Case Study

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# Simulation Modeling of the pH and TSS Quality of the Serongga River as a Result of Coal Mining Activities (Case Study PT. Baramega Citra Mulia Persada)

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## ABSTRACT

PT. Baramega Citra Mulia Persada is a coal mining company that carries out exploitation activities in the Kelumpang Hilir District, Kotabaru Regency, South Kalimantan Province. Various land use activities in river water areas, such as coal mining activities, are thought to have affected river water quality. Based on the description above, it is necessary to analyze the quality and status of river water around coal mining activities in an effort to control water pollution. River water sampling can describe river water quality more accurately but requires a long time and high costs. So, river modeling is carried out with the aim of minimizing observation costs and time. The appropriate modeling to simplify river water quality conditions is the Qual2kw model. Based on this description, the aim of this research is to determine the pH and TSS concentrations at each sampling point in the Serongga River and to create a pH and TSS model from wastewater. PT BCMP which flows into the Serongga River.

This research will be carried out at PT. Baramega Citra Mulia Persada is located in Kelumpang Hilir District, Kotabaru Regency, South Kalimantan Province. This research activity began with field observations by taking samples at three points, namely the upstream of the Serongga River, outfall, and downstream of the Serongga River at 4 (four) different time periods. The samples that were taken were then tested for pH and TSS at the Tanah Bumbu Regency Environmental Laboratory. Based on the results of laboratory analysis of pH and TSS, it shows that the concentration at the point source is in accordance with Governor Regulation No. 36 of 2008 concerning Waste Water Quality Standards, and at the upstream, outfall and downstream monitoring points of the Serongga River, the pH and TSS values are in accordance with Government Regulation No. 22 In 2021 in the Class II River Water Quality Standards section. The modeling results show that when the pH and TSS values at the point source range from 7.03-7.13 and the TSS ranges from 101-150 mg L-1, the pH and TSS values at the upstream, outfall and downstream monitoring points of the Serongga River are still in accordance with PP No. 22 of 2021. Simulation of the pH (6-9) and TSS (101-200 mg L-1) model scenario at pointsource shows that the pH and TSS values at the upstream, outfall and downstream monitoring points of the Serongga River are still within the quality standards in accordance with PP No.22 of

2021 in the Class II River Water Quality Standards section.

***Keywords:*** *Simulation Modeling, pH, TSS, Qual2kw*

## INTRODUCTION

Coal mining activities in Indonesia are generally or usually carried out using an open pit mining system (Open Pit Mining). This system causes negative impacts on the environment, such as significant environmental damage. The impacts of this environmental damage include loss of forest vegetation, loss of animals and plants (flora and fauna), as well as damage and loss of soil layers around coal mining areas. Once the source of mining minerals is exhausted, it will be impossible to restore or restore its original condition (Alim and Sitogasa, 2023).

Coal mining is a series of activities that include steps such as general investigation, exploration, feasibility studies, construction, mining stages, processing and screening, transportation and sales, as well as post-mining stages. Mining activities are a complicated and complex business, have high risks, are long-term, use high technology, require large capital, and are subject to regulations issued by various sectors. Another impact of coal mining is the transformation in natural topography. As a result of mining activities, large holes were formed which then turned into former mines similar to lakes. Waste water produced from coal washing will be channeled to processing ponds before finally reaching natural rivers (Suharto et al., 2017).

Problems that occur in coal mining, apart from the generation of acid mine water, are also the discharge of water runoff from open areas. Waste water must be managed to meet quality standards before being discharged into water bodies based on Ministry of the Environment Regulation No. 113 of 2003. Coal mining wastewater includes 4 (four) parameters, namely pH, TSS, Fe and Mn. Wastewater discharge generally comes from water from springs around the pit walls and rainwater runoff. Discharge affects the quality of waste water that will be discharged into the environment because it is related to acid mine drainage (Sitorus and Wahyudin, 2022).

Handling acid mine drainage is something that needs to be done during mining activities and after mining activities end (Ferdian, 2020). Based on previous research, knowing the characteristics of acid mine drainage can make the process of handling acid mine drainage easier (Kiswanto et al., 2018). So a study is needed on the effective handling of acid mine drainage. Planned and systematic acid mine water treatment will produce waste water quality that is safe for the environment (Anshariah, 2016). Management of waste water or acid mine water needs to be carried out before the water is disposed of or flowed into water bodies. The water that is disposed of by water bodies must be in a neutral condition or you could say that it has a pH above 6. So that it does not pollute the waters around the location. mines, so that local communities can still use water that comes from waters/water bodies/rivers. Management of acid mine water can be done by neutralizing the pH and purifying the water. Mine wastewater treatment aims to avoid the impact of acidic rock water on the quality of nearby surface water bodies as well as on soil quality. Surface water from various locations of coal mining and processing activities is channeled to a control system in the form of a settling pond for processing and monitoring before being released into water bodies (Syadza, 2022).

