Study of base map and marine thematic map usage to make coastal waters location permits map in coastal waters and small islands (study area: maratua island, east kalimantan)

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Abstract. Indonesia has 6.315.222 km² of marine areas, 16.065 islands, and 99.093 kilometers of coastlines. The government arranges Coastal Waters Location Permit regulation to manage its abundance of marine resources. But there are no technical aspects that control the marine base and thematics map usage to make the Coastal Waters Location Permit Map. This research examines the usage of Base Map (LLN Map, RBI Map, and Nautical Chart) and marine thematics map (RZKSNT Map) in Coastal Waters Location Permit Map establishment by plotting the site plan in each base and marine thematics map. This study covers technical aspects such as scale, projection system, horizontal datum, vertical datum, and site plan’s area comparison. This study finds that the base map which fits the most in Coastal Waters Location Permit Map establishment is a base map that has sea depth information with a scale no smaller than 1: 50,000 at the latest year so that it has high horizontal accuracy and denser contour intervals. The area calculation comparison result by digitizing and mathematical methods (manual calculation) does not obtain any significant differences in the value of the Location Permit object area, the largest difference in the area for each method is 0,0003%.

1. Introduction
The Indonesian sea area is 6,315,222 km², wider than the land area which is only 1,922,570 km², 16,065 islands, and coastline along 99,093 km [1]. It makes Indonesia has abundant coastal and marine resources so that the government has to work hard in the form of security and management of the marine, coastal, and small island resources. The regulation that addresses the Management of Coastal Areas and Small Islands is the Law of the Republic of Indonesia No. 27 of 2007, but amended by the Law of the Republic of Indonesia No. 1 of 2014 so that there are some fundamental differences such as the term Coastal Water Concession (HP-3) to Coastal Water Location License.

The definition of Coastal Water Location Permit is explained in general in RI Law No. 1 of 2014 concerning Management of Coastal Areas and Small Islands which states that "Coastal Water Location Permits are permits granted to utilize space from a portion of coastal waters covering sea level and sea columns up to the seabed at certain extent and / or to utilize some of the smaller islands ” [2]. Every person who makes use of space from a part of coastal waters and uses part of small islands permanently is obliged to have a Coastal Water Location Permit [3] Coastal Water Location Permit is given based on zoning plans for coastal area and small islands [4].

After the Coastal Water Location Permit is introduced in RI Law No. 1 of 2014 there are no operational regulations in the form of government regulations or ministerial regulations that discuss...
the procedures for granting Coastal Water Location Permits until now. On the other hand, the application for Coastal Water Location Permits by the community, cooperatives, and companies are increasing.

In order to respond to those requests for Coastal Water Location Permits, the Ministry of Maritime Affairs and Fisheries (KKP) has formulated the 2018 Minister of Maritime Affairs and Fisheries Draft Regulation on Administration of Coastal Water Location Permits in Coastal Areas and Small Islands. The draft regulation consists of 64 articles, one of which is to discuss technically the location map as a technical requirement for the application of Coastal Water Location Permits [5], map of existing sea space use [6], and the map for determining Coastal Water Location Permits by the government [7].

Water Coastal thematic map establishment of Coastal Waters Management Permits in Coastal Areas and Small Islands must still refer to RI Law No.4 of 2011 concerning Geospatial Information. Article 19 states that Thematic Geospatial Information (IGT) must refer to Basic Geospatial Information (IGD). Continued in Article 20 that in making IGT it is prohibited to change the position and level of geometric accuracy of the IGD section, and / or make the scale of IGT greater than the scale of the IGD it refers to. Based on these two articles, the making of the Map of Coastal Water Location Permit must refer to the IGD, namely the Indonesian Earth Map (RBI), the Indonesian Coastal Environment Map (LPI), and the National Marine Environment Map (LLN).

In addition to referring to the IGD, Coastal Water Permit Map establishment can be done by referring to the Marine Space Zoning Plan Map as IGT that has been made by the Ministry of Marine Fisheries (KKP) according to the functions and authorities based on the provisions of the legislation. The Sea Space Zoning Plan Map according to Law No. 1 of 2014 concerning Management of Coastal Areas and Small Island Islands includes the Zonation Plan for Small Islands (RZWP-3K) and Certain National Strategic Zoning Plans (RZKSNT) made on a base map which available in each region.

