into different regions that shall utilize subordinate tide station data that is nearest to the said region.

# 5 DEPTH SOUNDING

**Soundings** are measurements from the water surface to the seafloor that may or may not have been applied with corrections such as tide and sound velocity. When these measurements are corrected or post-processed, these elevations from the bottom to an established vertical datum, such as MLLW, are then referred to as **Depths**. Upon accounting for all contributing variables, there will be a resulting uncertainty or error collectively known as the **Total Propagated Uncertainty (TPU).**

## 5.1 GENERAL STANDARDS FOR DEPTH

*Table 1: Standards for Hydrographic Survey*[1]

| Order | Exclusive Order | Special Order | Order 1A | Order 1B | Order 2 |
|---|---|---|---|---|---|
| **Description of Areas** | Shallow areas where there is strict minimum under-keel clearance and maneuverability restrictions. | Shallow waters in major ports and harbors, shipping channels. Under-keel clearance is critical in these areas. | Areas shallower than 100 meters in berthing areas, ports and harbors, where under-keel clearance is less critical. | Areas shallower than 100 m where general depiction of the seabed is adequate and under-keel clearance is not an issue at all. | Areas deeper than 100 m where general depiction of the seabed is adequate. |
| **Maximum Allowable THU** | 1 m | 2 m | 5 m + 5% of depth | 5 m + 5% of depth | 20 m + 10% of depth |
| **Maximum Allowable TVU** | a = 0.15 m<br>b = 0.0075 | a = 0.25 m<br>b = 0.0075 | a = 0.5 m<br>b = 0.013 | a = 0.5 m<br>b = 0.013 | a = 1.0 m<br>b = 0.023 |
| **Feature detection** | Cubic features > 0.5m | Cubic features > 1 m | Cubic features > 2 m, in depths to 40 m; 10% of depth beyond 40 m | Not applicable | Not applicable |
| **Feature Search** | 200% | 100% | 100% | 3x depth or 25m, whichever is greater | 4x average depth |
| **Bathymetric coverage** | 200% | 100% | 100% | Recommended but not required | Recommended but not required |

In accordance with IHO Standards for Hydrographic Surveys, the formula below shall be used in the calculation for maximum allowable TVU at 95% confidence level.

$$TVU_{max}\,(d) = \sqrt{a^2 + (b * d)^2}$$

1 The International Hydrographic Bureau. (2020). Standards for Hydrographic Surveys, 6th Edition (S-44)

Where:

| | |
|---|---|
| a | represents the portion of the uncertainty that does not vary with depth |
| b | is a coefficient which represents the portion of the uncertainty that varies with depth |
| d | is the depth |
| b * d | represents the portion of the uncertainty that varies with depth |

Refer to *Table 1* for the values of the parameters "a" and "b".

### 5.1.1 Confidence Level

The confidence level (e.g. 95%) is calculated differently for one-dimensional (1D) and two-dimensional (2D) quantities. The 95% confidence level is defined as 1.96 x standard deviation for 1D quantities (e.g. depth, tide) and 2.45 x standard deviation for 2D quantities (e.g. position)

## 5.2 MULTIBEAM AND SINGLE-BEAM ECHOSOUNDERS

Full bathymetric coverage can only be achieved through the use of multibeam echosounding systems or the combination of a single-beam echosounder system and a bathymetric side scan sonar system.

### 5.2.1 Line Spacing

The following rules on line spacing shall be followed unless otherwise stated in the FPI:

Multibeam line spacing shall be set so that there is at least 200% coverage (100% overlap) in hydrographic surveys under Exclusive Order, and at least 100% coverage under Special Order and Order 1. Coverage shall refer to the usable swath of the multibeam system.

The maximum single-beam line spacing shall be set so that the grid resolution is 0.5 cm or better. This can be calculated by determining the actual distance of 0.5 cm using the rendering scale provided in the FPI. In survey areas where the general description belongs to that of Order 2, the minimum single-beam line spacing shall be set so that the grid resolution is at 1 cm on paper.

### 5.2.2 Sounding Density

If feature detection is required in the survey, a minimum of three (3) soundings per cell for at least 90% of the cells or grids of the survey area is required.

It is noteworthy that sounding density is different from sounding resolution; the latter depends on the physical characteristics of the multibeam footprint. Multiple soundings per cell does not guarantee feature detection.

### 5.2.3 Holiday

A holiday is defined as a collinear contiguous length of at least three (3) matrix cells.

## 5.3 Corrections to Soundings and Uncertainty Analysis

### 5.3.1 Corrections for Instrument Error

**Confidence checks** shall be performed periodically on multibeam and single-beam echosounder systems to ensure that all components are operating properly. Confidence checks and comparisons should be conducted on calm waters and at relatively flat bottom.

For single-beam echosounders, **bar check** shall be conducted at least once per project. The first bar check shall be performed before the start of survey data acquisition.

For multibeam echosounders, **bar check**, **beam angle tests**, and comparison of **nadir beam** of the same or another multibeam system, a single beam system or lead line shall be conducted at least once per project.

