



The Use of Spatial Data Relating to The Results of Hydrographic Surveys for Shipping Lanes

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Abstract. Spatial data on hydrographic survey reports is an essential part of fairway planning. In this study, the development of spatial data information in hydrographic survey maps is used for fairway planning to fulfill the availability of safe and efficient fairways. A Geographic Information System (GIS) is used as an analysis tool in the mapping process to analyze all forms of information, from the results of this study, the availability of spatial data on hydrographic maps can be used as a reference in determining a safe fairway that avoids seabed objects that can endanger passing vessels and allows vessels to sail with the shortest distance that is economically profitable, this paper emphasizes the importance of spatial data and its influence on nautical charts to support navigation, the results of the Bathymetry survey data processing show a depth figure of between 6.4m and 27.5m, which means most of the study areas are at a depth figure that is safe enough for ships to pass through. There are no obstacles that are dangerous to shipping lanes so the process of identifying shipping lanes can be carried out more easily without ignoring other safety aspects.

Keywords: Geographic Information System (GIS), spatial database, fairway.

1 Introduction

The development of technology that continues to grow allows all forms of presentation of geographic information to also continue to change, including geographic information systems (GIS), one of the advantages of GIS technology is that it allows users to be able to determine the actual location by referencing the Latitude and Longitude values which are basic information on a map, [1].

Project Based Learning (PBL) with the Title of Local Jetty Mapping and Fishermen Ship Shipping Lanes Study in Piayu Laut, Batam City is a learning method applied to conduct several parameter studies that affect shipping lanes so that consideration can be made for determining shipping lanes when entering and exiting the area of the Tanjung Piayu, this research was conducted on 5 and 7 March 2024, In this activity one of the activities carried out is a Hydrographic Survey which includes a Bathymetry and

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Debris Survey using single beam echosounder and Side Scan Sonar, the results of the measurements will be used as a reference to determining the shipping lanes in the study area, the purpose of this study is to produce a shipping lanes map equipped with spatial data by analyzing the results of bathymetric surveys and mapping seabed features so that they can be identified as safe and efficient shipping route maps.

The survey results in the form of maps equipped with spatial data can provide geographic information that is expected to provide benefits to users regularly [2], the availability of sea depth maps, seabed object maps, and shipping channel maps can facilitate local fishermen in determining safe shipping lanes to avoid areas that are considered dangerous for shipping lanes [3], in general, the final survey reports in the form of maps have Latitude and Longitude as horizontal references and seabed surface water depth as vertical references.

2 Research Method

2.1 Location

The research was conducted on 5 and 7 & March 2024 located in Kampung Tua Tanjung Piayu Batam city, located in Zone 48N with coordinate 399869.01 m E, 108588.23 m N, details of the research location can be see in the following figure below:

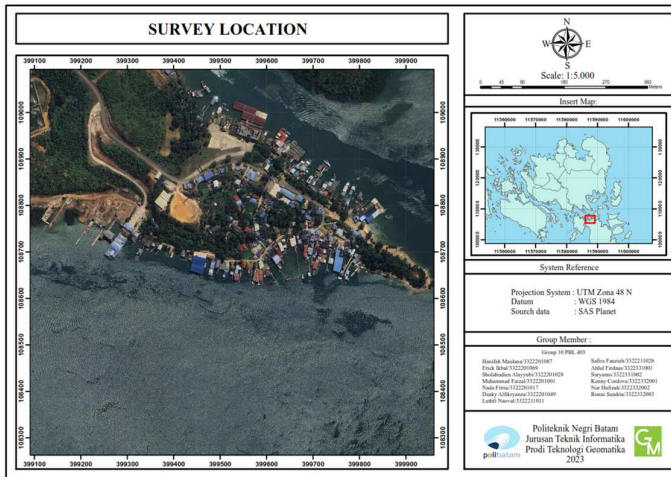


Fig. 1. Survey Location

2.2 Methodology

The research methodology carried out several stages as follows:

