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ANALYSIS CAPACITY OF SUNGAI TATAS AND SUNGAI BELASUNG IN BANJARMASIN CITY USING HEC-RAS SOFTWARE

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ABSTRACT

Tatas River and Belasung River, which have four sluice gates, have experienced a reduction in cross-sectional area and riverbed sedimentation. Therefore, an analysis of the river's cross-sectional capacity is necessary to assess the ability to accommodate the designed flood discharge. In this study, the analyses conducted include hydrological and hydraulic analysis. Hydrological analysis includes frequency analysis and plan flood discharge analysis. Hydraulic analysis uses 1D Unsteady Flow simulation in HEC-RAS software. Based on the research results, the design flood discharge values for return periods of 2, 5, 10, and 25 years are 1.63 m³/s, 2.05 m³/s, 2.35 m³/s, and 2.75 m³/s for the Tatas River, and 1.48 m³/s, 1.86 m³/s, 2.13 m³/s, and 2.49 m³/s for the Belasung River. The simulation results show that the cross-sectional capacity of the Tatas River and Belasung River is insufficient to accommodate the design discharge at all return periods.

Keywords: *Cross-sectional Capacity, Tatas River, Belasung River, HEC-RAS, Sluice Gate*

1. INTRODUCTION

The river has a significant role for the people of Banjarmasin City. High flood discharge and rising water levels will cause inundation and flooding around the river (Hamdani, 2021). The Tatas River and Belasung River surround the Masjid Raya Sabilal Muhtadin area, each having four sluice gates. These rivers have experienced a reduction in cross-sectional area and sedimentation (Alison et al., 2023). It has resulted in overflow. Overflow occurred, for instance, on January 2, 2025, with a rainfall of 22 mm in Banjarmasin City. Therefore, it is necessary to analyze the cross-sectional capacity of the Tatas River and Belasung River using HEC-RAS software so that the planned flood discharge can effectively be accommodated and drained.

2. THEORITICAL STUDY

FREQUENCY ANALYSIS

Frequency analysis uses probability distributions to identify the relationship between extreme events and their occurrence frequency with probability distribution (Triatmodjo, 2008). Determination of the appropriate probability distribution in

frequency analysis using the Normal, Log-Normal, Gumbel, and Log-Pearson Type III distributions. The distribution conformity test verifies whether the chosen distribution equation accurately represents the statistical characteristics of the analyzed data sample. This conformity test uses the Chi-square test and Kolmogorov-Smirnov test (Soewarno, 1995).

DESIGN FLOOD DISCHARGE

The peak discharge in a channel with a predetermined return period defines the design flood discharge. This estimates the design flood level at a specific return period (Tanudjaja & Sumarauw, 2018). The design flood discharge is calculated using the rational method. This method is commonly applied in waterworks planning. The hydrological parameters considered in determining the design flood discharge using this method are the design rainfall intensity, catchment area, and runoff coefficient (Triatmodjo, 2008).

HEC-RAS

Hydrologic Engineering Center's River Analysis System (HEC-RAS) is an interactive software system designed for hydraulic modeling. HEC-RAS includes four primary components: steady flow simulation, unsteady flow simulation, sediment transport analysis, and water quality modeling. It allows for simulating flood hydrographs using the 1D Unsteady Flow method based on the Saint-Venant equations. Additionally, HEC-RAS can simulate flood flow in rivers that pass through sluice gates (Brunner, 2024).

3. METHOD

RESEARCH LOCATION

The research location is on the Tatas River in Antasan Besar Subdistrict and the Belasung River in Kertak Baru Ilir Subdistrict, Banjarmasin Tengah District, Banjarmasin City, as shown in Figure 1.

