# Water Level Fluctuation Analysis in Segment 3 Jakabaring Sport City Channels, Palembang, Indonesia

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# *Water Level Fluctuation Analysis in Segment 3 Jakabaring Sport City Channels, Palembang, Indonesia*

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***Abstract*— Based on the division of river areas in the city of Palembang, there are 21 sub-watersheds, but only 18 sub-watersheds that lead directly to the Musi river, namely the Rengas Lacak, Gandus, Lambidaro, Boang, Sekanak, Bendung, Lawang Kidul, Buah, Juaro, Batang sub-watersheds. , Sei Lively, Keramasan, Kertapati, Kedukan Ulu, Aur, Sriguna, Jakabaring and Plaju.**
**This research was conducted to obtain a movement pattern at the station under review, namely the main channel of Jakabaring Sport City (JSC) using the HEC-RAS ver 4.1.0 program with rainfall data for a 5-year return period ($R_5$) and $Q_5$ flood discharge of 40.87 $m^3$/sec.**
**The results showed that the pattern of water flow movement in the main channel of JSC segment 3, especially in the return period of 5 years of rain at Sta. 0 + 000 (P14) there is an overflow as high as 1.50 m both in the return period ($R_2$, $R_5$, $R_{10}$, $R_{20}$ and $R_{50}$). Meanwhile, over flow height for Sta. 0 + 100 - Sta. 0 + 500 or channel P15-P19 ranges from 0.50 m to 1.00 m and at Sta. 0 + 600 or $P_{20}$ with a return period of $R_2$, $R_5$, $R_{10}$, R20 and $R_{50}$ there is no overflow.**

***Keywords*—The JSC channel; Flood discharge; IDF curve; HEC-RAS program; Water level fluctuation**

## I. INTRODUCTION

The physiographic area of the city of Palembang is located in a low-lying area in the form of floods plains and is included in an area that has the potential as a place for waterlogging. The potential for waterlogging is a factor that needs to be considered for most areas of the city of Palembang. The city of Palembang is located in the lowlands with an altitude between +2 m to +4 m above sea level (asl). as the capital city of the province of south sumatera, is located at a position of 104' 37 – 104' 52' east and 2' 52'- 3' 05 latitude which is currently developing rapidly, but in the midst of this development the city of Palembang is still plagued with flooding problems. . The current phenomenon of flooding does not only occur during the rainy season but when it rains with a duration of 3 hours it can cause flooding. Efforts in the form of maintaining city drainage channels, improving rivers that cross the city continue to be carried out, construction of flood control facilities and several rules have been issued for flood control. These efforts turned out to be outpaced by the development of the city.

The condition of the geography of Palembang city is a relatively at, so at certain locations it often experiences puddles (floods) caused by the flow of rainwater (run-off) which cannot be accommodated by the channel. In addition, at certain locations, puddles (floods) are also caused by the runoff of the Musi River. Floods that occurred in the city of Palembang caused problems for the Government to evaluate the existing drainage channels. The rainwater drainage channels have been built but need to be reviewed and evaluated to function properly. (Achmad Syarifudin, 2022).

The city of Palembang is divided into 19 sub-watersheds with drainage systems which include: Gandus, Gasing, Lambidaro, Borang, Sekanak, Bendung, Lawang Kidul, Buah, Juaro, Batang, S. Lincah, Borang, Nyiur, Sriguna, Aur, Kedukan, Jaka Baring, Kertapati and Keramasan. Flood-prone areas that have been recorded are in the Sekanak, Sriguna, Buah, Lawang Kidul, Lambidaro, Gandus, Jakabaring, Aur, and Kedukan sub-watersheds where there are several inundation locations that are community priorities. (Department of Pubic Works and Housing of Palembang city, 2018; Achmad Syarifudin, 2022).