- a. Site visit to Survey Location to identify study area

- b. Determining the Survey coverage area, by making the area to be surveyed
- c. Mobilization Survey team and Equipment
- d. The data acquisition process, including the Hydrographic survey process using Fish Finder and Debris Survey, using C-Max Side-scan Sonar, and the Verification process of survey data
- e. Registration Survey data
- f. Data processing and reporting
Analysis survey data and identification Shipping Lane

Details of the Methodology stages can be found in the following flow chart below:

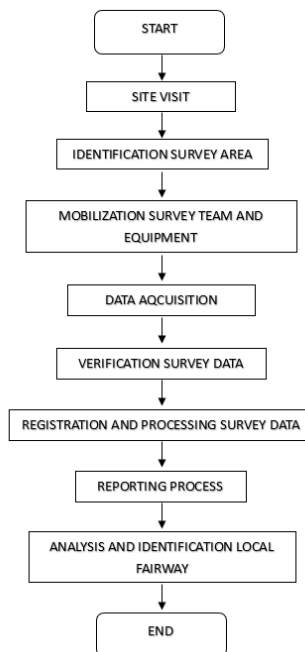


Fig. 2. Flowchart Diagram

This research aims to determine the seabed condition to determine a safe shipping Lane by making a shipping route map equipped with spatial attributes so that fishermen can use it later around the study location.

2.3 Spatial Data

Spatial Data which is the identity of data equipped with spatial information allows users to know the position of points on the earth's surface, making it easier for users to determine the coordinates needed, the availability of spatial data on shipping lane maps is essential for shipping to ensure the safety of the navigation system.

3 Result

The data are generated from the hydrographic survey here are as follows:

3.1 Bathymetry Survey

The water depth map is generated from the process of surveying the surface of the seabed using a Garmin Fish finder that mounted on a survey vessel, the ship will move according to the run line, bathymetric survey data is processed using ArcGIS software, with the survey raw data is corrected to BIG tidal prediction data from the nearest station to obtain the chart datum value that is used as a reference, and the water depth in the final report relative to the Lowest Astronomical Tide (LAT) to produce the lowest water depth value, manual measurements using a bar check on site must be carried out to verify the results of the bathymetry survey measurements.

The results of the bathymetry survey that show the area of Kampung Tua Tanjung Piayu has a relatively shallow depth ranging from 6.4 meters to 27.5 meters, the water depth map can be seen in Figure 3 below:

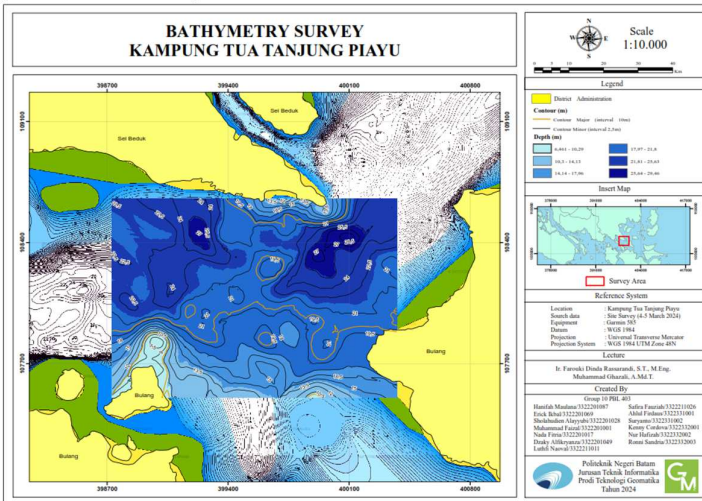


Fig. 3. Bathymetry Survey Report

The Bathymetry survey report shows the spatial data with X, Y values as horizontal references and water depth, allowing the map results to be used for activities that require spatial information, analysis and identification of shipping lanes are carried out by calculating the depth value in the study area. The depth value that is sufficient for the shipping lane will be determined as a shipping lane map to ensure that ships sail on a safe route according to technical calculations.