PT. Baramega Citra Mulia Persada is a coal mining company that carries out exploitation activities in the Kelumpang Hilir District, Kotabaru Regency, South Kalimantan Province with a Mining Business License (IUP) for Production Operations based on the Decree of the Regent of Kotabaru Number 545/06/IUPOP/D.PE/2010 since February 15 2010 regarding Approval of adjustments and merger of Mining Business Licenses for

Production operations to PT. Baramega Citra Mulia Persada covers an area of 4,341.1 hectares. PT. Baramega Citra Mulia Persada carries out coal mining activities using an open mining system. PT. BCMP always manages and monitors the results of acid mine drainage before discharging the waste water into the Serongga River.

PT. BCMP is committed to always managing and monitoring waste water before it flows into river bodies. PT. BCMP collaborates with SUCOFINDO in implementing the installation of the SPARING tool (Continuous and Network Wastewater Quality Monitoring System). Installation of this equipment is a form of the Company's commitment to maintaining water quality in accordance with established quality standards, namely based on Governor Regulation No. 36 of 2008 on Waste Water Quality Standards and Government Regulation No. 22 of 2021 concerning the Implementation of Environmental Protection and Management in particular for Class II River Water Quality Standards.

Various land use activities in river water areas, such as coal mining activities, are thought to have affected river water quality. Based on the description above, it is necessary to analyze the quality and status of river water around coal mining activities in an effort to control water pollution. River water sampling can describe river water quality more accurately but requires a long time and high costs. So river modeling is carried out with the aim of minimizing observation costs and time. The appropriate modeling to simplify river water quality conditions is the Qual2kw model. The Qual2kw model is a modern model that can simulate and simplify river water quality conditions presented in graphical form. Another supporting aspect in choosing modeling using the Qual2kw method is because Qual2kw has validation values that are good enough to represent river water quality (Rahmi, 2022).

The method that can be used to determine river water quality modeling according to the Decree of the Minister of Environment Number 110 of 2003 is the computational method. Computational methods are simulation methods with the help of computer programs, such as the Qual2Kw model. The Qual2Kw model is very efficient and able to model river water quality from upstream to downstream. In addition, the Qual2Kw model can stimulate the transport and presence of pollutants in waters. This model simulates a river in one dimension with non-uniform, steady flow and presents a river based on the impact of two sources, namely point sources and non-point sources. The Qual2Kw model can stimulate the parameters pH, alkalinity, inorganic suspended solids, pathogenic bacteria, algae, temperature, fast reacting CBOD, slow reacting CBOD, Dissolved Oxygen (DO), phytoplankton, organic and inorganic phosphorus, organic nitrogen, NH4-Nitrogen, NH3+ Nitrogen, conductivity, pathogenic bacteria and alkalinity (Indriani et al., 2016).

pH is one of the parameters whose concentration must be paid attention to and must be ≥ 6 and below 9. An increase in pH in water will reduce the solubility of metals in water, because an increase in pH changes the stability of the carbonate form to hydroxide which forms bonds with particles in the water so that it will precipitate to form mud. pH can affect the content of chemical elements or compounds found in waters, including influencing the content of heavy metals in waters such as Fe, Mn, Cd and Pb. The toxicity of heavy metals is also influenced by changes in pH, the toxicity of heavy metals will increase if there is a decrease in pH (Sukoasih and Widiyanto, 2017). Apart from pH, TSS is a parameter that must be met by quality standards. According to Governor Regulation No.36 of 2008, the TSS quality standard must be below 200 mg L-1, while in Government Regulation No.22 of 2021 for water bodies/rivers the TSS value is ≥ 50 mg L-1. High TSS concentrations will reduce water quality. Physical changes include the addition of organic and inorganic materials

to waters, creating turbidity and preventing sunlight from penetrating into water bodies. The photosynthesis process carried out by phytoplankton and other aquatic plants will be influenced by a decrease in sunlight penetration (Rinawati et al., 2016).
Based on the above and based on the needs of PT. Baramega Citra Mulia Persada, the author is interested in carrying out this research activity by creating pH and TSS simulations using Qual2Kw so that the company can find out what the pH and TSS concentrations are before channeling the acid mine water treatment results into the Serongga River.