The complexity of the river system can be seen from the various components of the river, for example the shape of the river flow and branching, river bed form, river morphology, and river ecosystem. The river branch will resemble a river tree starting from the first order to the nth order river. The river bed formation, when examined at a glance, is very difficult to identify and characterize. The shape of the meander groove is influenced by the longitudinal slope of the landscape, the type of river bed material, and the vegetation in the area (Maryono, 2007; Achmad Syarifudin, 2022).

One channel that has an important role in the city of Palembang is the Jakabaring Sport City (JSC) Main River which is located in a built area. In recent years, the Main river Jakabaring Sport City (JSC) is no longer able to accommodate the capacity (discharge) of water flow during the rainy season, not to mention a lot of water hyacinth in the channel. (Achmad Syarifudin, 2018)

Various efforts have been made, but these efforts have not been optimal in overcoming the problem of puddles (floods). These efforts are in the form of maintaining city drainage channels, cleaning river channels that cross the city. Likewise, studies related to flood control in urban areas, construction of flood control facilities have been made and several policies and regulations have been issued for flood control. These efforts turned out to be outpaced by the development of the city. (Achmad Syarifudin, 2018)

## II. Research Methods

### A. *Materials and tools*

Rainfall data as secondary data were analyzed statistically in the form of rainfall analysis using the norm, log-normal, log-pearson type 3 and gumbel method approaches. Based on a certain return period includes a return period of 2 years, 5 years, and 10 years, after that the rainfall intensity is calculated for the first time the concentration time is calculated. Then the rainfall intensity intensity (IDF) curve is made and calculate the planned discharge for each certain return period.
HEC-RAS software program ver. 4.1.0 is used to predict the overflow of water in the channel/river at each cross-sectional station based on the results of the topographic survey.

### B. *Research methods*

This research was conducted for the first time using empirical methods, including hydrological analysis and hydraulics analysis, then simulation was carried out using the HEC-RAS program. Hydrological analysis to determine the design rain with a certain return period and get an overview of the IDF (Intensity Duration Curve) curve as well as channel hydraulics analysis to calculate flood discharge and then a simulation is carried out with the help of the HEC-RAS 4.1.0 software program. (Baitullah, 2016).

In the hydraulic analysis, the water level profile is calculated using some data on the design flood discharge and drainage channels in the Jakabaring Sport City (JSC) main channel to obtain a water level profile. In this analysis also used the application program HEC-RAS 4.1.0. After getting the direct runoff discharge, the calculation results are simulated on the existing channel using HEC-RAS 4.1.0.

### C. *Stages, Process and Data Analysis*

After the data is collected, it is processed as follows:

a) Rainfall analysis

Rainfall data analysis with frquency analysis, then the selection of frequency distribution with the normal distribution method, normal log, pearson type III log, and gumbel. Then the suitability test to determine the difference in discharge from the calculation results. Conformity test using chi-squared and rainfall intensity with smirnov-kolmogorov.

b) Design Flood Discharge Analysis

Calculating the design flood discharge using the rational equation method previously determined the intensity of rain, time of concentration and runoff.

c) Hydraulic Analysis

This analysis is carried out by calculating the planned flood discharge using the rational formula.

d) Numerical modeling

The HEC-RAS program version 4.1.0 (open source) is used for modeling the Jakabaring Sport City (JSC) Main Channel to determine the ability of the trough/channel body to accommodate flood discharge within a certain return period.

## III. Results and Discussion

The results of the calculation of the intensity of rain for each return period in a span of 10 minutes. So that IDF curves can be made with the help of Ms. Excel. The following is the shape of the IDF curve from the rain intensity data that has been obtained which is shown in Figure 1.