3.2 Debris Survey

Mapping of the Seabed feature which is one of the most important parameters to determining the shipping Lanes map to ensure that there are no obstacle or dangerous objects that can cause damage to the bottom of the vessel hull, the process of Debris survey using C-Max Side scan sonar which can record seabed conditions and connect directly to the GNSS antenna to determine the Horizontal position, survey equipment will be installed on the survey vessel and run according to the prepared run line, the survey process with 100% overlap as the part of verification stage and ensure data accuracy, survey raw data filtering process needs to be carried out to ensure the quality of the survey data, registration, and data processing using SonarWiz software to produce the final report of the sea bad feature.

There are no objects found on the seabed that are dangerous for ships to pass through in the Tanjung Piayu area, so it is safe enough for shipping lanes, the map of seabed objects can be seen in the following figure below:

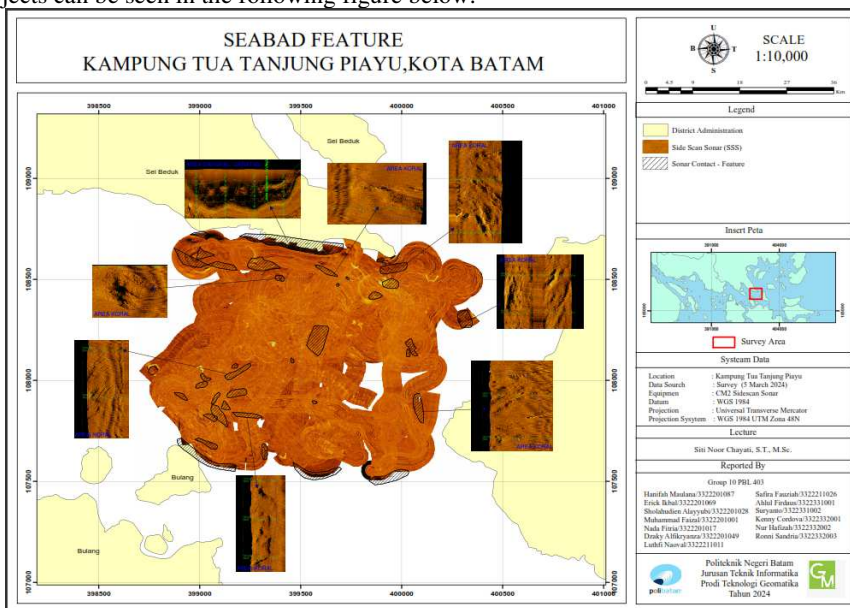


Fig. 4. Debris Survey Report

According to the results of the Hydrographic survey in the Tanjung Piayu area are located in Zone 48N with coordinate values 399869.01 m E, 108588.23 m N, Found the water depth between 6.4m to 27.5m, for the results of Debris survey only found several layers of hard soil in the form of coral reefs at a relatively safe depth and no obstacle or dangerous objects were found that could interfere with the shipping Lanes.

Based on the results of observations during the study process and according to KP Regulation N0.18 Thn 2021 concerning the division of fish catch areas, the Tanjung Piayu area is a line 1 fish catch area with a permitted vessel size of 5GT-30GT, there is

also one type of Passenger Ferry that always routinely passes through the Tanjung Piayu.

From several types of ships passing through at the study area, it can then be calculated the depth requirements of the shipping Lanes in the Tanjung Piayu area with the formula below:

$$H = d + G + R + P \tag{1}$$

- H = Depth of Shipping Lanes
- d = Vessel Water Draft
- G = Vessel Squad effect
- R = Free Space 10% -15% from Vessel Water Draft
- P = Accuracy of Survey equipment

