

Analysis Study of the Water Quality of Siombak Lake Medan North Sumatera

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Abstract—Siombak Lake located in the northern part of Medan City, was formed as a result of land excavation for the construction of the Belawan-Medan-Tanjung Morawa (BELMERA) toll road. Over time, this man-made lake has experienced significant environmental stress due to tidal flooding and surrounding urban activities, negatively impacting water quality and the local ecosystem. This study aims to evaluate the current water quality of Lake Siombak using the Storet method, based on the Minister of Environment Regulation No. 115 Year 2003. Sampling was conducted at four strategic points representing various anthropogenic influences. The results showed that the lake water is brackish and experiences daily tidal fluctuations influenced by the Belawan River which empties into the Malacca Strait. High concentrations of pollutants, including phosphate, ammonia, BOD and heavy metals, were recorded at several sampling points, indicating moderate to severe water pollution. This indicates eutrophication and ecological degradation, impacting aquatic life and neighboring communities.

Keywords—Siombak Lake, Pollution, Water Layout, Water Quality

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I. INTRODUCTION

Siombak Lake is located in the northern part of Medan city and administratively in Paya Pasir Village, Medan Marelan District. Siombak Lake covers an area of 41.11 hectares and has a maximum depth of 5 meters. The lake serves multiple purposes, including fishing, flood control, water absorption, providing habitat for aquatic life, and as a tourist destination. Siombak Lake is situated between the Terjun River and the Deli River. The lake was formed as a result of land excavation for the construction of the Belawan-Medan-Tanjung Morawa (BELMERA) toll road, which spans 34 km.

Frequent tidal flooding threatens tourism activities and nearby residential areas, leading to changes in the environmental quality of the lake's waters. According to the directives of the Directorate General of Water Resources, Siombak Lake is included in the "Preparation of Strategic Water Resources Plan for Priority Lakes - Western Region" with the job title "DED Revitalization of Siombak Lake."

This directive aligns with the Medan City Regulation No. 1 of 2022 concerning the Spatial Planning of Medan City for 2022-2042, which includes plans for constructing a levee for flood control as part of the DED Revitalization of Siombak Lake.

II. METHOD

A. Location and Time of Research

This study was conducted at Siombak Lake, located in Medan City, North Sumatra Province. Morphometric data of the lake were measured in November 2021. A purposive random sampling method was used to determine the stations. Station 1 is the outlet location, Station 2 has significant community activities, Station 3 has considerable tourism activities, and Station 4 is situated near the landfill.

B. Water Quality Measurement

Water quality was measured using methods from APHA (2012). The results were compared to water quality standards set by Government Regulation No. 21 of 2022. To assess the water condition, the Storet method (Minister of Environment Regulation No. 115 of 2003) was used. This method compares measured values to standard values to determine pollution levels [12].

According to Tchobanoglous et al. (1993), if a parameter meets the standard, it scores 0 [25]. If not, it receives a negative score. The total score determines pollution levels:

- 0: Meets standards (clean)
- -1 to -10: Light pollution
- -11 to -30: Moderate pollution
- Below -31: Heavy pollution

This scoring system follows the U.S. Environmental Protection Agency (USEPA) guideline

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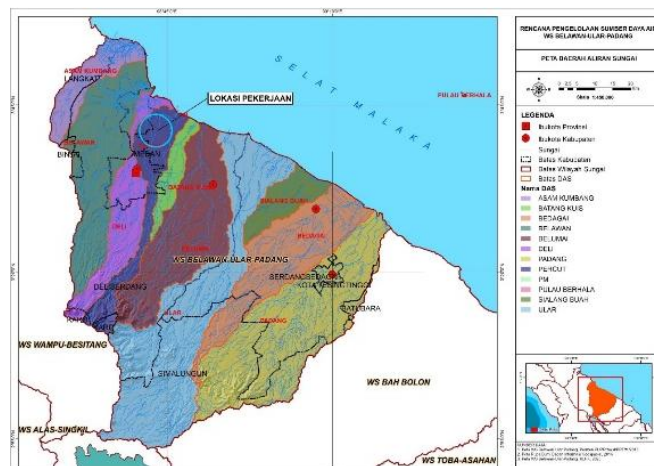


Figure 2. Location Map of the Detailed Engineering Design (DED) for the Revitalization of Lake Siombak in the Belawan-Ular-Padang River Basin

