

# Spatial Analysis of Water Quality in Area of the Riverbank of Musi River in Palembang City

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## Spatial Analysis of Water Quality in Area of the Riverbank of Musi River in Palembang City

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**Abstract** - The report by WALHI in 2016 showed that based on the quality status of the Musi River water in Gandus District is in abad status, which means that it has been polluting, which can come from the high activity of citizens and industry in the riverbank on that river. Geographic Information System (GIS) as a system that can collect, store, transform, display and correlate spatial data and geographic phenomena, can be used to obtain the pollution spread based on water quality. The purpose of this research is to find out the physical and chemical quality distribution the water of Musi River in the Gandus district by using the Geographic Information System (GIS). This research is a descriptive study with the survey methods. Determining point sampling of river water using purposive sampling technique, Research held in Gandus district consist by 5 kelurahan namely Kelurahan Pulokerto, Kelurahan Gandus, Kelurahan Karang Anyar, Kelurahan Karang Jaya and Kelurahan 36 Ilir. Sampling refers to SNI 698957-2008 and a instantaneous sampling method (grab sampling), with the total of sample are 20. The results of the research are the status of pH, temperature, Turbidity, BOD and COD are still under the quality standards based on Pergub No. 16 Tahun 2005 about Water supply and quality standard of river water, but for the consetration of ammonia in all sampling locations exceeds the quality standards. The results of the GIS analysis showed that the majority of pH spread is at the acid degree, temperature 30 ° C, turbidity meter < 50 NTU, BOD > 1.500 mg/L, COD > 5.000 mg/L and the average concentration of ammonia is 0.420 mg/l. In conclusion that based on the parameters of pH, temperature, turbidity, BOD and COD water quality of the Musi river in the district Gandus is good but for the ammonia parameter showed poor quality. Suggestion for residents and industries around the waters of Musi River in Gandus district is to maintain the cleanliness of the river and reduce the activities that can pollute the river.

**Keywords:** physical quality, chemical water, Musi River, Geographic Information System

### I. Introduction

The population growth grows as time changes. If population growth continues to increase while it is not balanced with increasing development of facilities, infrastructures and facility settlement, so it

tends to create a very crowded settlement. Thus the condition of a crowded resident settlement can contribute to the opportunity or bad cause of the condition of city environment. Capacity of the existing settlement space are insufficient to fill the necessity of a decent resident's house. The slums in the middle of the city has a low-quality housing characteristic, the building is made of materials that not qualify, sometimes consist by all traces of materials, sanitation and clean water supplies are generally not available or insufficient [1].

The condition of sanitation settlement environment nowadays shows the reduction in the degree of environmental quality, in future is accompanied by the development of various types of diseases. Aspects of environmental quality and aspects of life must be a priority in managing the environment. The culture of building houses on the riverbank can cause pollution in rivers, and resulted in various environmental sanitation problems in settlements on the riverbanks. This is caused by household waste so it interfere the aesthetics and function of the river [2]. This condition is also seen in Gandus subdistrict. Crowded residential pattern. Located in the riverbank. Organic building layout, following the riverside line. Building distances vary, and irregular, but the average distance is near. Many wet areas by the riverbank are puddle and slum, as well as the high activity of the people on the Musi River in a residential neighborhood.

Musi River is a natural resource that is one of the main lines of trade and the largest water supplier for residents of South Sumatera and

for various sectors, agriculture, settlements, fisheries, industry etc [3]. At the upper part of the river Musi there is a crowded residential area in the city of Palembang with the flow of Musi River that through the settlement, where the activity of citizens in river waters is still quite high, including the activities of washing, bathing and defecating, where many peoples dispose their leftover food, garbage and dirt or feces, both human and animal waste, even the activity of boat washing. High activity in river waters can also affect the quality of the river water, even causing pollution of the river water. Surely, this condition will affect the people who live in the river, considering there are many activities of the community in the river waters. Based on the results in WALHI report in 2016 the quality status of the river Musi water in Gandus subdistrict is bad [4]. As an effort to overcome the problem, the first step is to determine the spread of the pollution level. Geographic Information System (GIS) as a system that can collect, store, transform, display and correlate spatial data and geographic phenomena, can be used to obtain pollution spread based on water quality [5].