### 5.3.2 Vessel Static Offsets

The vessel configuration survey (VCS) is performed to position various sensors (e.g. transducers, GNSS antennae and IMU) on the survey vessel in relation to a common reference point (RP). VCS should be done as accurately as possible. A crude approach is by using a level and tape measure but it is highly recommended to use an electronic/optical instrument (e.g., total station). After a 3D least squares adjustment of the VCS measurements, coordinate system transformation should be performed to convert the results into a vessel-fixed frame. All points are shifted so that the new origin (0,0,0) is the RP, and the reference frame is translated and rotated to bring the axes to the desired vessel frame.

### 5.3.2 Corrections for Draft

Generally, draft is the vertical distance between the water surface and the reference point of the transducer. Draft correction has two components, the static draft and dynamic draft.

**Static draft** is the vertical distance between the water surface and the reference point of the transducer when the vessel is stationary. Draft should be monitored before, during, and after survey to account for changes in loading, e.g. fuel consumption, change in number of passengers.

**Dynamic draft** refers to the vertical displacement of the transducer when the vessel is making way. Dynamic draft has two components – squat and settlement. The hydrographer should account for dynamic draft by determining different draft values at different vessel speeds.

### 5.3.3. Corrections for Sound Velocity

The **Sound Velocity Profile (SVP)** is a significant correction in hydrographic surveys because it rectifies the ray tracing path of the acoustic wave due to changing water temperature, salinity and pressure (depth). Sound velocity profiles should be collected as often as operationally possible in a manner which accounts for the spatial and temporal variability in the survey area. The hydrographer should also save the salinity, temperature and pressure value of each cast. At least two SVP casts using sound velocity profilers (e.g. CTD, velocimeter or XBT) shall be performed on a survey day. The first cast shall be performed before the start of survey data acquisition.

The **Surface Sound Velocity** shall be acquired continuously in multibeam surveys through a surface sound velocity sensor. This is important in beam steering. If the difference between the sound velocity values given by the surface probe and the profiler is at least 1 m/s, an XBT cast should be acquired; and for a difference of 2 m/s, an SVP cast should be acquired. Consequently, the difference between the SSV and SVP shall be continuously monitored.

### 5.3.4 Corrections for Vessel Motion

Roll, pitch, yaw/heading, heave and navigation timing error should be recorded and corrected in multibeam surveys. The uncertainties associated with these measurements can be found in the manufacturer's specifications.

### 5.3.5 Corrections for Grid Convergence

Except on the longitudinal center of a projection zone, there will always be an angular difference with the grid north of a projection system (e.g. UTM) and the true north. For multibeam surveys, to reduce yaw / heading errors, the grid convergence angle should be accounted for in the patch test to allow its correction during the data acquisition and processing.

### 5.3.6 A-posteriori Uncertainty Determination and Management

The TPU management is highly recommended to be discussed in the Descriptive Report. This section is generally about the Error Budget or Uncertainty Management, which accounts for the individual uncertainties of each variable in the survey system. The hydrographer should review the methods to which the uncertainties and biases associated with the survey system can be reduced. A table of uncertainties or errors, such as those readily available in the processing software, can be used in the discussion.

The following are some of the sources of uncertainties or errors associated with depth, as per IHO S-44 5th Edition:

1. Vertical datum errors;
2. Vertical positioning system errors;
3. Tidal measurement errors, including co-tidal errors where appropriate;
4. Instrument errors;
5. Sound speed errors;
6. Ellipsoidal / vertical datum separation model errors;
7. Vessel motion errors, i.e. roll, pitch and heave;
8. Vessel draught;
9. Vessel settlement and squat;
10. Sea floor slope;
11. Time synchronization / latency; and
12. Spatio-temporal sound speed distribution

The a-posteriori uncertainty profile per survey day should be created based on field-collected data, supplemented by a-priori uncertainty data when needed. The sources of uncertainty should be extensively documented.

A graphical estimate for the a-posteriori uncertainty per survey day should be performed at the maximum survey depths, accounting for seafloor slope. A review of the uncertainty budget must be made when the inner beams (multibeam without overlap from adjacent survey lines) exceed the requirements of *Table 1*.

## 5.4 QUALITY CONTROL

### 5.4.1 Multibeam Sonar Calibration

For multibeam surveys, patch test shall be performed at the beginning of the hydrographic survey project, before survey data acquisition, and every time there are modifications with instrument configuration. Patch test is conducted to determine the misalignment of the transducer and the navigation timing error. The uncertainties associated with these quantities should also be determined.

Before the determination of patch test values, draft corrections, sound velocity corrections and tide corrections should be applied. Patch test should be conducted in an area similar in bottom profile to the survey area, during relatively calm seas, and in deep areas. The following order in processing patch test data is recommended: latency (navigation timing), pitch, roll, yaw (heading). Adjustments will be made iteratively until motion artifacts are minimized.

The results of the patch test, along with the procedures, shall be discussed in the Descriptive Report. The hydrographer should assess the adequacy of the patch test results, and may repeat the procedure, if necessary.