## MATERIALS & METHODS

### Time and Place of Research

This research was carried out at PT BCMP located in Kelumpang Hilir District, Kotabaru Regency, South Kalimantan Province. This research was carried out from June 2023 to April 2024

### Method of Collecting Data

1. Observation
2. Laboratory Analysis

### Sample Determination Methods

Sampling in this study used purposive sampling technique. Purposive sampling is a technique for determining samples with certain considerations. In this study, the things considered in determining the sampling point were the accessibility of the location and the safety of researchers when taking samples.

### Data Analysis

The results of the pH and TSS analysis in the laboratory were then modeled using the QUAL2KW application, then the model formed was calibrated and validated using the RMSE method. Root Mean Square Error (RMSE). RMSE is one of the equations that can be used to calculate the model error value. RMSE can be calculated using the following equation:

$$RMSE = \left(\frac{\sum(y_i - y^{\wedge}{}_i)^2}{n}\right)^{1/2}$$

RMSE = Root Mean Square Error
Yi = Laboratory test result value
y^I = Modeling result value
i = Sequence of data in the database
n = number of data

After validating the model using RMSE. Next, a model simulation is carried out with the aim of getting a picture of the object in accordance with several conditions. In this research, a scenario was carried out with numbers not exceeding the quality standards contained in the regulations of the Governor of South Kalimantan for water that will be released into the river so that it is accepted by the River Class 2 classification (South Kalimantan Government Regulation No. 22 of 2021).

## RESULT AND DISCUSSION

### Results of laboratory analysis of pH and TSS

**Table 1. Results of laboratory analysis of pH and TSS**

| Tgl Pengambilan Sampel | Hulu | | Outfall | | Hilir | |
|---|---|---|---|---|---|---|
| | pH | TSS | pH | TSS | pH | TSS |
| May 05 2023 | 7,2 | 2,7 | 8 | 2,3 | 7,1 | 2,8 |
| June 12 2023 | 7 | 16 | 6,2 | 6,6 | 6,6 | 21 |
| June 15 2023 | 7 | 17 | 6,9 | 7,1 | 7,1 | 21,6 |
| June 21 2023 | 6,8 | 16,3 | 7,7 | 7 | 7 | 20,8 |

Samples were taken and analyzed at the Environmental Laboratory of the Tanah Bumbu Regency Environmental Service and the results of the pH and TSS tests were known. PT. BCMP also uses a network-based pointsource monitoring system usually called SPARING which was installed by Sucofindo. This sparing is to make it easier to monitor waste water remotely. In the results of measurements at the laboratory, the pH and TSS value of the point source on May 5 2023 was 7.07 and the TSS was 104.70 mg $L^{-1}$, however at this time the point source was not being supplied to water bodies (Appendix 1 No. 1). On June 12 2023 the results of pH and TSS monitoring via SPARING were 7.13 and 101 mg $L^{-1}$ (Appendix 1 No 2). On June 15 2023, the SPARING monitoring results showed that the pH value was 7.09 and TSS was 100.50 mg $L^{-1}$ (Appendix 1 No 3). Monitoring via SPARING on June 21 2023 showed that the pH value was 7.07 and TSS was 100.20 mg $L^{-1}$ (Appendix 1 No 4).

Pointsource is a source of pollution originating from certain points along the receiving water body (river). The source of this pollution can be clearly identified by the location of the source. The source of this pollution mainly comes from liquid waste disposal pipes from industries that do not process their waste. Apart from that, this pollution also comes from effluents resulting from waste processing at IPAL (Waste Water Treatment Plant) which do not meet the specified waste water quality standards (Syahril, 2016).

The results of laboratory analysis show that on May 5 2024 the pH value at the upstream point was 7.2, the outfall point was 8 and at the downstream point was 7.1. The results of the TSS analysis show a relatively low number because on that date there was no pointsource flow. The TSS value at the upstream point is 2.7 mg L-1, at the outfall point it is 2.3 mg L-1, and at the downstream point it is 2.8 mg L-1.

On June 12 2023, June 15 2023 and June 21 2023 pointsource flows occurred so that there was an increase in the TSS value at each sampling point. On June 12 2023, the pH value at the upstream point was 7, then at the outfall point it was 6.2 and at the downstream point it was 6.8, while the TSS value at the upstream point was 16 mg $L^{-1}$, the outfall point was 6.6 mg $L^{-1}$ and the downstream point is 21 mg $L^{-1}$. On June 15 2023 the pH value at the upstream point was 7, the outfall point was 6.9 and the downstream point was 7.1, while the TSS value at each point was 17 mg $L^{-1}$, at the outfall point was 7.1 mg $L^{-1}$ and at downstream points of 21.6 mg $L^{-1}$. On June 21 2023, the pH value at the upstream point of the Serongga River was 6.8, the outfall was 7.7 and downstream of the Serongga River was 7. Meanwhile, the TSS concentration at the upstream point of the Serongga River was 16.3 mg $L^{-1}$, at the outfall point of 7 mg $L^{-1}$ and at the lower point of the Serongga River the TSS is 20.8 mg $L^{-1}$.