## II. Materials And Methods

### A. Types of Research

This research is a descriptive study with the survey method. As for determining the location of taking sampling point of river water using purposive sampling technique, which is determined by researchers in consideration as a location of the crowded activities of residents around the river

### B. Research Location

Research conducted in Sebrang Ulu I subdistrict, especially in 4 village office, namely 1 Ulu, 5 Ulu, 7 Ulu, and 9-10 Ulu. The village selection is based on pre-survey results and interviews with the subdistrict chief of Sebrang Ulu 1 about the area that traversed by the Musi River. As well as Gandus Subdistrict consisting of 5 village office namely

Pulokerto, Gandus, Karang Anyar, kelurahan of Karang Jaya and 36 Ilir. In each Kelurahan specify 2 sampling stations, and each station is determined 2 point of sampling location.

### C. Sampling Methods

Sampling is done in reference to SNI 06-2412-1991 and SNI 698957-2008 about the method of sampling the surface water, carried out at the time of tide and receding [6] [7]. Sampling method is a instantaneous sampling (grab sampling), the samples were taken at the time of tide and receding on the Musi River.

Tool :

1. Scoop with telescopic stalk
2. Sample bottles
3. Bucket / bucket bottle
4. Integrated sampler
5. Ice thermos

Material :

1. Reagen /preservatives according to analysis provisions
2. Paper / label and ice cube

Work Steps :

1. Prepare a sampling tool in the form of an integrated sampler or a bucket bottle or scoop with telescopic stalk, or a closed sample bottle.
2. Specify the location/point/sampling station. Specify the number and depth of sampling. As for the sampling point of the river water is done with purposive sampling is in the location where the high activity of residents around and on the surface water. It is intended to see the quality of water that is directly used by residents for daily needs.
3. Use a bucket bottle or a scoop with a long stalk If the location of the water cannot be reached directly by hand. If it reachable, use a sample bottle directly.
4. Rinse the sampling tool with water that has taken, 3 (three) times;
5. Take the example according to the allocation analysis and mix water then homogenize it;

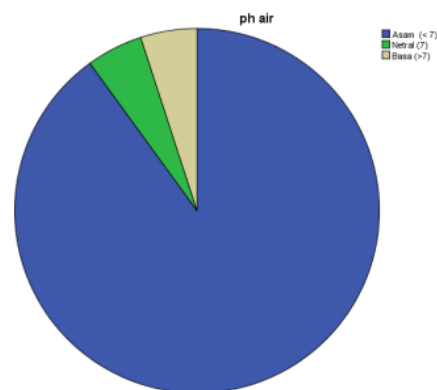
6. Take that into the appropriate container of the allocation analysis;
7. Provide preservatives that fit to the allocation analysis. Close perfectly.
8. Attach / Attach labels to the container / sample bottle.
9. Do the test for field parameters include BOD, COD, Turbidity, ammonia and H<sub>2</sub>S
10. Do the test immediately for field parameters include temperature and pH, because it can change rapidly and can not be preserved
11. The results of field parameter test are recorded in a exclusive notebook;

#### D. Processing dan Analysis Data

The data analysis using a spatial analysis. The activities conducted at this stage are by the method of overlay maps or mapping through the Geographic Information System (GIS) program ARC. View. One of the advantages of an analysis with an overlay map is that the visible visualizations from multiple variables can be widely presented. Some of the overlays performed in this study are maps of the research area with the survey result data resulting in water quality map based on physical and chemical parameters, with the use of Geographic Information System (GIS) its discovered the distribution location with qualified water quality or not based on an environmental quality standards.