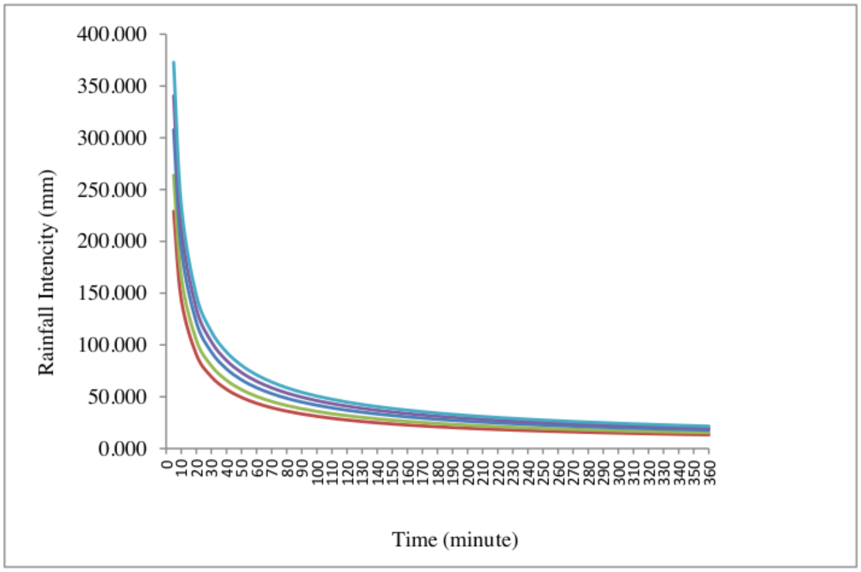


*Fig 1. IDF curve graph (Intensity Duration Frequency)*

*A. Jakabaring Sport City channel flow debit*

To calculate the runoff discharge (Run Off) using the Rational Formula. The results are as in table 1.

TABLE I. THE RESULTS OF THE CALUCULATION OF RUNOFF DISCHARGE

| **Return Period (Year)** | **C** | **I (mm/jam)** | **A (km²)** | **Q (m³/det)** |
|---|---|---|---|---|
| 2 | 0,8889 | 257,1460 | 5,58 | 35.47 |
| 5 | 0,8889 | 296,2446 | 5,58 | 40,87 |
| 10 | 0,8889 | 345,6414 | 5,58 | 47,69 |
| 20 | 0,8889 | 382,2866 | 5,58 | 52,74 |
| 50 | 0,8889 | 418,6661 | 5,58 | 57,76 |

*B. Simulation Results*

After inputting data in the HEC-RAS program, then running a test, the simulation results are obtained in the form of a graph of fluctuations in water level changes in each cross section of the channel.

The pattern of water flow movement in the JSC segment 3 main channel for the 5 year rain return period (PF2) can be seen as shown below:

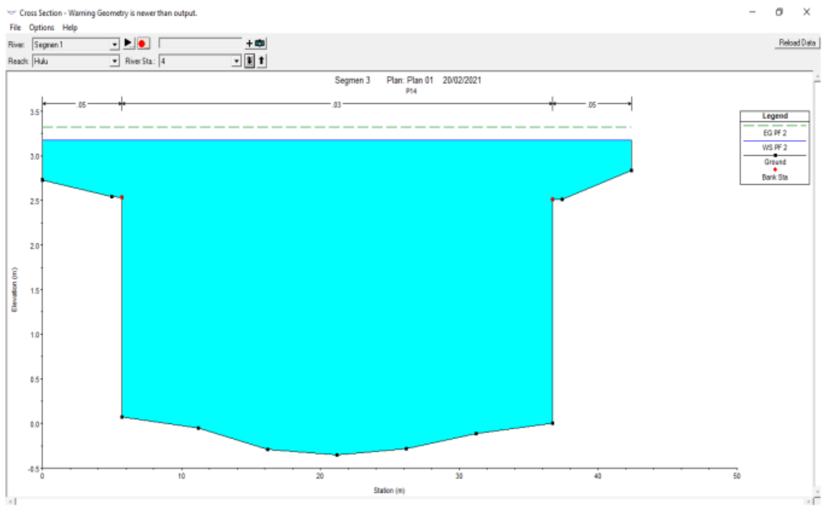


*Fig 2. Pattern of water flow movement in the main channel of JSC Sta. 0+000 (P14)*

In Figure 2. it can be seen that there is a decrease in the water level in the channel at Sta.0+000 (P14) of approximately 0.50 m, resulting in overflow (overflow).