The territorial waters of Maratua Island in East Kalimantan have a Map of the Specific National Strategic Area Zoning Plan (RZKSNT) which is made referring to the Indonesian Coastal Environment Map (LPI) as a base map. There are also other base maps in the waters of Maratua Island, which is the LLN Map. The same condition also occurs in other waters in the Madura Strait, East Java Province, which has RZWP-3K Map that is made referring to the RBI Map as a base map, although LPI Maps and LLN Maps are also available. Different conditions are found in the waters of the city of Bitung, North Sulawesi, where the RZWP3-K map is based on the LPI Map even though there are also maps of the RBI and LLN.

This study examines the use of basic maps such as the National Marine Environment Map (LLN), Indonesian Sea Maps, and Indonesian Rupabumi Maps (RBI), as well as marine thematic maps in the form of Specific National Strategic Zoning Plan Maps (RZKSNT) for making Coastal Water Location Permits in the territorial waters of Maratua Island, Berau Regency, East Kalimantan Province, as a study area.

2. Research Methodology
In this study there are several inputs, processes, and outputs produced, which are outlined in this following flowchart:
3. Analysis and Result

3.1. Analysis

The analysis conducted in this study is the analysis of the process that was carried out in Chapter II. There are 5 analysis processes described in sections 3.1 through 3.5.

Marine base map:
1. Maratua Island RBI map (1:50,000, 2010)
2. East Kalimantan LLN map (1:250,000, 2013)
3. East Kalimantan Nautical Chart (1:209,000, 2013)

Marine thematics map: Maratua Island RZKSNT map (1:32,000, 2018)

File submission from the applicant in the form of coordinates and site plan drawing of the proposed object

Aerial photograph of the site plan verification with the scale of 1:2,000 and year of 2018

Plotting of the submitted object for location permits to RBI map, LLN map, nautical chart, and RZKSNT map

Geometrical description of submitted object to each map

Calculation of Location Permit submitted object area using each base map

Calculating the distance from the coastline on each map to the site plan

The value of the distance from the coastline of each map to the site plan position

Contour line presentation

Analysis:
1. Comparison of coordinates \((x, y)\) submission of coastal waters location permit to the field verification results;
2. Comparison of shifting coordinate points \((x, y)\) submitted object of coastal waters location permit on each base map and marine thematic map;
3. Comparison of coastal line differences on each base map and marine thematic map to the submitted location objects coastal waters;
4. Comparison of geometry differences and area of submitted objects of coastal waters permit on each base map and marine thematic map;
5. Use of cartographic elements on each base map and marine thematic map for making coastal waters location permit

Research Result:
1. Procedure for Using Base Maps and Marine Thematic Map for Making Water Location Permit
2. Water Location Permit Model Map
3.1.1. Comparison of Coordinates \((x, y)\) of Coastal Waters Location Permit Submitted Object to the Field Verification Results

The submitted site plan position has a difference of 3,032 meters to the site plan position that has been verified by KKP. The object that was built in 2015 is not in accordance with the site plan submitted for Coastal Waters Location Permit in 2017. The difference is shown in Figure 1.

![Figure 1. Differences in Existing Conditions in the Field with the Site Plan of the Submitted Resort for Location Permit (Ministry of Maritime Affairs and Fisheries, 2018)](image)

This certainly violates the provisions that have been made by the Ministry of Maritime Affairs and Fisheries where the site plan of the submitted object should have the same geometric shape as the coastal waters area that will be used and the submitted permit object in the field. Differences in the description of the proposed resort site plan with the resort being built can result in a wide difference between the resorts at the time of application and its realization in the field.

3.1.2. Comparison of Coastline Differences on Each Base Map and Marine Thematic Map to the Submitted Object of Coastline Waters Location Permit.