### III. Result

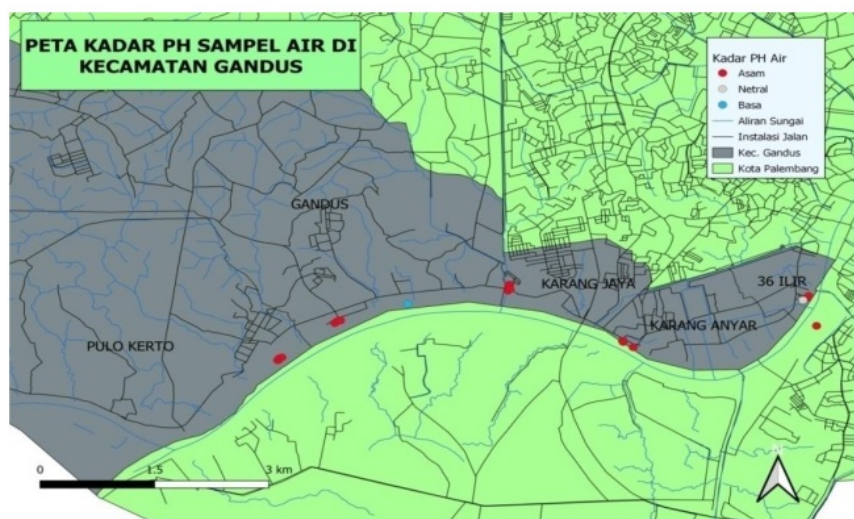
1. Quality of water pH in the riverbank of Musi river, Gandus sub-district of Palembang



**Picture1. Diagram of a pH water quality of Musi River water in Gandus subdistrict Palembang**

Based on the results of the research showed that in Gandus subdistrict with the capture of 20 sample points, average degree of acidity (pH) water is 6.74. The lowest measured water pH is 6.42 and the highest water pH is 7.11, with the majority water pH quality as much as 18 samples (90%) is at the acid degree, and each is only 1 sample (5%) is at the alkali degree and neutral. The result of pH measurements at 20 locations in Gandus subdistrict was obtained that the lowest water pH touched the acid degree, neutral and slightly above neutral and it is alkali.





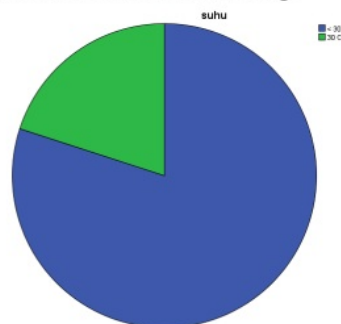
**Picture 2. Map of the water pH quality of Musi River in Gandus Subdistrict**

Based on the water quality distribution map it can be seen that water quality distribution with more acid pH along Musi River in Gandus subdistrict, especially in five village. Only a few points indicating a neutral pH condition and that is in village 36 Ilir. The condition of water acidity degree can be influenced by the activities of the community around the Musi River waters. The research by Azwar et al o<sup>8</sup> the Metro River in Malang city shows that fluctuations in pH value are influenced by waste of organic and inorganic sewage to the river. The normal water that is eligible for a life has a pH in about 6.5 – 7.5. The pH value of unpolluted water is usually close to neutral (pH 7) and fulfills the lives of almost all aquatic organisms [8].

Several bussines that can be undertaken for the control of river pollution, such as [9]: industrial waste has to be neutralized first before it disposal to the river, forbidding to dispose the waste to the river. But the role of society is also very important to environmental pollution due to lack of awareness of the consequences that negatively affect the pollution of the river water. Furthermore, the strategy by increasing the

inventory and identification of water pollutants, improving waste management, and improve the river water quality monitoring [10].