River water has its own qualities and characteristics. This is influenced by the quantity and quality of pollutants that enter river water. Kalimas River river water quality is obtained from primary data and secondary data. Primary data was obtained from sampling results from 3 (three) points in the field, namely the Upper Serongga River, Outfall and Lower Serongga River. At each point, river water was taken using a bucket, then put into a 330 ml bottle and then stored in a cooling box and then taken to the Environmental Laboratory of the Tanah Bumbu Regency Environmental Service. The function of the cooling box is to maintain the temperature of the sample water to remain stable (Adani et al., 2013). The samples that have been taken are then analyzed according to the observation parameters, namely pH and TSS.

**pH and TSS modeling results**

pH modeling is carried out according to the results of pH and TSS measurements in the field which are then analyzed in the laboratory. The following are the results of pH and TSS modeling carried out using the Qual2Kw application.

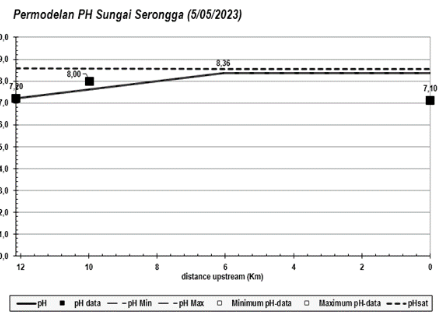


**Figure 1. Results of pH modeling for Serongga River monitoring points on 05 May 2023**

On May 5 2023, there was no flow from the point source to the river body, so it is known that the pH measurement in the laboratory at the upstream point of the Sengga River was

7.2 and in the modeling the pH value was the same, namely 7.2. The Serongga River outfall point can be seen in the above figure, that the pH value in the laboratory test results is 8, while in the modeling results it is 8.35. At the downstream point of the Serongaga River, it can be seen that the pH value in the laboratory analysis results is 7.1 and the modeling results it is 8.35. From the results of this modeling, it is known that the pH quality standard, both in the laboratory analysis results and in the modeling results, is still below the established quality standard.

The results of this modeling were then validated using the RMSE method and obtained a result of 0.749. This value is below 10 and almost close to 0 so that the modeling created is very close to the actual value in the field. This is in accordance with the statement of Abba et al., (2017) which states that the results of a small RMSE value indicate the accuracy of the method for estimating the error rate in measurements.

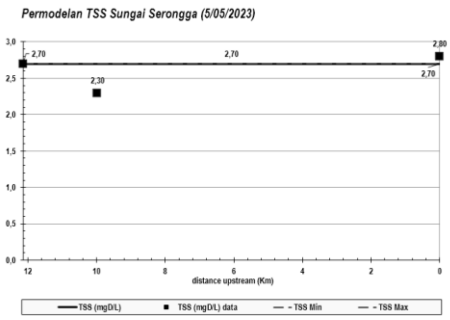


**Figure 2. Results of TSS modeling for Serongga River monitoring points on 05 May 2023**

The results of TSS analysis in the laboratory show that the TSS value at the upstream point of the Serongga River when the pintsource is not flowing into the river body is 2.7 mg $L^{-1}$. In the modeling results, the TSS value has the same value, namely 2.7 mg $L^{-1}$. At the Serongga River outfall point, the TSS value from laboratory analysis is 2.3 mg $L^{-1}$, while in modeling the value is 2.7 mg $L^{-1}$. Meanwhile, at the downstream point of the Serongga River, the TSS value is 2.8 mg $L^{-1}$ and in the modeling results the TSS value is 2.7 mg $L^{-1}$. The modeling results show the same numbers at the three monitoring points, this is because there is no pointsource flow occurring.

The results of the RMSE validation carried out show that the determination value is 0.24. The RMSE value shows that the number is below 10 and close to 0, so we know that this model can show the actual situation in the field.