There is a difference in the position of the coastline drawn on one map from another map shown in Figure 2.
Figure 2. Difference of Coastline Description on Each Map

If the difference in coastline is defined in terms of distance to the Indonesian Nautical Chart, the calculation results will appear as shown in Table 1 as follows:

| Ke Peta                                      | Jarak (m) |
|----------------------------------------------|-----------|
| Rencana Zonasi Kawasan Strategis Nasional Tertentu (RZKSNT) | 428       |
| Peta Rupabumi Indonesia (RBI)                | 371       |
| Peta Lingkungan Laut Nasional (LLN)          | 311       |

The map of the Zoning Plan for Specific National Strategic Areas (RZKSNT) whose coastline information refers to the topographical map of Indonesia informs the coastline with different conditions. Both maps inform the difference in coastline as far as 57 meters. This can be caused by differences in the year of making on the RBI Map (2015) which is used as a reference in making the RZKSNT Map with the RBI Map (2010) which is used as a base map even though both maps have the same scale (1: 50,000). Then, the difference in years can affect the information presented by each map. The difference in information is caused by differences in the existing conditions in the area studied, both because it is in the form of changes caused by nature or by humans. Therefore, the map that is used should be the map with the most recent year of manufacture so that the information presented by the map is an up to date condition and is the closest to the existing condition in the field, so the information on the map does not differ much from the existing condition.
3.1.3. Comparison of Shifting Coordinate Points (X, Y) Objects for Coastal Waters Location Permit on each Base Map and Marine Thematic Map.

To find out the shift of coordinate points (X, Y), it is done by placing four site plan coordinate points on each base map and RZKSNT map (Figure 4).

Figure 4 shows that the four site plan coordinate points depicted on each of the different base maps do not have a significant influence on the shifting points of the object, including on the Nautical Chart which has a different projection system than the other base maps. This result is proven by comparing distance calculations on LLN maps, RBI maps, and manual calculations using mathematical methods. Calculation of distances on LLN Maps and RBI Maps is carried out on the same object contained in each map, measurements are carried out three times. The results of comparative measurements are shown in Table 2.
Tabel 2. Comparison of Distances on LLN Maps, RBI Maps, and Mathematical Methods

| Distance Measurement (times) | Distance Measurement on Base Map | Distance Calculation by Mathematical Method (m) |
|-----------------------------|---------------------------------|-----------------------------------------------|
|                             | LLN 1:250.000                  | RBI 1:50.000                                  |
| 1                           | 81315.91161                    | 81315.91109                                   |
| 2                           | 81315.91172                    | 81315.91148                                   |
| 3                           | 81315.91125                    | 81315.91158                                   |
| Mean                        | 81315.91153                    | 81315.91138                                   |

3.1.4. Comparison of Geometry Differences and Area of Objects for Coastal Waters Location Permit on each Base Map and Marine Thematic Map.

Besides not having a shift in the coordinates of each base map and RZKSNT map, Figure 4 shows that there are no differences in the site plan geometry depicted on different maps. Likewise, the results of the calculation of sea area submitted for the issuance of Location Permit on each map give different but not too significant results. The sea area is calculated using two methods, namely the area calculation using the digitization method and the coordinate method. Table 3 shows the results of the calculation of coastal water area on each map. The area calculation using the digitization method is carried out three times, this is done to minimize the difference in the value of the area caused by the line drawing process when digitized.

Table 3. Comparison Results of the Calculation Area of Digitization and Mathematical Methods

| No. | Map          | Digitation Method (m²) | Mathematical Methods | Difference (%) |
|-----|--------------|------------------------|----------------------|---------------|
|     |              | I                      | II                   | III           | Rata-Rata     | (m²)          |               |
| 1   | LLN (1:250.000) | 6820,912               | 6820,899             | 6820,914      | 6820,908      | 6820,901      | 0,000100344   |
| 2   | RBI (1:50.000)  | 6820,895               | 6820,906             | 6820,878      | 6820,893      | 6820,901      | ~              |
| 3   | RZKSNT (1:32.000) | 6820,922               | 6820,922             | 6820,925      | 6820,923      | 6820,901      | 0,000315369   |
| 4   | Peta Laut (1:200.000) | 6820,858               | 6820,969             | 6820,89     | 6820,904      | 6820,901      | 3,93692E-05   |

It can be seen that the largest area of difference produced on each map is 0,0003% so it can be concluded that the effect of different projection systems, horizontal datum, and vertical datum used on different base maps and RZKSNT maps do not have a significant effect on the shape and area of the object.

3.1.5. Use of Cartographic Elements on Each Base Map and Marine Thematic Map for Making Coastal Waters Location Permit.

The use of the analyzed cartographic elements is the scale, accuracy of the base map, and the contours found on the RBI Map and LLN Map. The difference in scale causes different accuracy of the information presented on each map. The larger the scale of the map used, the more detailed the information presented on the map. As presented in Figure 4, the 2010 RBI Map with a scale of 1:50,000 provides more detailed terrestrial / coastline information (more visible terrain curves)
compared to the 2010 LLN Map which has a scale of 1: 250,000 and the 2013 Sea Map which scale of 1: 200,000. The smaller the scale available, the more information is missing from the map. For Coastal Waters Location Permits, a large scale and latest year base map should be used so that the presentation of terrestrial or coastline information is more accurate.