Grid convergence should be considered; it may be mitigated by conducting the patch test on the center of the survey area.

### 5.4.2 Cross Check Analysis

Cross check lines shall be acquired and processed in addition to the regular or development lines. These will be used in the cross check analysis where the statistical difference of the soundings between the main lines and cross check lines will be evaluated.

The cross check lines should have good temporal and spatial distribution in the survey area. They should be run at angles of 60° to 90° to the regular lines. Also whenever possible, the cross check lines should be acquired under different conditions, such as different day (or time of day), tide, vessel and echosounder system.

For multibeam and single-beam surveys, the spacing between cross check lines should not exceed 15 times the line spacing of the regular lines. Each major division of the survey area should have at least two cross check lines, considering that the area divisions account for temporal and geographic variations.

The hydrographer shall evaluate the statistical depth difference between the main lines and cross check lines to see if they meet the maximum allowable TVU at 95% confidence level for that survey area. Any deviation from the standard shall be reviewed and investigated, and if necessary, additional cross check lines shall be acquired to assist in the resolution of the discrepancies. Software programs for cross check analysis can be used such as those bundled with the acquisition software.

For single-beam cross check analysis, the maximum allowable depth uncertainty at 95% confidence level shall be calculated as 1.96 * standard deviation. For multibeam cross check analysis, software programs such as *Fledermaus* v7 or *Qimera* should be used.

The cross-check analysis will not estimate the THU, hence other methods should be considered for the calculation of THU.

### 5.4.3 A-posteriori Uncertainty Analysis

Bathymetric data should be applied with uncertainty profiles to allow CUBE processing and filtering for the generation of CUBE-filtered soundings. These soundings can be analyzed in suitable analysis tools for the derivation of the uncertainty function (e.g. TVU vs. Depth curve) and checking against *Table 1* limits. The curve plots should be presented in the Descriptive Report.

A BAG file should be made from the CUBE-derived surface to allow for the graphical presentation of the geographic vertical uncertainty distribution using suitable analysis tools. The geographic plots should also be presented in the Descriptive Report.

# 6 FEATURES

A feature is any natural or man-made object that can be represented cartographically for safety of navigation.

## 6.1 GENERAL STANDARDS FOR FEATURES

The following table is to be interpreted in conjunction with the full text in this document. These standards only apply on associated measurements as required by the hydrographic survey project. The values presented are uncertainties at 95% confidence level.

*Table 2: Standards for Features in Hydrographic Surveys*[2]

| Criteria | Exclusive Order | Special Order | Order 1A | Order 1B | Order 2 |
|---|---|---|---|---|---|
| **Horizontal Positioning of Fixed ATONs and DTONs** | 1 m | 2 m | 2 m | 2 m | 5 m |
| **Horizontal Positioning of Floating Object and ATONs** | 5 m | 10 m | 10 m | 10 m | 20 m |
| **Horizontal Positioning of Coastline** | 5 m | 10 m | 10 m | 10 m | 20 m |
| **Horizontal Positioning of Features Less Significant to Navigation** | 5 m | 10 m | 20 m | 20 m | 20 m |
| **Vertical Uncertainty of Overhead Clearances** | 0.3 m | 0.5 m | 1 m | 2 m | 3 m |

## 6.2 DATA ACQUISITION

Positional accuracy of features shall be in compliance to *Table 2*.

2 The International Hydrographic Bureau. (2020). Standards for Hydrographic Surveys, 6th Edition (S-44)

### 6.2.1 Aids to Navigation (ATONs)

Positions of aids to navigation shall be obtained using survey-grade GNSS equipment, and must satisfy accuracy requirements in *Table 1*. In most cases, RTK positioning is adequate. Photos must also be taken during the survey. The following attributes shall be identified:

- Name
- Position
- Category/shape of buoy/light/beacon/landmark
- Color and/or color pattern
- Nature of construction
- Characteristics
- Condition

### 6.2.2 Dangers to Navigation (DTONs)

Dangers to navigation or DTONs are natural (shoal, rock and reef) or man-made (wrecks, obstructions, and piles) features that are potentially dangerous to surface navigation. The least depth should be determined by multibeam echosounder system and/or side scan sonar with single-beam echosounder. In cases when the location of DTON is too dangerous for the vessel to survey, other means may be employed. The following attributes shall be identified:

- Position
- Category of wreck/obstruction
- Water level effect
- Value of sounding relative to the chart datum

Previously reported anomalous features in the survey area and those detected during the survey shall be thoroughly examined to provide accurate and detailed depiction of contours. The least depths shall be determined if confirmed to be existing.