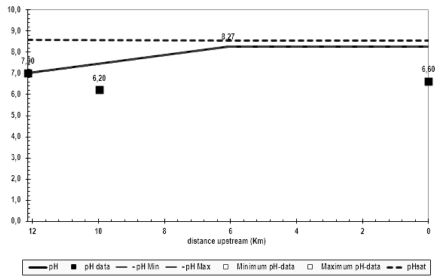


**Figure 3. Results of pH modeling for Serongga River monitoring points on 12 June 2023**

On June 12 2023, the results of laboratory analysis of the pH value at the Serongga River upstream monitoring point were 7 and the modeling results the value was the same, namely 7. The Serongga River outfall monitoring point showed that the pH analysis results were 6.2, while the modeling results were 6.2. 8.26. The pH value at the downstream monitoring point of the Serongga River is 6.6 and in the modeling results it is 8.26.

The results of the RMSE validation of the modeling show a determination number of 1.527. This figure is still below 10 so the modeling made is still close to the existing value in the field.

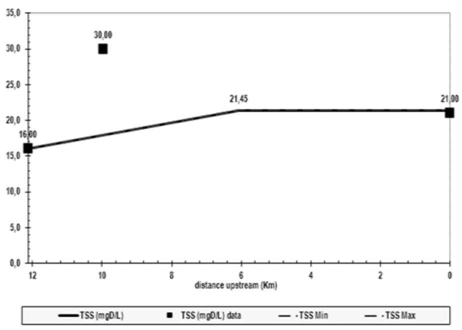


**Figure 4. Results of TSS modeling for Serongga River monitoring points on June 12 2023**

Figure above shows a comparison of TSS values at each monitoring point in the Serongga River based on the results of laboratory analysis and based on modeling results using the Qual2Kw application. Based on the results of laboratory analysis, it can be seen that the TSS value at the upstream monitoring point of the Serongga River is 16 mg $L^{-1}$ and in the modeling results the TSS value is the same, namely 16 mg $L^{-1}$. At the Serongga River outfall monitoring point, it can be seen that the TSS value is 30 mg $L^{-1}$ and in the modeling results it is 21.45 mg $L^{-1}$. The third monitoring point, namely downstream of the Serongga River, shows that the TSS analysis results are 21 mg $L^{-1}$, while the modeling results are 21.45 mg $L^{-1}$.

The modeling results were then validated using the RMSE method and showed that the determination value was 4.94. This value is still below 10 so that the TSS modeling created can be said to be almost close to existing conditions in the field.

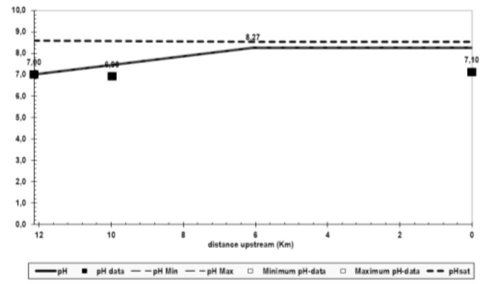


**Figure 5. Results of pH modeling for Serongga River monitoring points on 15 June 2023**

The results of the pH analysis at the monitoring point upstream of the Serongga River were 7, while the modeling results showed that the pH value was the same as the laboratory analysis results, namely 7. At the outfall monitoring point, the pH value from the laboratory analysis was 6.9, while in the modeling results the pH value was 8.26. The downstream monitoring point of the Serongga River has a pH value of 7.1 based on laboratory analysis results, while the pH value in the modeling results is 8.26. The difference between the pH value from laboratory analysis and the pH value in the modeling results is an error factor in modeling so that the model created needs to be validated using the RMSE method. Based on model validation using the RMSE method, the results showed that the determinant value was 1.032, which is still below 10, so the model can still be used as a reference in determining that the river is still able to accommodate the pollution load from the PT point source. BCMP.

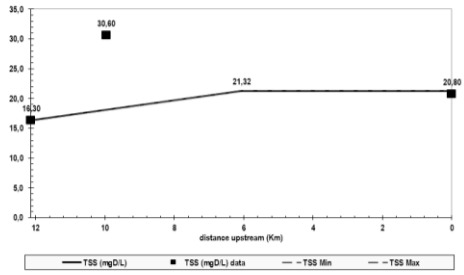


**Figure 6. Results of TSS modeling for Serongga River monitoring points on June 15 2023**

In the TSS parameters measured on June 15 2023, the results showed that based on laboratory analysis the TSS value at the monitoring point upstream of the Sengga River was 17 mg $L^{-1}$, while in the modeling results the TSS value was the same, namely 17 mg $L^{-1}$. Laboratory analysis at the outfall monitoring point was 34.5 mg $L^{-1}$ while in modeling it was 21.99 mg $L^{-1}$. At the downstream monitoring point of the Serong River, the TSS value is 21.6 mg $L^{-1}$, while in the modeling results the value is 21.99 mg $L^{-1}$. The TSS value modeled using the Qual2Kw application has a value that is still below Class 2 river water quality standards so it can be said that the river is still able to accommodate the pollution load from the point source of PT. BCMP