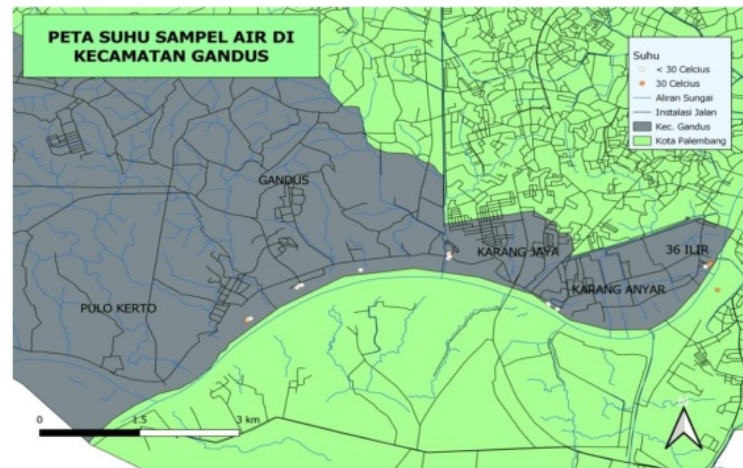
2. The quality of water temperature in the riverbank of Musi river, Gandus Subdistrict of Palembang



**Picture 3. Diagram of water temperature quality of Musi river in Gandus**

Based on the results of this study showed that in the district of Gandus with the intake of 20 sample points the average water temperature is 29,85 °C. The lowest measured temperature is 29 °C and the highest temperature is 31 °C, with the majority water

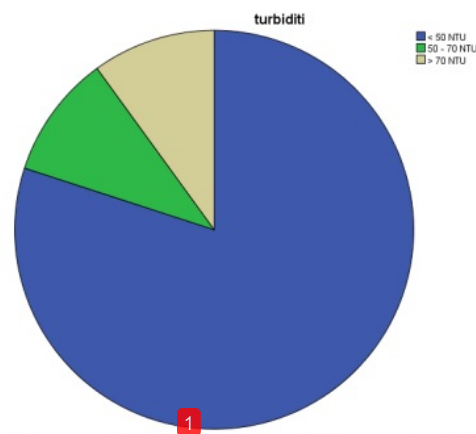
temperature quality of 15 samples (75%)  
temperature is at 30 °C.



**Picture 4. Map of water temperature quality of Musi River in Gandus district of Palembang**

The temperature conditions of the river waters can be influenced by the activities of the community around the water. For example, research conducted by Diana Hendrawan shows that 83% rivers and 79% situ in DKI Jakarta are in bad category. It is because the river and situ has not maintained well, the lack of public and government awareness in the effort to maintain rivers and lakes [11]. Research by Lutfi Aris shows that the education and knowledge of citizens gives a quite good influence on their attitudes and actions in throwing waste/waste domestic in rivers [12]. As well as various studies have shown that one of the biggest cause of river pollution is the activity of citizens around the river that does not pay attention to the factor of river environmental hygiene [13]. It is important to increase surveillance and monitoring frequency, increase the number of watchpoints, law enforcement and local rewards for citizens and industry in environmental management [14].

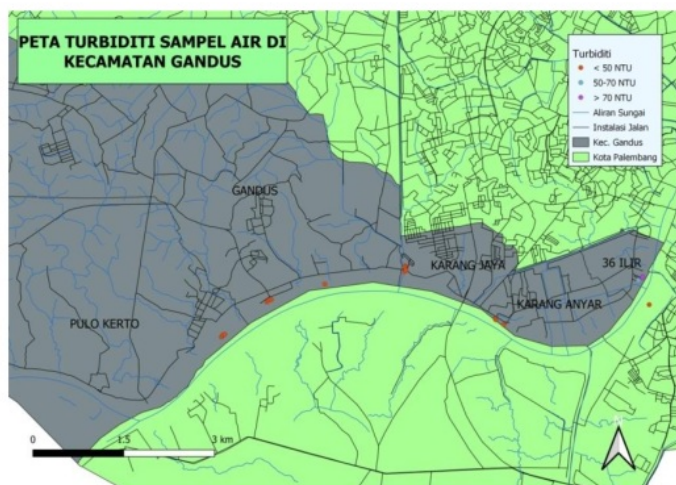
3. The quality of Water Turbidity in the Riverbank of Musi River Gandus Subdistrict of Palembang City