Any sighting or discovery of dangers to navigation shall be reported to NAMRIA by accomplishing *NAMRIA-HNC-Form 10 - Hydrographic Note* or using the *e-HNote module of the Philippine Online Maritime Safety Information System* (https://isportal.namria.gov.ph/OMSIS/HNote10.aspx)

### 6.2.3 Submerged Installations

Positions of submerged cables and pipelines shall be determined by multibeam echo sounder system (MBES) and shall be verified by corresponding authorities (e.g., port authority, Philippine Coast Guard, telecommunications company). The following attributes shall be identified:

- Position
- Category of pipeline/cable
- Status or condition

### 6.2.4 Seabed Characteristics

Seabed characteristics shall be obtained in harbors, anchorage areas and areas of likely anchorage, as well as other critical areas. Sampling at waters less than 200 m in depth is normally spaced at frequencies not exceeding 500 meters. Higher sampling frequency should be done at designated anchorage areas, and lower sampling frequency may be employed on other, less critical areas.

Seabed characteristics shall be acquired by sampling and diver observation, if necessary. Bottom sample frequency should be carefully determined to obtain adequate characterization of the survey area.

Seabed characteristics may also be inferred by other means (e.g. backscatter data from echosounders, side scan sonar, sub bottom profiler, video, etc.).

### 6.2.5 Coastline

High and low water lines defining intertidal area shall be determined to the accuracies given in *Table 2*. Category of coastline shall be noted.

Low water line shall be derived by conducting single beam hydrographic survey during high water. Reducing sounding to chart datum by applying draft and tide correction allows the delineation of MLLW line.

Manual depth measurement is recommended when surveying in areas that may compromise the safety of the platform and transducer. Manual depth measurements shall be recorded using *NAMRIA-HNC-Form51 Manual Depth Measurement Data Sheet*.

High water line can be approximated from marks of shells or debris left when the waves reached the foreshore during high water. High water line can be delineated by walking through these physical evidences or selecting points that generally depicts the reach of waves during high water using GNSS receiver either in real time kinematic (RTK) or post-processed kinematic (PPK) positioning method. Another method is by capturing aerial photos or drone shots during high water and digitizing the reach of the water along the coast.

Coastline configuration may also be extracted from latest satellite imagery using specialized GIS programs and tools.

### 6.2.6 Shoreline Construction

Positions of fixed artificial structures between and/or adjoining the water and the land shall be determined using GNSS receiver in RTK or PPK mode to accuracies given in *Table 2*. The following attributes shall be identified:

- Category of shoreline construction
- Water level effect
- Nature of construction

- Status or condition
- Color and/or color pattern
- Other relevant characteristics observed

### 6.2.7 Current Observation

The Hydrography Branch may require a field party to conduct current observation. Currents of at least 0.5 knots are considered significant to affect surface navigation specifically along channels, anchorages and adjacent wharf areas.

### 6.2.8 Elevations and Clearances

Elevations and clearances shall be determined to the accuracies given in *Table 2*. For clearances above navigable waters critical to navigation, apply corresponding tidal datum (MHHW) to the height.

### 6.2.9 Topographic Information

If topographic survey is possible, positions of topographic features such as conspicuous landmarks, buildings, tanks and port and harbor installations shall be determined using GNSS receiver in RTK or PPK mode to accuracies given in *Table 2*. Photos should be taken during the survey. The following attributes shall be identified if applicable:

- Name
- Position
- Category
- Status or condition
- Color and/or color pattern
- Nature of construction
- Height, vertical length, or elevation
- Other relevant characteristics observed

## 6.3 Data Processing and Analysis

Features detected must be processed and validated during the survey, and must meet survey requirements in compliance to *Table 2*. Edited sounding data from regular sounding lines, cross check lines and shoal examinations must be compared against each other to resolve any discrepancy during the survey. Adequate sounding detail and coverage must be obtained to validate the existence of significant features, prior to leaving the survey area. Whenever possible, water column data should be collected to corroborate features.

## 6.4 DOCUMENTATION

Features observed and validated during the survey shall be included in *Hydrographic Survey Descriptive Report*, with all supporting data for analysis. Appropriate recommended action for each feature shall be reported to determine whether the feature must be depicted, deleted or amended. Submission of smooth sheet with properly identified and geocoded photographs of features is recommended.

# 7 DELIVERABLES

All survey deliverables, following the recommended Hydrographic Data Folder Structure (*See Annex),* shall be submitted to Hydrography Branch, thru Hydrographic and Geomagnetic Data and Management Section (HGDMS).

## 7.1 FIELD REPORTS

### 7.1.1 Progress Reports

Progress reports shall be submitted weekly or daily, if reasonably practicable, to HGDMS and to the command directly supervising the field work for the duration of the operation. This will make the concerned office updated of the current situation and will be able to determine immediate action plans if needed. The progress report shall be comprised of, but not limited to, the following:

a. Personnel and their assignment
b. Status of all equipment and platforms
c. Activities undertaken, weather and sea condition
d. Accomplishments showing percentage done versus overall target
e. Intentions for the following week
f. Survey coverage showing accomplished areas with the survey limits shown and overlaid on an appropriate chart or background image.
g. Hypack matrix files or any grid bathymetry
h. Remarks and/or recommendations

### 7.1.2 Navigational Warnings/Notice to Mariners

Incidents and/or updates (DTONs and ATONs) not indicated in the chart and/or ENC that need to be made known to the maritime community shall be reported immediately. On-going activities that may disrupt normal navigation shall also be reported (e.g. hydro survey, dredging, reclamation, etc.). Reporting of any sighting or discovery of any feature that is significant to safety of navigation shall be reported to NAMRIA by accomplishing *NAMRIA HNC Form10 – Hydrographic Note* for the issuance of navigational warnings and inclusion in the Notice to Mariners. Reports and relevant data should be immediately sent either through mail at NAMRIA-Hydrography Branch, 421 Barraca St., San Nicolas, Manila, through email at maritime.affairs@namria.gov.ph and maritime.concerns@gmail.com or by using the e-HNote module in the Philippine Online Maritime Safety Information System (https://isportal.namria.gov.ph/OMSIS/HNote10.aspx).