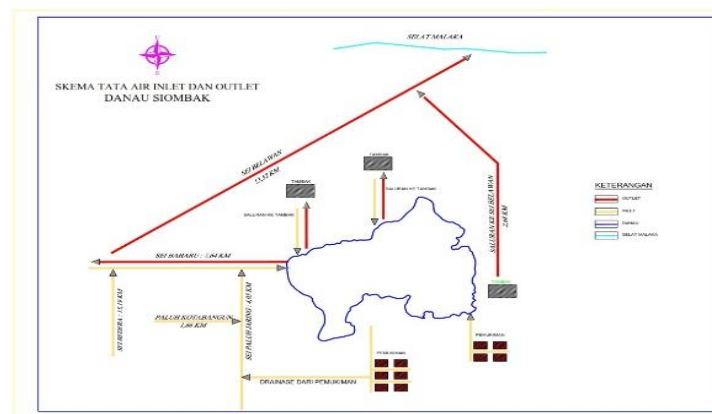


Figure 3. Inlet and Outlet Water Management Scheme of Siombak Lake

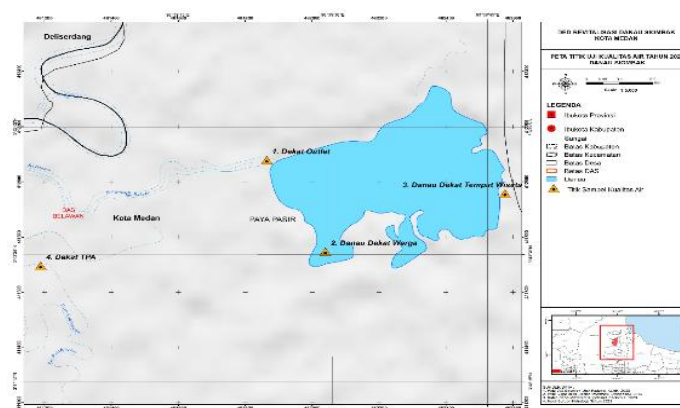


Figure 4. Water Sampling Location Map



Figure 5. Parameters Above Water Quality Standards Based on Water Quality Analysis

Based on the administrative unit approach, the Belawan-Ular-Padang River Basin includes Medan City, Pematang Siantar City, Tebing Tinggi City, Simalungun Regency, Serdang Bedagai Regency, and Deli Serdang Regency. The area of each regency within the Mamberamo-Tami-Apauvar River Basin can be seen on the following map:

D. Enviromental Plan for the Project Site Water Quality of Siombak Lake

Siombak Lake is influenced by the tidal waters of the Belawan River, which flows into the Strait of Malacca.

TABLE 2.
PARAMETERS ABOVE WATER QUALITY STANDARDS BASED ON WATER QUALITY ANALYSIS

Parameter	Point 1	Point 2	Point 3	Point 4
TDS	2196	2324	2182	2166
TSS	69	29	25	30
Color	50	40	30	30
BOD 5	28.8	7.0000	10.91	6.81
COD	92.9068	22.58	34	23.4717
Chloride	1532.47	1305.8	1468.41	1463.48
Nitrite	0.1235		0.4484	0.2634
Ammonia	2.6537			
H2S	0.3284	0.0243	0.0257	0.0228
Cl2	0.21	0.06	0.1	0.08
Boron	0.8985	1.057	0.9354	0.8896
Iron	0.3049			
Mn	0.01805	0.818	0.0776	0.03427
Zn	0.70555	0.1746	0.20687	0.10406
Cu	0.1192	0.442	0.0823	0.0394
Timbal	0.0872			
Fecal Coliform	540	130	220	350

The water in Siombak Lake is brackish. Siombak Lake experiences tides daily. The water quality in Siombak Lake is still safe for fishing. Both benthic and nektonic organisms are unstable. The waters of Siombak Lake are generally eutrophic (Limnological Status) – [1].

The survey and investigation of Siombak Lake were conducted based on a water management scheme [2]. Sampling was carried out using purposive random sampling, meaning the water analysis was based on its use. The sampling map can be seen in the following figure:

From the laboratory analysis results, it can be seen that the surface water condition of Siombak Lake around the project site generally has parameter values above the quality standards (Odum, 1996) based on Government Regulation No. 22 of 2021 concerning the Implementation of Environmental Protection and

Management [21]. The parameters that are above the quality standards are as follows:

E. Fauna

The fauna around Siombak Lake includes the Great Egret (*Ardea alba*) and the Intermediate Egret (*Egretta intermedia*), which are found spatially and temporally in the Siombak Lake ecosystem. There are also the Rhinoceros Hornbill (*Buceros rhinoceros*), the Brahminy Kite (*Haliastur indus*), and the Silvered Leaf Monkey (*Trachypithecus cristatus*), which were found only once in the study area (Biodiversity of birds and mammals in the Lake Siombak ecosystem) – (Dirk & Koudenburg, 1995). Brackish water organisms such as mullet, halfbeak, pufferfish, white shrimp, and mangrove crab live in Siombak Lake. Freshwater fish found include tilapia, mujair, snakehead, and climbing perch [15].

F. Flora

The aquatic organisms in Siombak Lake are very

unique and distinctive, including both flora and fauna. The uniqueness of the Siombak Lake ecosystem is highlighted by the presence of mangroves such as nipa palm and mangrove trees growing along various lake boundaries. Nipa palm and apple mangrove trees are the most extensive and dense types of mangroves in Siombak Lake.

On the sides of Siombak Lake, the mangrove condition is good, while in the lake's ecosystem, it is damaged. Seven types of mangroves, five types of coastal plants, and one type of aquatic plant were found. Additionally, twelve species of fish, seven species of arthropods, as well as clams, shrimp, and crabs were found in Siombak Lake [4].

IV. CONCLUSION

Siombak Lake plays an important role as a water catchment area, flood control, recreation area, and habitat for various aquatic biota. However, the results of the study show that Lake Siombak has experienced a decline in environmental quality due to human activities, sea tides, and influences from surrounding rivers. The pollution is caused by community activities, tides, and the influence of the surrounding rivers. Although the ecosystem still shows the presence of typical flora and fauna, mangrove conditions and water quality are declining. Therefore, revitalization through the construction of embankments, retention ponds, and pumping systems is necessary to maintain the ecological and social functions of the lake.

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