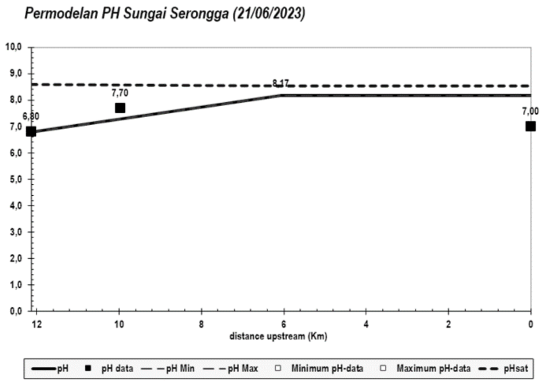


**Figure 7. Results of pH Modelling for Serongga River monitoring points on 21 June 2023**

Laboratory analysis was carried out on all samples taken at the Serongga River monitoring point. On June 21 2023, the results of laboratory analysis and modeling results at the upstream monitoring point of the Serongga River showed the same pH concentration, namely 6.8. At the outfall monitoring point, the pH value based on laboratory analysis results was 7.7, while in modeling results the value was 8.16. The pH analysis at the downstream monitoring point of the Serongga River is 7, while the modeling results show a value of 8.16. The RMSE validation results show that the determination value of the modeling created is 0.72. This shows that the modeling results have a value below 10 and almost close to 0, so this model has a good level of accuracy and can be used as a basis for assessing the river's ability to accommodate pollution loads from the point source PT. BCMP.

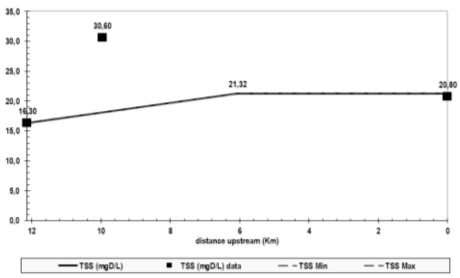


**Figure 8. Results of TSS modeling for Serongga River monitoring points on June 21 2023**

The results of the analysis in the figure above show that the TSS concentration at the monitoring point upstream of the Serongga River is the same as the modeling results made, namely 16.3 mg $L^{-1}$. The TSS concentration at the Serongga River outfall monitoring point is 30.6 mg $L^{-1}$, whereas in the modeling results it is 21.32 mg $L^{-1}$. At the downstream monitoring point of the Serongga River, the TSS concentration analysis results were 20.8 mg $L^{-1}$, while the TSS concentration modeling results were 21.32 mg $L^{-1}$. The modeling results were then validated using the RMSE method resulting in a determination value of 5.36. This value is still below 10 so that in modeling it can be said that the smaller the value produced, the better the forecasting results will be (Cholis et al., 2019).

Modeling of Serongga River monitoring points using Qual2Kw shows varying model validation for each research sample. On May 5 2023, the RMSE pH value was 0.749 and the RMSE TSS was 0.238. This model met the requirements to be used as a scenario model simulation because the RMSE pH and TSS values were < 10 and close to 0. However, this model could not be used because on that day there is no flow from pointsource from PT. BCMP. On June 12 2023, a pointsource flow occurred with a pH value of 7.13 and a TSS of 101 mg $L^{-1}$, so that the model created had an RMSE pH value of 1.527 and a TSS RMSE of 4.843. On June 15 2023 the pH value at the pointsource was 7.06 while the TSS value was 100.50 mg $L^{-1}$. On June 21 2023, the RMSE pH value was 0.72, while the RMSE TSS was 5.36 with a pointsource flow pH of 7.07 and TSS of 100.20 mg $L^{-1}$. This RMSE method is a model selection tool based on the error in the estimation results. The error shows how big the difference between the estimation results is and the value to be estimated. This value will be used to determine which model is the best and can be used to simulate scenario models (Putri et al., 2020). In this research, it is known that the sampling date of June 12 2023 was used to simulate the scenario model because the RMSE pH and TSS values were below 10.