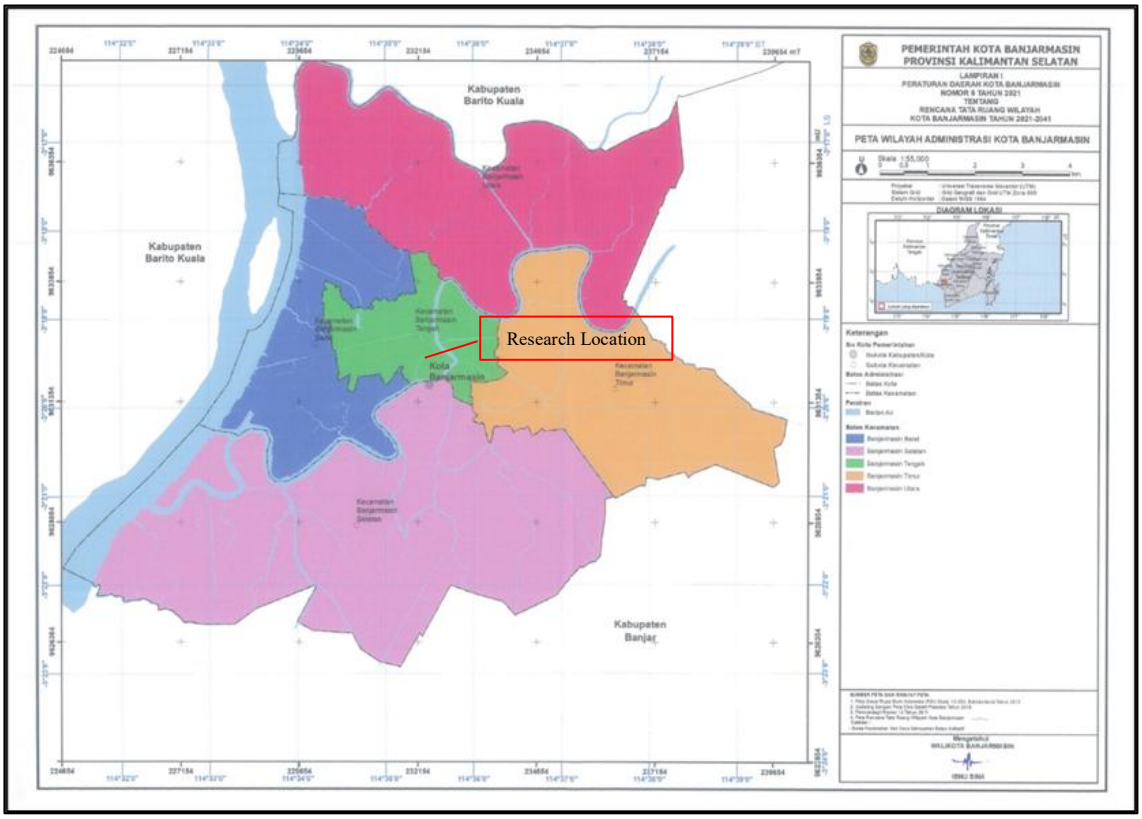

Figure 1. Research Location

Source: https://simtaru.banjarmasinkota.go.id/ (Accessed on 15 January 2025)

PRIMARY DATA

Primary data refers to information data obtained directly from the research location. Primary data in this study are in the form of survey documentation and data from measurements of the existing geometry of the Tatas River and Belasung River cross-sections using echosounder and waterpass tools assisted by measuring signs and meters.

SECONDARY DATA

Secondary data refers to information data obtained from references rather than collected directly from the field. Secondary data in this study includes hydrological data in the form of rainfall data from Meteorological Station Klas II Syamsudin Noor Banjarmasin for 49 years from 1973 to 2023. Additionally, the study incorporates drainage area data based on the provisions of SNI 03-3424-1994 regarding road surface drainage planning, technical data on floodgate operations, and tidal observation data from the Martapura River in the Banjarmasin City Tugu Nol construction project in 2023.

DATA ANALYSIS

After data collection, the next step is data analysis. The data analysis conducted in this study includes hydrological and hydraulic analysis. The hydrological analysis involves rainfall frequency analysis followed by the determination of the appropriate distribution method, which leads to the calculation of the design rainfall values and the distribution fitting test. The design flood discharge analysis to determine the peak discharge in the Tatas River and Belasung River using the rational method. The hydraulic analysis includes cross-section capacity analysis to determine and compare the cross-section capacity with and without sluice gates, using 1D Unsteady Flow simulation in HEC-RAS 6.5.