## 7.2 DIGITAL DATA

### 7.2.1 Bathymetric Data

#### *7.2.1.1 Raw Bathymetric Data*

Raw bathymetric data are files with no processing or editing done except the ones applied during acquisition such as roll, pitch yaw and timing biases, static/dynamic draft and instrument offsets. Raw digital files of bathymetric data shall be submitted in the original format from the acquisition software.

#### *7.2.1.2 Processed Bathymetric Data*

Final edited and sorted bathymetric data files shall be submitted. Manual and/or automatic filtering for noise reduction and smoothing of the projected/predicted surface shall be done. Filtering and removing of soundings shall be done with utmost diligence to prevent inaccurate removal of significant features. All necessary corrections shall be applied to the edited files such as:

a. Instrument installation offsets
b. Roll, pitch, heading and timing biases.
c. Instrument draft (static and dynamic)
d. Delayed Heave data (if available)
e. Reduced tidal data
f. Sound speed data

#### *7.2.1.3 Bathymetric Attributed Grid (BAG)*

Navigation surfaces in the form of Bathymetric Attributed Grid (BAG) should be submitted as one of the formats of the final depth information from the survey. This is part of the NAMRIA Hydrography Branch's ongoing migration to the S-100 framework.

### 7.2.2 Tidal Data

#### *7.2.2.1 Raw Tidal Data*

When a portable tide gauge is used for the duration of the survey, the downloaded data shall be submitted. The data shall contain the date, time and depth readings. The time zone must be specified, whether UTC or local time.

#### *7.2.2.2 Reduced Tidal Data*

The reduced tidal data is the processed data relative to the chart datum (MLLW). Tide corrections shall be applied to bathymetric data to reduce soundings to MLLW.

### 7.2.3 Sound Speed Profile Data

Sound speed profile data files shall be submitted and labeled with their corresponding time and date of acquisition. A digital log file containing the time and geographic location (latitude and longitude with degree-minute-second format) of each cast shall be submitted.

### 7.2.4 Feature Mapping and GNSS Observation Data

Data from coast lining and feature mapping survey and GNSS observation shall be submitted including the whole project from the processing software used. They can be from survey, computer-aided design (CAD), or geographic information system (GIS) programs.

### 7.2.5 Scanned Field Sheets/Survey Logs

Survey party shall properly fill out field sheets during survey operations. These logs will make the foundation of a thorough and clear metadata. Each operation (topographic and hydrographic survey, GNSS observation, field calibrations) shall have a separate daily log with corresponding NAMRIA forms completely filled-out by the field party. All field sheets shall be properly named, scanned and backed-up.

### 7.2.6 Vessel Attitude Data

If available, the vessel's real-time and processed motion data (roll, pitch, yaw, heave) should be submitted with the summary statistics per survey day (roll, pitch, heading, heave, position & speed uncertainty).

## 7.3 POST SURVEY REPORTS

### 7.3.1 Project Report

The project report is a brief description of the accomplished survey. This shall include, but not limited to, the following data:

a. The basis/authority of the project
b. Purpose
c. Survey platform/s used with description
d. Composition of the party
e. Project limits
f. Chronology of activities
g. Survey methods
h. Adequacy of the survey (based on the FPI)
i. Remarks

### 7.3.2 Port Information

The field party shall provide information required for Philippine Coast Pilot by accomplishing *NAMRIA HNC Form 11 – Hydrographic Note for Port Information*. Other field information verification may be needed as requested by the Maritime Affairs Division for comparison against previous/existing Coast Pilot information. The latest socio-economic profile of the locality shall also be submitted when available.

Mariners may also opt to submit e-HNotes thru the Online Maritime Safety Information System (https://isportal.namria.gov.ph/OMSIS/HNote11.aspx).