## Results of Simulation Model Scenarios for pH and TSS of the Serongga River

Sampling was carried out 4 (four) times at the same sampling point on different collection dates, namely May 5, June 12, June 15 and June 21 2024. All collection dates were modeled and then calibrated using RMSE. The calibration results show that the sample with RMSE was below 10, namely June 12 2024 and then this data was used as a basis for creating pH and TSS modeling simulations at predetermined sampling points on the Serongga River. This modeling was created by simulating the pH at the point source in accordance with the minimum and maximum quality standards that can be released into river bodies, namely 6-9. Based on the modeling simulation results, it is known that when the pointsource pH is 6, the pH value in the waters is 8.17, then when the pointsource pH is 7, the pH in the Serongga River is 8.27, when the pointsource pH is 8, the pH in the river Serongga is 8.28 and when the pointsource pH simulation is 9, the pH in the Serongga River is 8.79.

A comparison of the pH of laboratory analysis results with the Serongga River Upstream, outfall and Downstream Serongga River points can be seen in figure. The pH concentration at the Upstream point of the Serongga River as a result of laboratory analysis is 7, the same as the pH modeling simulation results of 6-9. At the outfall point, the laboratory analysis results are 6.2, while in the pointsource pH model simulation results of 6, 7, 8, and 9, the respective pH values are 6.25, 8.26, 8.37, 8, respectively. 29. At the downstream point of the Seronga River, the pH value from laboratory analysis is 6.6 and when the pH at the point source is simulated at 6, 7, 8, and 9, the pH modeling results in the Seronga River are 6.25, 8.26, respectively. 8.27 and 8.28.

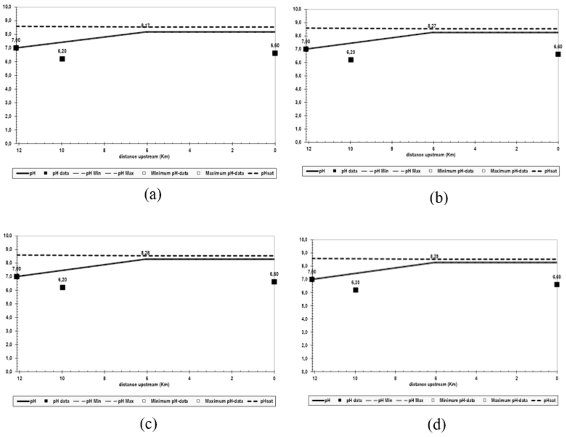

**Figure 9. (a) pH 6 simulation, (b) pH 7 simulation, (c) pH 8 simulation, (d) pH 9 simulation**

**Table 2. Comparison of pH Values from Laboratory Analysis Results, Simulation Results and Class 2 River Water Quality Standards**

| No | Titik Pantau | Hasil Pengujian (LHU) | pH 6 | pH 7 | pH 8 | pH 9 | Ba Mu |
|---|---|---|---|---|---|---|---|
| 1 | Hulu Sungai Serongga | 7 | 7 | 7 | 7 | 7 | 6- |
| 2 | Pantau Outfall | 6,2 | 6,25 | 8,26 | 8,27 | 8,28 | 6- |
| 3 | Hilir Sungai Serongga | 6,6 | 6,25 | 8,26 | 8,27 | 8,28 | 6- |

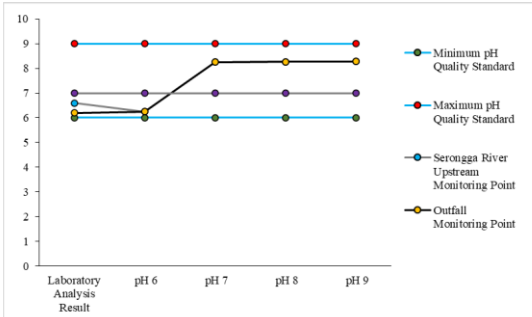


**Figure 10. Comparison of pH Values at Sampling Points with Class II Water Quality Standards**

The pH value at each sampling point is still below the Class 2 river water quality standards. At the Upstream point of the Serongga River, the pH values at sampling on 05 May, 12 June, 15 June and 21 June 2024 showed that the pH concentration was 7.2 7, 7 and 6.8 respectively. At the outfall sampling point the pH values on each sampling date were 8, 6.2, 6.9 and 7.7 and at the downstream point of the Serongga River, respectively 7.1, 6.6, 7.1 and 7. A good pH concentration is a pH level that still allows biological life in the water to run well. A good pH for wastewater is neutral pH, namely 7 (Ramadhani, 2016).