**Picture 5. The Quality of Water Turbidity in Musi River in Gandus Subdistrict**

Based on the results of the average turbidity of water is 47.86 NTU. As for the lowest measured turbidity is 32.95 NTU and the highest turbidity is 77 NTU, with the majority water turbidity quality of 16 samples (80%) is at a turbidity of < 50 NTU, and 4 samples (20%) are at Turbidity > 50 NTU.





**Picture 6. Map of the Quality of Water Turbidity in Musi River in Gandus Subdistrict Palembang City**

The results of the research by Helfa Sefina et al on the waters of the Musi River in Gandus subdistrict were obtained that almost all environmental indicators showed that the environmental conditions of Gandus subdistrict had a high level of vulnerability. This condition shows that the influence of environmental management based on several management policies in Gandus subdistrict has not materialized. Musi River which should be a conservation area but now as a residential area that can harm the health of residents in the environment itself [15]. For environmental sustainability have to use a community participation approach which directly related to the field in order to improve the quality of public conditions that exist on the river boundary in the district of Gandus, Palembang. In addition, research by Alprida on Batang Ayumi River water shows that the color on the river water, seen in dense brown. Water in color means it contains other ingredients that can hazardous to health. Color on water can be caused by any contact between water with organic substances that have been weathered so that produces

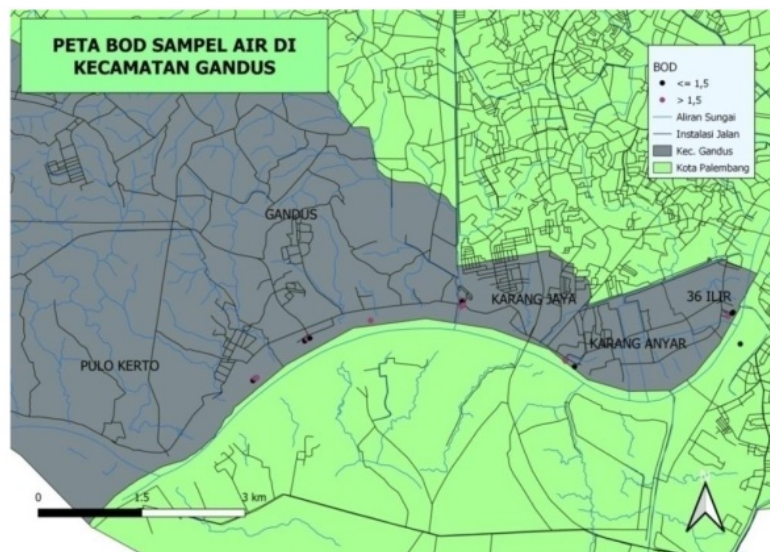
soluble compounds, elements Fe and Mn [16].

4. The quality of BOD water in riverbank of Musi River in Gandus Subdistrict of Palembang City

**Table 1. Quality of BOD water of Musi River in Gandus Subdistrict of Palembang City**

	Frequency	%
BOD		
≤ 1,5	9	45
> 1,5	11	55
Total	20	100

Based on BOD parameter checking by using the BOD sensor method at 20 sampling points, the results shows that 11 sampling locations with BOD levels > 1.500 mg/l and 9 locations with the results of a BOD rate of < 1.500 mg/l. This number is still under the quality standards based on Governor's Regulation of South Sumatera Number 16 Year 2005 about water supply and quality standard of river water.