### 7.3.3 Descriptive Report

The descriptive report contextualizes the hydrographic survey data. It details the processes involved in the acquisition of data, factors that may affect the accuracy of the survey, instruments and software used, results of the survey and recommendations.[3] The report shall contain, among other things, the following details;

a. Datum and time reference – horizontal and vertical datum, coordinate system, projection and time zone used in data gathering
b. Horizontal controls – description of established and/or recovered geodetic control point/s and the configuration parameters of the base station
c. Vertical controls – vertical datum and description of existing tide station or installed tide gauge and the results of tidal leveling after installation and before dismantling the tide gauge
d. Operational systems – echosounder, attitude, positioning and navigation system, sound speed profiler, tidal equipment and seabed sampler
e. Data acquisition and processing systems
f. Quality assurance – survey planning, error budget, data acquisition instrument parameters, calibrations and data processing
g. Correction to soundings – vessel/instrument offsets, position and attitude, tide and sound velocity corrections
h. Cross line comparison – results of the cross check analysis including the graphs and the order in which the survey falls
i. Results of the survey – chart comparison, seabed samples, aids and dangers to navigation and shore delineation
j. Remarks and recommendations – This shall include remarkable conditions and experiences by the field party that may have affected the results of the survey and recommendations that can help future projects that may encounter similar situation

3 Cole, M. (2014, May 21). *NOAA improves public access to hydrographic survey descriptive reports.*

### 7.3.4 Smooth Sheets

Smooth sheets are the final product of a hydrographic survey.[4] These sheets are only used internally by the hydrographic office and are not intended for navigational purposes.[5] These sheets are plotted at appropriate sizes and scales specified in the FPI. All pertinent data gathered by the field party and other data deemed relevant shall be reflected in the smooth sheet such as:

a. Topographic data (if topographic survey was conducted) or appropriate background image (e.g., old chart, ENC file, and latest aerial photo)
b. Depth curve
c. Soundings spaced at 1cm
d. Title block indicating:
   - Title of the project
   - Field Project Instruction No.
   - Scale
   - Duration of survey
   - Platform Used
   - Personnel/party involved
   - Coordinate system and datum (horizontal and vertical) used
   - Equipment used
   - Processing software

Separate sheets, of appropriate large scale with information previously mentioned, for areas that need to be highlighted in the report shall be submitted (e.g. port area, wrecks and obstructions).

A separate topographic smooth sheet shall also be submitted if applicable. This smooth sheet shall clearly depict the coastlines and all significant inshore features and aids to navigation.

### 7.3.5 Calibration Forms

Latency test, Patch Test, Bar Check with bar check report from the acquisition software, bar chain measurement and dynamic draft calculations shall be submitted and will form part of the descriptive report.

4 Hawley, J. (1931). *Hydrographic Manual, U.S. Department of Commerce, U.S. Coast and Geodetic Survey*. U.S. Government Print Office.

5 Zimmermann, M. A., & Benson, J. (2013). *Smooth Sheets: How to Work with them in a GIS to Derive Bathymetry, Features, and Substrates*.

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# HYDROGRAPHIC DATA FOLDER STRUCTURE

| Folder | Subfolders | Description |
|---|---|---|
| Existing Data | Background Files | Existing ENC or raster files used during planning and data acquisition |
| | Existing Controls | Description of existing horizontal and vertical controls (tide station and tidal benchmarks) used |
| | Field Project Instructions | Scanned copy of the signed and approved FPI (pdf) |
| Metadata | Processing logs | .pdf format |
| | Reports of Survey | .pdf and .doc<br>Hydrographic and Topographic Survey Descriptive Reports, Project Report |
| | Accomplishment Reports | .pdf and .doc |
| | Survey logs | Scanned copy of survey logs (HNC Forms) |
| | Vessel Configuration Survey Reports | .pdf |
| | Survey photographs | Geotagged |
| Raw | GNSS Observation | |
| | Topographic survey data | |
| | Tide | |
| | Sound speed profiles (SVP) | |
| | Multibeam data | |
| | Single beam data | |
| Processed | GNSS Observation data | |
| | Topographic survey data | |
| | Tide and tidal leveling results | |
| | Sound speed profiles (SVP) | Include logs containing geographic location (degree-minute-second format) and time of casts |
| | Multibeam data | Regular survey lines and cross check lines in separate sub-folders |
| | Single beam data | Regular survey lines and cross check lines in separate sub-folders |
| Session | Bathymetric surfaces | Digital elevation models (DEM) |
| | Tiffs/Matrices | Matrices of final data. |

| | | |
|---|---|---|
| Products | Contours/depth curves | 0-m, 2-m, 5-m, 10-m, 20-m, 50-m, 100-m, 200-m, 500-m, 100-m, .. |
| | Soundings | Unsorted and Sorted (10 m, 25 m, 50 m, 100 m and spacing used for smooth sheets) in XYZ format |
| | Smooth sheets | .tiff and .pdf |
| | Shapefiles | Shapefiles of survey areas<br>Shapefiles of ZOC |
| Validation | Crosscheck analysis results | Statistics (text files) and spreadsheets |
| | Surface comparison | MB vs SB data (if available)<br>New vs old data (if available) |
| | Bathymetric data list | Listing of all regular lines and check lines used in analysis (.doc or .xls) |

Notes:

1. If a folder/subfolder is empty, create a "*This folder is empty.txt*" file inside the folder.
2. Be descriptive when naming files, e.g. include bin size and sorting radius used.
3. Include "README.txt" to explain what files are in the folder, the format (e.g. xyz-grid or xyz-geographic, whole area or sub-area).