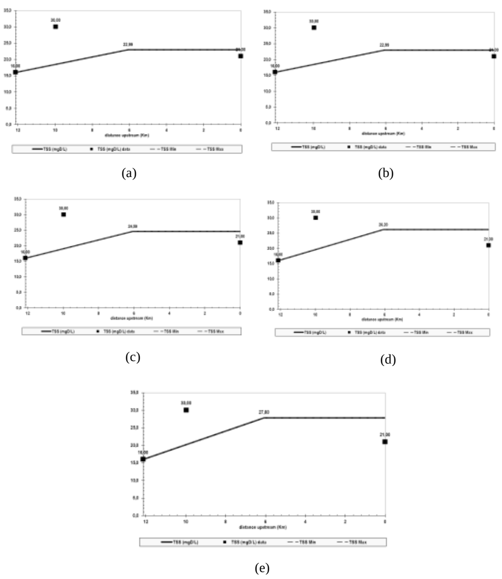

**Figure 11. (a) TSS 101 Simulation, (b) TSS 125 Simulation, (c) TSS 150 Simulation, (d) TSS 175 Simulation dan (d) TSS 200 Simulation**

Similar to the pH concentration, the TSS concentration at the three observation points is also below the Class 2 river water quality standards. The results of TSS measurements in the laboratory at the upstream point of the Serongga River were 16 mg $L^{-1}$, at the outfall point it was 30 mg $L^{-1}$ and at the downstream point of the Serongga River it was 20 mg $L^{-1}$. TSS simulation on pointsource starts from simulating TSS to 101 mg $L^{-1}$, 125 mg $L^{-1}$, 150 mg $L^{-1}$, 175 mg $L^{-1}$ and 200 mg $L^{-1}$. In the TSS simulation of 101 mg $L^{-1}$ to the TSS simulation of 200 mg $L^{-1}$ at the point source, the TSS value at the Upstream point of the Serongga River is 16 mg $L^{-1}$. At the outfall point with simulated TSS of 101 mg $L^{-1}$ and 125 mg $L^{-1}$ the TSS concentration is 22.9 mg $L^{-1}$, when the TSS is 150 mg $L^{-1}$ the TSS in the outfall is 24.59 mg $L^{-1}$, TSS pointsource 175 mg $L^{-1}$, the modeling result is 26.20 mg $L^{-1}$, and modeling TSS 200 mg $L^{-1}$ at pointsource, the TSS value in the outfall is 27.80 mg $L^{-1}$. At the downstream monitoring point of the Serongga River, if the pointsource simulation TSS value is 101 and 125 mg $L^{-1}$, then at the downstream monitoring point of the Serongga River the TSS value is 22.9 mg $L^{-1}$, when the TSS simulation is 150 mg $L^{-1}$, the TSS is downstream of the Serongga River is 24.59 mg $L^{-1}$, when the TSS at the point source is 175 mg $L^{-1}$, the TSS at the downstream point of the Serongga River is 26.20 mg $L^{-1}$, and when the TSS at the point source is 200 mg $L^{-1}$, then the TSS at the Lower Serongga River monitoring point is 27.80 mg $L^{-1}$. The TSS concentration at each observation point, based on the results of laboratory analysis, is below the Class 2 river water quality standard and from the modeling results that have been carried out, the TSS concentration results also show the value is below the Class 2 river water quality standard.

If there is an increase in TSS in the waters, it will increase the level of turbidity which in turn inhibits the penetration of sunlight into the water column. The lack of intensity of sunlight entering the waters due to the high TSS that occurs will inhibit the growth of phytoplankton. These suspended solids can also have a negative impact on aquatic ecosystems, fishermen's catches and other potentials such as fisheries cultivation activities (Winnarsih et al., 2016). Apart from that, (Rizka et al., 2020) also stated that high TSS concentrations tend to cause high sedimentation. The effect of TSS on waters causes light entering the waters to be blocked, which can reduce photosynthetic activity in living creatures in the waters.

## CONCLUSION

Based on the results of laboratory analysis and Qual2Kw modeling of pH and TSS parameters, the conclusions of this research are as follows:

1. 1) The results of laboratory analysis of pH and TSS show that the concentration at the point source is in accordance with Governor's Regulation No. 36 of 2008 concerning Waste Water Quality Standards, and at the upstream, outfall and downstream monitoring points of the Serongga River, the pH and TSS values are in accordance with Government Regulation No. 22 of 2021

in the Class II River Water Quality Standards section.

2. The modeling results show that when the pH and TSS values at the point source range from 7.03-7.13 and the TSS ranges from 101-150 mg L-1, the pH and TSS values at the upstream, outfall and downstream monitoring points of the Serongga River are still in accordance with the PP. No.22 of 2021.
3. Simulation of the pH and TSS scenario model at the point source in accordance with the range of values in Governor Regulation No.36 of 2008 shows that the pH and TSS values at the upstream, outfall and downstream monitoring points of the Serongga River are still within the quality standards in accordance with PP No.22 of 2021.

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