4. RESULT AND DISCUSSION

RAINFALL FREQUENCY ANALYSIS

The rainfall data used are the maximum daily rainfall records from the Syamsudin Noor Meteorological Station over 49 years. The selection of the distribution type for the data set relies on statistical parameters. Based on the calculation of the statistical parameters, the distribution type that fits and meets the distribution requirements is Log Pearson Type III. The results of the statistical parameter calculations using the Log Pearson Type III distribution are as follows.

a. Mean

$$\bar{\chi} = \frac{97{,}834}{49} = 2{,}00$$

b. Standard Deviation

$$S = \sqrt{\frac{0{,}593}{49-1}} = 0{,}111$$

c. Coefficient of Skewness

$$C_s = \frac{49\ x\ 0{,}03498}{(49-1)(49-2).\,0{,}111^3} = 0{,}615$$

After determining the distribution type that satisfies the distribution requirements, the distribution alignment test uses the Chi-square and Smirnov-Kolmogorov tests with acceptable results. The calculated design rainfall for return periods of 2, 5, 10, and 25 years are 96.74 mm, 121.77 mm, 139.44 mm, and 163 mm, respectively.

DESIGN FLOOD DISCHARGE

The design discharge calculation uses the Rational Method. The results of the design discharge calculations for the Tatas River and Belasung River appear in Table 1 below.

Table 1. Results of the Design Flood Discharge Calculation

Description	Maximum Flow Rate (m^3/s)			
	2	**5**	**10**	**25**
Tatas River	1,632	2,054	2,352	2,750
Belasung River	1,478	1,860	2,130	2,490

HYDRAULIC ANALYSIS

The cross-section capacity analysis in this study uses HEC-RAS 6.5 software. The 1D Unsteady Flow type is employed, with boundary conditions upstream of the river using flow hydrograph data from the design flood discharge and downstream using stage hydrograph data from the tidal data of the Martapura River. This river also provided sluice gates. The results of the cross-section capacity simulation for the Tatas River and Belasung River are as follows**.**