Picture 7. Map of BOD quality of Musi River in Gandus Subdistrict of Palembang City

The BOD examination is required to determine the pollution burden caused by resident wastewater or industry, and to design a biological treatment system for the polluted water. BOD level on the water of Musi River in Gandus district taken at 20 locations in 5 Kelurahan is still under the quality of the standard and that is 2.000 mg/l. However, seeing the high activity of organic waste disposal by local residents, whether from daily activities such as defecating at the river, disposal of fish dung or other domestic activities, so still important to do preventive action towards activities that can contribute pollutants in the Musi River, where the complexity of river water quality is influenced by a variety of factors such as changing seasons, human behaviour to water, water flow discharge, river current velocity, river width, the rate of development, the number of inhabitants, and so on.

Another studies have shown the results of BOD concentrations of Musi River in Kertapati and Gandus subdistricts at the first receding, second receding and second tide has

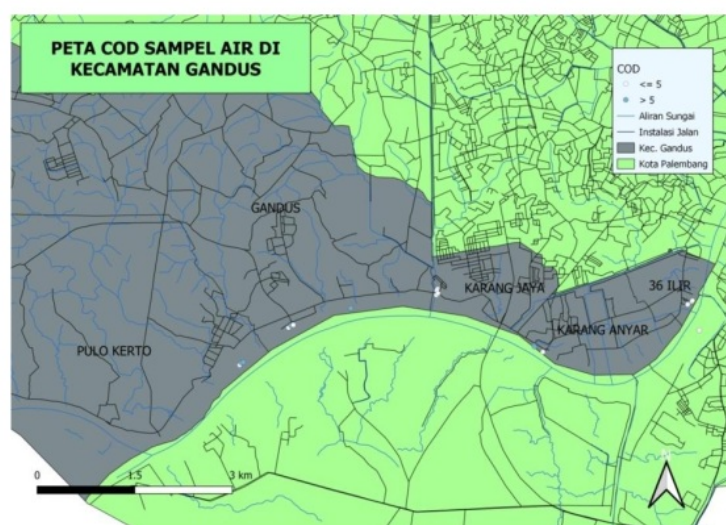
passed the value of BML of the water based on Governor's Regulation of South Sumatera Number 16 Year 2005. Large amount of BOD values are not good for the life of aquatic organisms. BOD is an oxygen requirement for some of bacteria to decompose all the organic substances nor as suspended in water into simpler organic substances. The run out oxygen that has been consumed makes the biota lack of oxygen and cannot live.<sup>17</sup> High BOD conditions also occur on the water of Metro river in Kepanjen city Malang District. There are the quality status of Metro River Kepanjen City at the Watch point 1 shows the quality status of the water in a good condition, while at the watchpoint 2 and 3 shows have been "mild pollutants" [18].



5. The Quality COD water in the riverbank of Musi River in Gandus Subdistrict of Palembang City

**Table 2. Quality COD water of Musi River in Gandus Subdistrict of Palembang City**

COD	Frequency	%
$\leq 5$	13	65
$> 5$	7	35
Total	20	100



**Picture 8. Map of quality COD water at Musi River in Gandus Subdistrict of Palembang**

According to the examination of COD parameters using SNI method 6989.2 -2009, the results that there are 13 locations (65%) Sampling with COD levels  $> 5.000$  mg/L and 7 locations (35%) With the result of COD levels  $< 5.000$  mg/L. This number are still under the quality standards based on Governor's Regulation of South Sumatera Number 16 Year 2005 about water supply and quality standard of river water. COD or chemical oxygen needs are the amount of oxygen needed to oxidize the organic substances that present in a liter of water samples. COD is a measure of water pollution by organic substances that can naturally be

oxidize through a microbiological process, resulting in reduced dissolved oxygen in the water. COD measurement is held because in organic materials it is often found ingredients

that are not biodegradable and can only be chemically decomposed.