# HYDROGRAPHIC NOTE

NAMRIA-HNC-Form10 Ver3 Rev00

| SENDER INFORMATION | | | ☐ Tick box if not willing to be named as source of this information | |
|---|---|---|---|---|
| Name of ship or sender | | | | MM/DD/YYYY |
| | Name | Signature | IMO Number | Date |
| Address of sender | | | | |
| E-mail Address | | | Telephone/ Mobile No. | |

| INSTRUCTIONS (At the back) | | | |
|---|---|---|---|
| Subject | | | |
| General Locality | | | |
| Position: | Latitude | Longitude | |
| Position fixing system used | | Datum | |
| Charts affected | | Edition | |
| ENCs affected | | | |
| Latest Notice to Mariners held | | | |
| Nautical Publications affected (Edition No.) | | | |
| Details of anomaly or observation | | | |

A replacement copy of Chart No. _____ is required (see Instruction 4).

## INSTRUCTIONS

1. Mariners are requested to notify the Hydrography Branch of the National Mapping and Resource Information Authority (NAMRIA) when new or suspected dangers to navigation are discovered, changes observed in aids to navigation, or corrections to publications that are seen to be necessary. Mariners can also report any ENC display issues experienced.

2. This form and its instructions have been designed to help both the sender and the recipient. It should be used, or followed, closely, whenever appropriate. Copies of this form may be obtained gratis from the NAMRIA Hydrography Branch at 421 Barraca St., San Nicolas, Manila, or by requesting thru email at maritime.affairs@namria.gov.ph.

3. **Position:** When a position is defined by sextant angles or bearings (true or magnetic being specified) more than two should be used in order to provide a check. Distances observed by radar should be quoted. However, when there is a series of fixes along a ship's course, only the method of fixing and the objects used need to be indicated. Latitude and longitude should only be used specifically to position the details when they have been fixed by astronomical observations or GPS and a full description of the method, equipment and datum used should be given.

4. **Paper Charts:** A cutting from the largest scale paper chart is the best medium for forwarding details, the alterations and additions being shown thereon in red. When requested, a new copy will be sent in replacement of a chart that has been used to forward information, or when extensive observations have involved defacement of the observer's chart. If it is preferred to show the amendments on a tracing of the largest scale chart (rather than the chart itself) these should be in red as above, but adequate detail from the chart must be traced in black ink to enable the amendments to be fitted correctly.

   **Electronic Navigational Charts (ENCs):** A screen grab of the largest scale usage band ENC with the alterations and additions being shown thereon in red.

5. **Soundings:** When soundings are obtained, it is important to ensure that full details of the method of collection are included in this report. This include nut no limited to:

   a. Make, model, and type of echo sounder used.
   b. Whether the echo sounder is set to register depths below the surface or below the keel; in the latter case the vessel's draught should be given.
   c. Time, date and time zone should be given in order that corrections for the height of the tide may be made where necessary, or a statement made as to what corrections for tide have already been made.
   d. Where larger amounts of bathymetric data have been gathered, only those areas where a significant difference to the current chart or ENC should be specifically mentioned on the H102. The full data set may also be sent in, with an additional note added to this effect. If no significant differences are noted, the bathymetric data may still be of use, and sent in accordingly. Where full data sets are included, a note as to the data owner and their willingness for the data to be incorporated into charts and ENCs included.

5. **For Echo Sounders that use electronic 'range gating',** care should be taken that the correct range scale and appropriate gate width are in use. Older electro-mechanical echo sounders frequently record signals from echoes received back after one or more rotations of the stylus have been completed. Thus, with a set whose maximum range is 500m, an echo recorded at 50m may be from depths of 50m, 550m or even 1050m. Soundings recorded beyond the set's nominal range can usually be recognized by the following:

   a. the trace being weaker than normal for the depth recorded;
   b. the trace passing through the transmission line;
   c. the feathery nature of the trace.

   As a check that apparently shoal soundings are not due to echoes received beyond the set's nominal range, soundings should be continued until reasonable agreement with charted soundings is reached. However, soundings received after one or more rotations of the stylus can still be useful and should be submitted if they show significant differences from charted depths.

6. **Reports which cannot be confirmed or are lacking in certain details should not be withheld.** Shortcomings should be stressed and any firm expectation of being able to check the information on a succeeding voyage should be mentioned.

7. Changes to Port Information should be forwarded using Hydrographic Note for Port Information. Where there is insufficient space on the forms additional sheets should be used.

8. Reports using this form and relevant data should be sent either through mail at NAMRIA Hydrography Branch, 421 Barraca St., San Nicolas, Manila or through email at maritime.affairs@namria.gov.ph.

An acknowledgement or receipt will be sent and the information then used to the best advantage which may mean immediate action or inclusion in a revision in due course; for these purposes, the UKHO may make reproductions of any material supplied. When a Notice to Mariners is issued, the sender's ship or name is quoted as authority unless (as sometimes happens) the information is also received from other authorities or the sender states that they do not want to be named by using the appropriate tick box on the form. An explanation of the use made of contributions from all parts of the world would be too great a task and a further communication should only be expected when the information is of outstanding value or has unusual features.