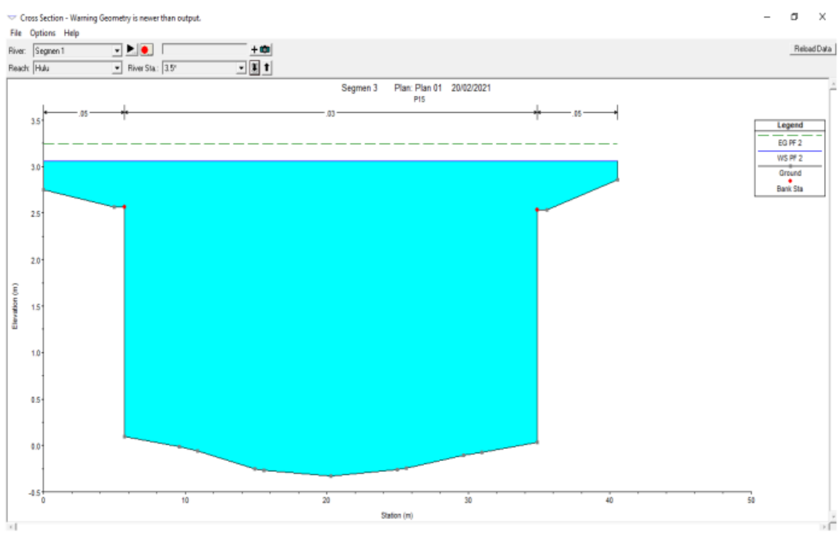


*Fig 3. Pattern of water flow movement in the main channel of JSC Sta. 0+100 (P15)*

In Figure 3. it can be seen that there is a decrease in the water level in the channel at Sta.0+100 (P15) of approximately 0.30 m, so that there is still overflow (overflow).

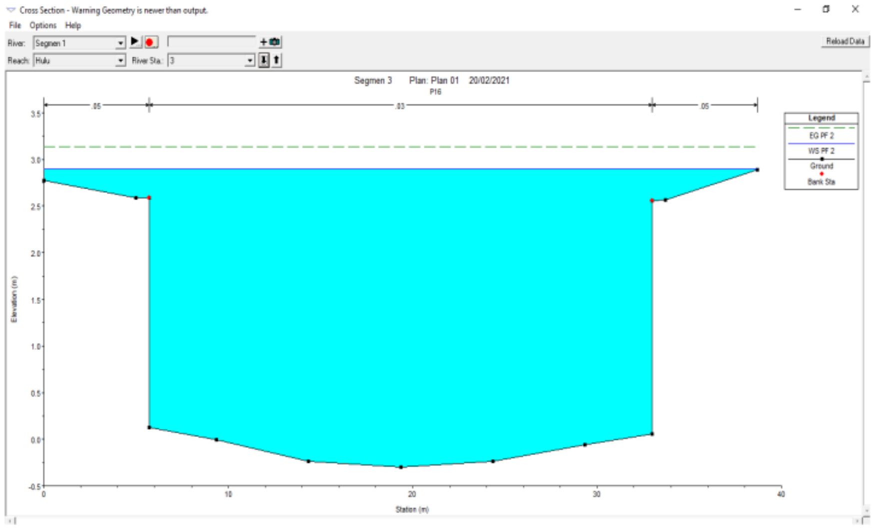


*Fig 4. Pattern of water flow movement in the main channel of JSC Sta. 0+200 (P16)*

In Figure 4. it can be seen that there is a decrease in the water level in the channel at Sta.0+200 (P16) of approximately 0.20 m, resulting in overflow (overflow).