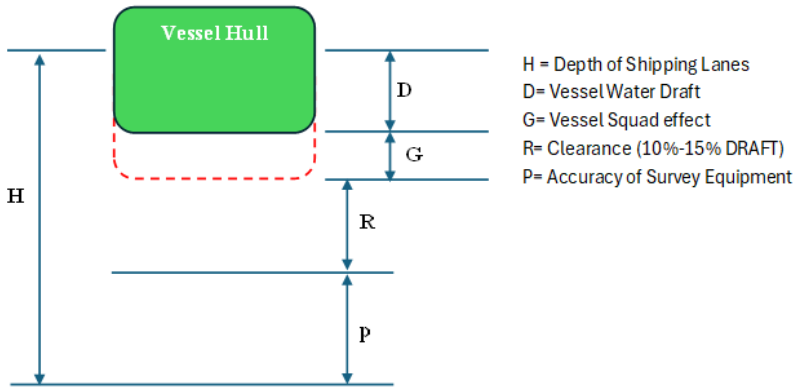


Fig. 5. Depth of Shipping Lanes Calculation Diagram

The channel calculation can conclude the need for shipping lanes as deep as 3.2m, with the water depth of the sea obtained from the Hydrographic survey results between 6.4m till 27.5m, it can be concluded that the area of Tanjung Piayu is safe for ships to pass through technical calculations.

There are several other calculations used in determining the shipping channel such as the calculation of current speed, pH of seawater, calculation of seabed slope, as well as the approach method used in determining the shipping Lanes but not included in the topic of the study, so that in the end it can be determined the location of the safest shipping channel position for ships to pass through in the Tanjung Piayu as shown on the Shipping Channel Map below:

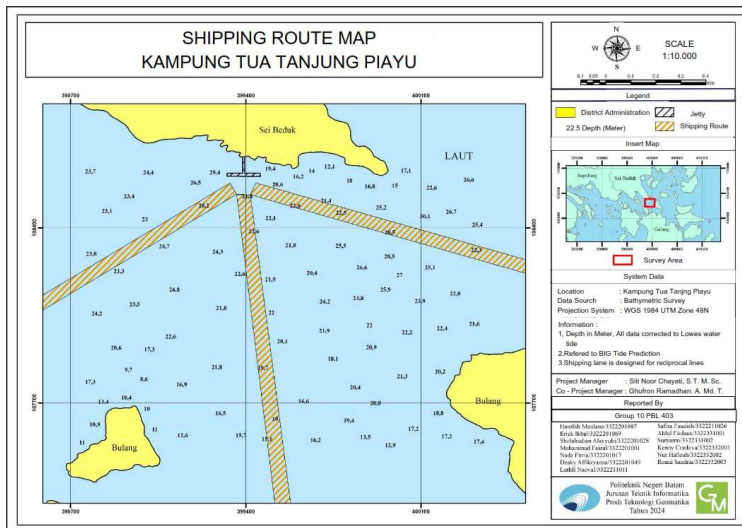


Fig. 6. Shipping Lane Route Map at Tanjung Piayu

The Shipping Lanes on the Map above are designed to support two-way shipping channel navigation by considering the width of the vessel and are equipped with spatial data attributes that are expected to be truly usable and useful for navigation needs [5].

The methodology used by analyzing the results of this bathymetric survey is considered quite accurate and efficient by considering the water depth and the seabed features which can guarantee the safety of ships passing from the potential grounding and damage to the vessel hull, this analysis is considered important to ensure the safety and efficiency of operations and to avoid accidents in shipping activities, with a shipping route it can be ensured that the ship is sailing on the track and monitored properly.

4 Conclusion

Based on the results study, the following conclusions and suggestions can be drawn as follows:

1. Hydrographic Survey results show a safe water depth to be used as a shipping lane.
2. No dangerous objects were found on the surface of the seabed that could endanger the ship's crossing path.
3. Shipping lane route map is the result of identifying variations in water depth and comparing it with the draft of ships passing through the area.
4. The results of the seabed condition map obtained from the Hydrographic Survey results and has equipped with Spatial Data information allow users to be able to utilize the Shipping Lane Map as a reference in Maritime Navigation, a safe shipping

lane will be realized with the Spatial data information in the form of Latitude, Longitude and sea depth values on the Ship-ping Channel Map of Tanjung piayu.

5. Regular monitoring of seabed conditions is necessary to ensure changes occur in the shipping lane area.
6. Warning signs are mandatory and should be placed in the shipping lane area to ensure the ship is sailing on the correct route.

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