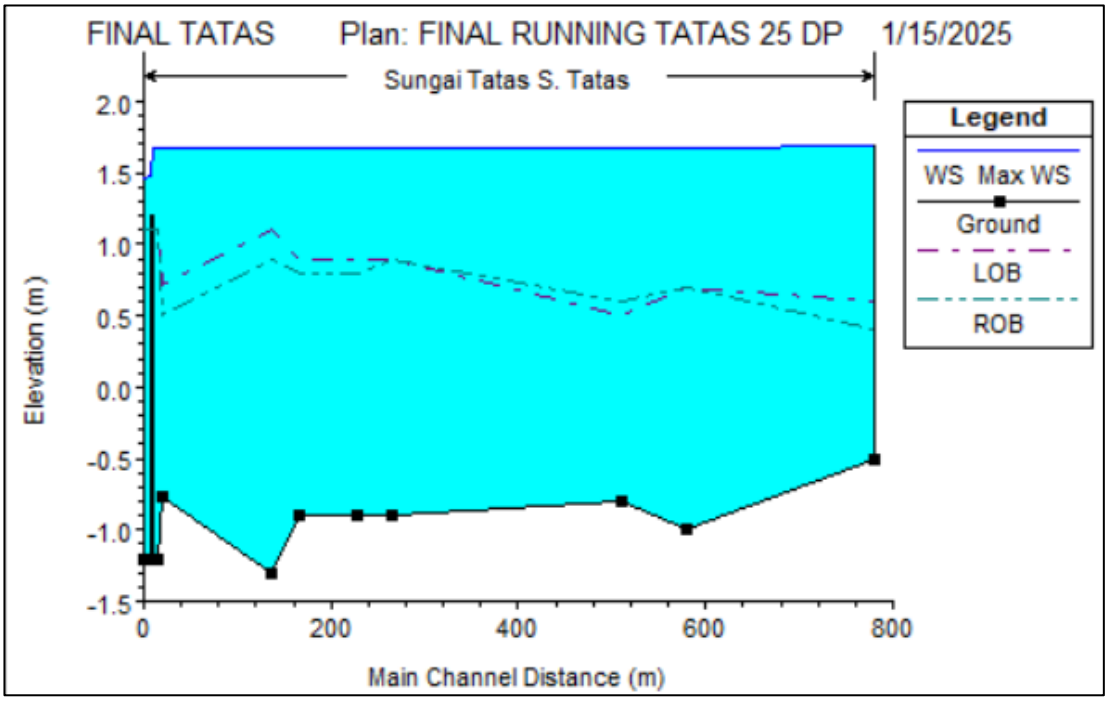

Figure 2. Tatas River Water Surface Profile for a 25-Year Return Period

Based on the HEC-RAS simulation results for the Tatas River at all the return periods the water surface overflows along the river cross-section, with the overflow height varying between 0.54 and 1.17 meters. The output results from the HEC-RAS simulation for the Tatas River are as follows.

Table 2. Output Profile of HEC-RAS Simulation Results for Tatas River

No.	Cross	Water Surface Elevation (Maks)				No.	Cross	Flow Area (Maks)			
		Q2	Q5	Q10	Q25			Q2	Q5	Q10	Q25
1	8	1,54	1,60	1,65	1,69	1	8	6,65	6,85	7,00	7,17
2	7	1,54	1,59	1,63	1,68	2	7	22,4	22,9	23,3	23,8
3	6	1,54	1,59	1,63	1,68	3	6	19,2	19,7	20,0	20,5
4	5	1,54	1,59	1,63	1,67	4	5	15,6	16,0	16,3	16,7
5	4	1,54	1,59	1,63	1,68	5	4	32,8	33,6	34,2	34,9
6	3	1,54	1,59	1,63	1,67	6	3	31,0	31,7	32,2	32,9
7	2	1,54	1,59	1,63	1,67	7	2	21,9	22,4	22,8	23,2
8	1	1,54	1,59	1,63	1,67	8	1	27,1	27,8	28,3	28,9
No.	**Cross**	**Q Total (Maks)**				**No.**	**Cross**	**Vel. Chnl (Maks)**			
		Q2	**Q5**	**Q10**	**Q25**			**Q2**	**Q5**	**Q10**	**Q25**
1	8	1,62	2,05	2,35	2,75	1	8	0,25	0,30	0,34	0,38
2	7	1,63	2,05	2,35	2,75	2	7	0,07	0,09	0,10	0,12
3	6	1,63	2,05	2,35	2,75	3	6	0,09	0,10	0,12	0,13
4	5	1,63	2,05	2,35	2,75	4	5	0,10	0,13	0,14	0,16
5	4	1,63	2,05	2,35	2,75	5	4	0,05	0,06	0,07	0,08
6	3	1,63	2,05	2,35	2,75	6	3	0,05	0,06	0,07	0,08
7	2	1,63	2,05	2,35	2,75	7	2	0,07	0,09	0,10	0,12