# HYDROGRAPHIC NOTE FOR PORT INFORMATION

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**NOTES**

1. This form lists the information required for Philippine Coast Pilot and has been designed to help the sender and the recipient. The sections should be used as an aide-memoir, being used or followed closely, whenever appropriate. Where there is insufficient space on the form an additional sheet should be used.
2. **Reports which cannot be confirmed or are lacking in certain details should not be withheld.** Shortcomings should be stressed and any firm expectation of being able to check the information on a succeeding voyage should be mentioned.
3. **DATA PRIVACY STATEMENT:** NAMRIA values your right to data privacy. We are committed to be faithful stewards in safeguarding your personal and sensitive information under the Data Privacy Act of 2012 (RA 10173). We ask for your personal information and email addresses on our Hydrographic Notes so we can confirm receiving the Note. We do not use your information in any way other than in the furtherance of our vision and mission as Philippines Hydrographic Office.

## OBSERVER/REPORTER INFORMATION

| | | |
|---|---|---|
| | | ☐ **Tick box if not willing to be named as source of this information** |
| **Name of Observer/Reporter** | **Signature** | |

| | | |
|---|---|---|
| | | MM/DD/YYYY |
| **Name of ship or Office** | **IMO Number** | **Date** |

| | | | |
|---|---|---|---|
| **Address of sender** | | | |
| **E-mail Address** | | **Telephone/ Mobile No.** | |

| | | |
|---|---|---|
| **Name of Port** | | |
| **Approximate Position** | Latitude | Longitude |
| **Port Authority**<br>Name and contact details | | |
| **General Remarks**<br>• Principal activities and trade.<br>• Latest population figures and date.<br>• Number of ships or tonnage handled per year.<br>• Maximum size of vessel handled.<br>• Copy of Port Handbook *(if available)*. | | |
| **Berthing Facility**<br>• Type (L-pier, T-pier, wharf, etc.)<br>• Names, numbers or positions & lengths.<br>• Depths alongside. | | |
| **Storage Facility**<br>• Area of open storage area and warehouse<br>• Existence of reefer facilities, cold storage, and special storage facilities. | | |
| **Anchorages**<br>Position, designation, depths, holding ground, shelter afforded. | | |
| **Pilotage**<br>• Authority for requests.<br>• Pilot boarding position.<br>• Regulations (compulsory or not).<br>• Name of pilot association and contact details. | | |

# HYDROGRAPHIC NOTE FOR PORT INFORMATION



| | |
|---|---|
| **Tugs**<br>• Number available.<br>• Name of tug operator and contact details | |
| **Directions**<br>• Entry and berthing information.<br>• Tidal streams.<br>• Navigational aids. | |
| **Small Craft Facility**<br>Name of yacht club, contact no., email address. | |
| **Cargo Handling**<br>Containers, lighters, Ro-Ro etc. | |
| **Repairs**<br>• Hull, machinery and underwater.<br>• Shipyards.<br>• Docking or slipping facilities.<br>• *(Give size of vessels handled or dimensions)*<br>• Divers. | |
| **Rescue and Distress**<br>• Salvage, Lifeboat, Coastguard, etc.<br>• Name of nearest Coast Guard station and contact details. | |
| **Supplies**<br>• Fuel (with type, quantities and methods of delivery)<br>• Fresh water (with method of delivery and rate of supply)<br>• Provisions. | |
| **Services**<br>• Medical.<br>• Ship Sanitation.<br>• Garbage and slops.<br>• Ship chandlery, tank cleaning, compass adjustment, hull painting. | |
| **Communications**<br>• Nearest airport or airfield.<br>• Port radio and information service. (with frequencies and hours of operating) | |
| **Government Services**<br>• Customs<br>• Quarantine<br>• Plant and Animal Quarantine<br>• Immigration | |
| **Local Situation**<br>• Health facilities (nearest hospitals, clinics, health centers)<br>• Banks and money remittance facilities | |
| **Views**<br>Photographs (where permitted) of the approaches, leading marks, the entrance to the harbour etc. | |
| **Additional Details:** | |

The TWG for the Updating of NAMRIA Standards for Hydrographic Surveys are as follows:

| | |
|---|---|
| Chairperson: | LT ALVIN V ABRAHAM |
| Vice-Chairperson: | LT MARLON E ESTROPIA |
| Members: | LT KURT LOUIS A MONTEMOR |
| | LTJG PAOLA RUTH Z GUARTE |
| | LTJG RENZ B VASQUEZ |
| | LTJG CLARIZZA MAE B BIONG |
| | LTJG MARCK DANIEL R SANTOS |
| Secretariat: | |
| | ENS JOSHUA BREN G EBRADA |
| | PENS JOSHUA M ALARIN |

The revisions were made by the TWG as per Branch Order 011 Series of 2024 dated April 03, 2024.

Special thanks to LT MARLON E. ESTROPIA and PENS JEREMIAH D MANUEL for the cover image.