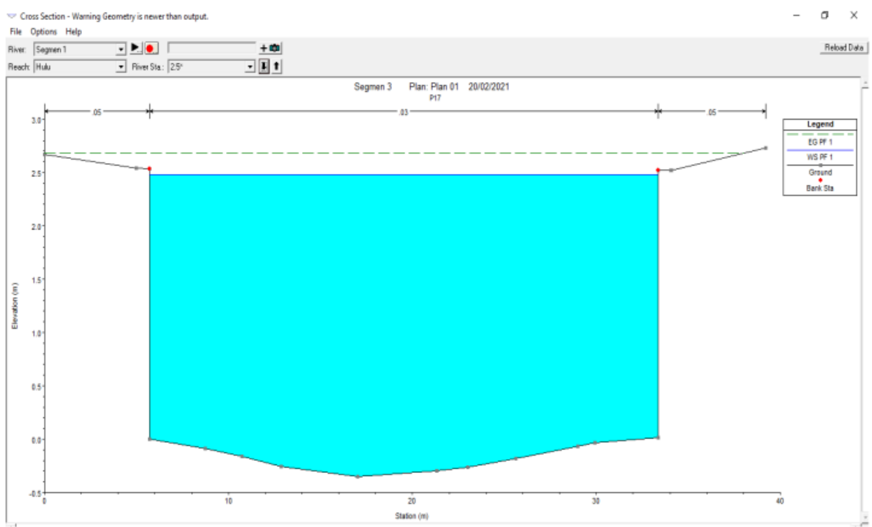


*Fig 5. Pattern of water flow movement in the main channel of JSC Sta. 0+300 (P17)*

In Figure 5. it can be seen that there is a decrease in the water level in the channel at Sta.0+300 (P17) of approximately 0.10 m, so there is no overflow (overflow).

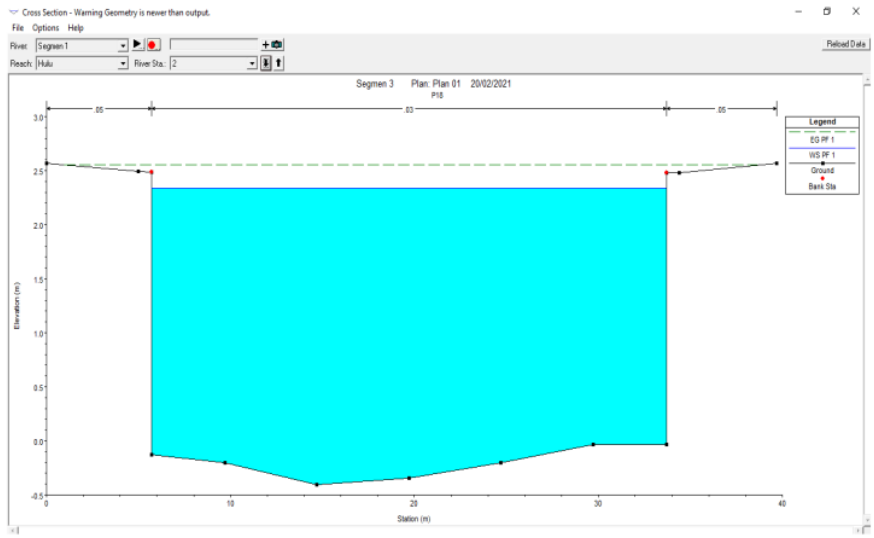


*Fig 6. Pattern of water flow movement in the main channel of JSC Sta. 0+400 (P18)*

In Figure 6. it can be seen that there is a decrease in the water level in the channel at Sta.0+400 (P18) of approximately 0.20 m, so there is no overflow (overflow) at this station.