Location shifting on the RBI Map to the actual location in the field as far as 5 meters and 10 meters can cause the location of objects on the map to be outside of the proposed zoning so that the submission of a Location Permit is deemed not in the zone and cannot be issued by the KKP or the Provincial Maritime Service even though the location of the object in the field is suitable with the provisions of the Zoning Plan. Another impact of the shift can cause the location of the proposed object to overlap with other adjacent objects. The results of this shift in the location are shown in Figure 5.

![Figure 5. Object Shift Visualization on a 1: 25,000 scale RBI Map](image)

The contour information presented in the LLN Map should be more concentrated in the sea area, but the contour information presented in the LLN Map in the East Kalimantan region does not cover the sea. In other words, the contour information presented is only limited to land areas so it does not fit the definition of the LLN Map which should function to present information on the Indonesian sea area. This condition makes the LLN Map on Maratua Island present almost the same information as the RBI Map, which presents contours on land. The only difference lies in the contour interval presented, namely the 100 m interval on the LLN Map, and 25 meters on the RBI Map. Figure 6 shows contour information on both the LLN Map and the RBI Map that were stopped in land area.

![Figure 6. Contour Information on LLN and RBI Maps Does Not Cover the Sea](image)
3.2. Results
There are two results in this study, the Procedure for Using Base Maps and Thematic Marine Maps for the Making of Coastal Waters Location Permits, and Coastal Waters Location Permit Model Maps.

3.2.1. Procedure for Using Base Maps and Marine Thematic Maps for Establishing Coastal Waters Permit Locations.
The procedure for using a basic map and a marine thematic map for the establishment of a Coastal Waters Location Permit is shown in Figure 7

![Diagram](image)

**Figure 7.** Procedure for Using Base Maps and Marine Thematic Maps for Making Location Permit Maps in Coastal Areas and Small Islands.
3.2.2. Map Model of Coastal Waters Location Permit.
Based on the procedures for using the basic map and marine thematic map in Figure 7, four models of Coastal Waters Permit Location in the Maratua Island waters are produced. The following is a model of a Map of Coastal Waters Permit Locations in the Maratua Island region, Berau Regency, East Kalimantan. Map of Coastal Water Location Permit in this study is only made for sea surface space only, does not inform the sea column space and the seabed (Map is displayed in two dimensions).

3.2.3. Coastal Waters Location Permit Map of Maratua Island Waters Using the 2010 LLN Base Map scale 1: 250,000
In the model of the Coastal Waters Location Permit Map of Maratua Island by using the LLN Base Map of 2010 scale 1: 250,000, the site plan and boundaries submitted for the Coastal Waters Location Permit are not visible (Figure 8). Therefore, a 1: 250,000 LLN Map cannot be used as a Map of Coastal Waters Permit Locations in the Maratua Island waters.

3.2.4. Coastal Waters Location Permit Map of Maratua Island Using the 2010 RBI Base Map scale 1: 50,000
In the model of Map of Coastal Waters Location Permit for Maratua Island Waters using 1: 50,000 scale RBI Base Map, site plan and boundaries submitted for Water Location Permit are not visible (Figure 9). Therefore, a 1: 50,000 scale RBI Map cannot be used as a Map of Coastal Waters Permit Locations in the Maratua Island waters.
3.2.5. Coastal Waters Location Permit Map Maratua Island Using the Indonesian Ocean Map 2013 scale 1: 250,000.

In the Maratua Island Waters Area Permit Location Map model using the Indonesia Ocean Map 2013 scale 1: 250,000, the site plan and boundaries submitted for the Coastal Waters Location Permit are not visible (Figure 10). Therefore, a 1: 250,000 Indonesian Sea Map cannot be used as a Map of Coastal Waters Permit Locations in the Maratua Island waters.

**Figure 9.** Map Model of Coastal Waters Location Permit Using 2010 RBI Map Scale 1: 50,000

**Figure 10.** Model Map of Coastal Waters Location Permit Using the 2013 Indonesia Ocean Map Scale 1: 200,000
3.2.6. Coastal Waters Location Permit Map of Maratua Island Using the 2018 National Strategic Area Zoning Plan Map scale 1: 32,000.