Although from the measurement results still under the quality standards of 10 mg/l based on Governor's Regulation of South Sumatera Number 16 Year 2005. But looking at the numbers that are not so far with the limits of quality standards and the high activity of residents who can exposure chemicals in the water, the increase in the next

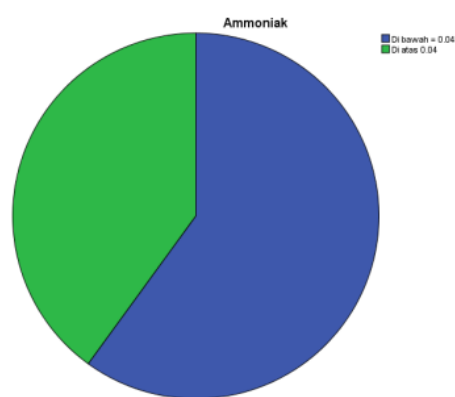
COD number will be affected by the life of animals in that water.

Water pollution conditions in a waters can be indicated by parameter measurements, one of the parameters is COD (Chemical Oxygen Demand) or chemical oxygen requirement for oxidation reaction toward waste in the water [19]. As an example of research by Yudo on the Ciliwung River which shows that the pollution condition that occurs it dominated by domestic waste pollution consequently the high concentration of BOD, COD, ammonia, phosphate, detergent and *E coli* bacteria [20].

6. The Quality Ammonia water in the riverbank of Musi River in Gandus Subdistrict of Palembang City

**Table 3. Quality Ammonia water of Musi R River in Gandus Subdistrict of Palembang City**

	Frequency	%
Ammonia		
≤ 0,04	12	60
> 0,04	8	40
Total	20	100



**Picture 9. Diagram of The quality of ammonia water in Musi river in Gandus Subdistrict**

Based on the examination of ammonia parameters using SNI 06-6989.30 -2004 method, it is obtained that all exceeds the quality of water based on Governor's Regulation of South Sumatera Number 16 Year 2005 that the maximum level of quality ammonia on a river is 0. While the results of the examination is obtained that the average of ammonia in 20 locations is 0.420 mg/l. Ammonia can be toxic to humans if the amount that enters the body exceeds the amount that can be detoxifying by the body. In humans, the biggest risk is from the inhalation of ammonia fumes, which results in some effects including irritation of the skin, eyes and respiratory tract. If dissolved in the waters it will increase the concentration of ammonia causing poisoning for almost all aquatic organisms. According to Fawel, et al ammonia can be toxic to humans if the amount that enters the body exceeds the amount that can be detoxifying by the body it is not more than 100 mg/kg every day (33.7 mg of ammonium ions per kg of body weight per day) that can Affects metabolism by changing the acid-base equilibrium in the body. The high content of ammonia can be caused by the amount of urea content and the process of ammonification derived from the decomposition of organic substances by microbes [21]. Furthermore, the residential area that most of the population still doing their daily activities on the river water. Domestic wastewater and industrial waste flowing into the river affects the ammonia levels in that waters. This is the condition that happened to the water of Musi River in Gandus subdistrict

In maintaining the quality of the river water from the variety of pollution, need to do the calculation of the load capacity of the river pollution based on the river water allotted per segment so as it can be determined the maximum of pollution load. The capacity of pollution load can be used as the basis for the determination of location permits for business and/or activities, the determination of

environmental permits relating to the disposal of wastewater to water sources, determination of policies in controlling the water pollution, and forming the regional spatial plan [22].

#### IV. CONCLUSION

Based on the results of the study it can be concluded that the Musi river water in the Subdistrict of Gandus especially in the 20 points of measurement is not polluted when viewed based on parameters pH, temperature, turbidity,  $\text{BOI}$ ,  $\text{COD}$  and  $\text{H}_2\text{S}$ , because it is still below the water quality standard based on governor regulation number 16 year 2005. While for the ammonia parameter shows the condition of polluted water because it exceeds the water quality standard based on governor regulation number 16 year 2005.

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