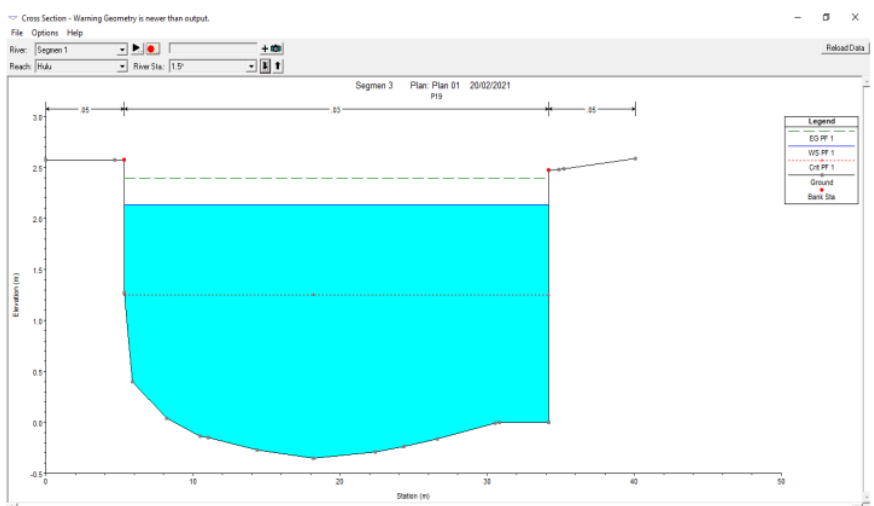


Fig 7. Pattern of water flow movement in the main channel of JSC Sta. 0+500 (P19)

In Figure 7. it can be seen that there is a decrease in the water level in the channel at Sta.0+500 (P19) of approximately 0.50 m, so that there is no overflow at this station.

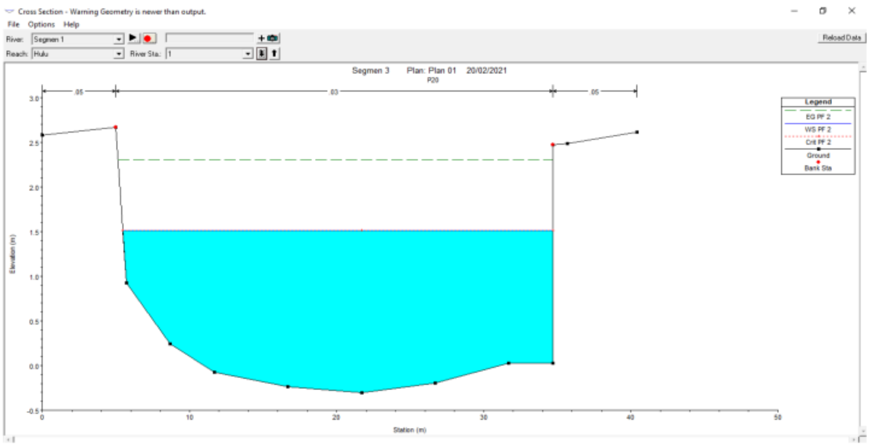


*Fig 8. Pattern of water flow movement in the main channel of JSC Sta. 0+600 (P20)*

In Figure 8. there is no further decrease in the water level in the channel at Sta.0+600 (P20), so there is no overflow (overflow) at this station.

## IV. Conclusion

The pattern of water flow movement in the JSC segment 3 main channel, especially in the 5 year return period of rain at Sta. 0+000 ($P_{14}$) there is an overflow of 1.50 m in both return periods ($R_2$, $R_5$, $R_{10}$, $R_{20}$ and $R_{50}$). While the high overflow (over flow) for Sta. 0+100 – Sta. 0+500 or channels $P_{15}$-$P_{19}$ ranging from 0.50 m to 1.00 m and at Sta. 0+600 or $P_{20}$ in both the $R_2$, $R_5$, $R_{10}$, $R_{20}$ and $R_{50}$ return periods, no overflow occurs.

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