In the Maratua Island Waters Area Permit Location Map model using the 2018 National Strategic Area Zoning Plan (RZKSNT) scale 1: 32,000, the site plan and boundaries proposed for the Coastal Waters Location Permit appear, but still look small although larger compared to the Map of Coastal Waters Permit Location using the RBI Map (Figure 11). Thus, the National Strategic Zoning Plan Map scale of 1: 32,000 cannot be used as a Map of Coastal Waters Permit Locations in the Maratua Island Waters.

![Figure 11. Model Map of Coastal Waters Location Permit Using 2018 RZKSNT Map Scale 1: 32,000](image)

In addition to the four models above, making Coastal Waters Location Permit Maps can be done using high-resolution satellite imagery and unmanned aerial photography, so that the resulting scale can be larger (eg 1: 1,000 and 1: 2,500). Whereas sea contour information can be completed using contours obtained from the Indonesian Sea Map. The following is a model of a Map of Coastal Waters Permit Location using 1: 2,000 scale aerial photography (Figure 12).
4. Conclusions and Suggestions

4.1 Conclusions

After getting the results and analysis from this study, it can be concluded that:

1. The fittest base map used for making Coastal Water Location Permit is a base map that has sea depth information on a scale not smaller than 1: 25,000 and at the latest year, so that it has high horizontal and vertical accuracy and closer contour intervals.

2. If the LPI and LLN Maps are not available, then the RBI Map can be used to make Coastal Water Location Permit map, with information on the sea contours referred to in the Indonesian Nautical Chart.

3. The base map in the coastal waters of Maratua Island, namely the 2010 RBI Map scale 1: 50,000, the LLN Map 2010 scale 1: 250,000, the 2013 Sea Map scale 1: 200,000, cannot be used as a Map of Coastal Waters Permit Locations. Only marine thematic maps namely 2018 RZKSNT on a scale of 1: 32,000 can display objects along with the location permit boundaries.

4. Marine thematic maps that can be used for making Coastal Water Location Permit Maps are Zoning Plan Maps (RZWP-3K, RZKSN, and RZKSNT) that have been determined by the government, containing information on sea depth and map scale in accordance with the base map used.

5. Map of Coastal Waters Permit Locations can be made with a scale larger than the scale of the base map if using measurement data and satellite image or high-resolution aerial photography.

4.2 Suggestions

These are suggestions from the authors so that further research can be done better:

1. This study is conducted only on the RBI Map, LLN Map, Sea Map, and RZKSNT Map. LPI Maps should also be reviewed so that the research conducted can involve all types of existing marine base maps.
2. The base map that is used as a reference for making RZKSNT should be the same basic map as the base map that was studied in the study. It can minimize the number of comparison parameters so that the study results can be more accurate.

3. It is better to use the LPI and LLN Maps which have contour information up to the coastal and marine areas, so that the sea contours on the LPI Map and LLN Maps can be used on the Coastal Water Location Permit Map model.

4. It is best to use the largest map scale available, and use a map making year with a difference of not more than 5 years with the research year.

5. Map of Coastal Waters Location Permit should also display sea column and seabed space information.

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5. References
[1] Geospatial Information Agency. 2017.
[2] Republic of Indonesia Law No. 1 Article 1 Paragraph 18. 2014.
[3] Republic of Indonesia Law No. 1 Article 16. 2014.
[4] Republic of Indonesia Law No. 1 Article 17. 2014.
[5] Draft Regulation of the Minister of Maritime Affairs and Fisheries of the Republic of Indonesia in Chapter II. Recording of Registration, concerning Administration of Location Permits for Coastal Waters in Coastal Areas and Small Islands, Editor. 2018: article 12.
[6] Draft Regulation of the Minister of Maritime Affairs and Fisheries of the Republic of Indonesia in Part III. Examinations, c.A.o.L.P.f.C.W.i.C.A.a.S. Islands, Editor. 2018: Article 15.
[7] Draft Regulation of the Minister of Maritime Affairs and Fisheries of the Republic of Indonesia, in Chapter IV, Other Provisions, c.A.o.L.P.f.C.W.i.C.A.a.S. Islands, Editor. 2018: Article 57.