8	1	1,63	2,05	2,35	2,75	8	1	0,06	0,07	0,08	0,10

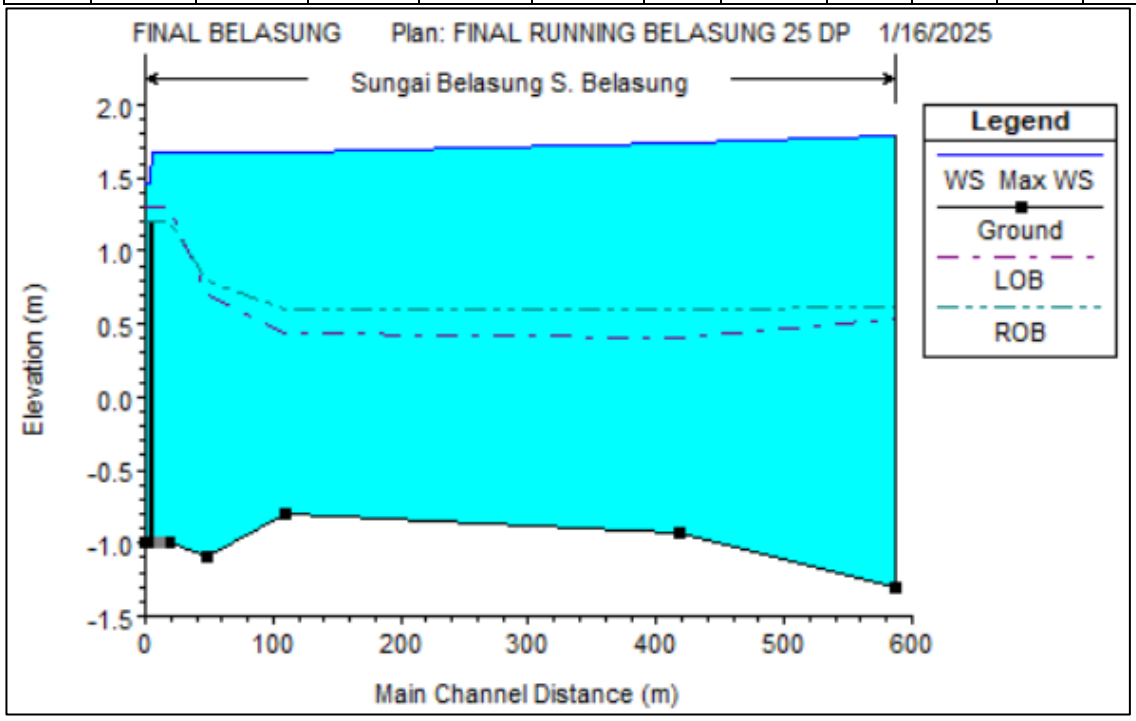

Figure 3. Belasung River Water Surface Profile for a 25-Year Return Period

Based on the HEC-RAS simulation results for the Belasung River at all the return periods the water surface overflows along the river cross-section, with the overflow height varying between 0.83 and 1.30 meters. The output results from the HEC-RAS simulation for the Belasung River are as follows.

Table 3. Output Profile of HEC-RAS Simulation Results for Belasung River

No.	***Cross***	***Water Surface Elevation* (Maks)**				**No.**	***Cross***	***Flow Area* (Maks)**			
		Q2	**Q5**	**Q10**	**Q25**			**Q2**	**Q5**	**Q10**	**Q25**
1	4	1,58	1,66	1,72	1,79	1	4	8,35	8,62	8,81	9,07
2	3	1,56	1,63	1,68	1,74	2	3	4,42	4,56	4,66	4,80
3	2	1,53	1,59	1,62	1,67	3	2	9,00	9,23	9,37	9,57
4	1	1,53	1,59	1,62	1,67	4	1	13,8	14,2	14,4	14,7
No.	**Cross**	***Q Total* (Maks)**				**No.**	***Cross***	***Vel. Chnl* (Maks)**			
		Q2	**Q5**	**Q10**	**Q25**			**Q2**	**Q5**	**Q10**	**Q25**
1	4	1,48	1,86	2,13	2,49	1	4	0,18	0,22	0,24	0,27
2	3	1,48	1,86	2,13	2,49	2	3	0,33	0,41	0,46	0,52
3	2	1,48	1,86	2,13	2,49	3	2	0,16	0,20	0,23	0,26
4	1	1,48	1,86	2,13	2,49	4	1	0,11	0,13	0,15	0,17

5. CONCLUSION

The design flood discharge for the Tatas River and Belasung River in Banjarmasin City at return periods of 2, 5, 10, and 25 years, calculated using the Rational Method, are as follows: 1.63 m^3/s, 2.05 m^3/s, 2.35 m^3/s, and 2.75 m^3/s for the Tatas River, and 1.48 m^3/s, 1.86 m^3/s, 2.13 m^3/s, and 2.49 m^3/s for the Belasung River. Based on the simulation results, the cross-sectional capacity of the Tatas River and Belasung River is insufficient to accommodate the design discharge at all return periods.

REFERENCES

Alison, D., Sunaryo, R. G., Damayanti, R., Arsitektur, M., Teknik, F., Petra, U. K., No, J. S., Wonocolo, K., & Timur, J. (2023). Permanesi Kawasan Masjid Raya Sabilal Muhtadin Banjarmasin. *ATRIUM: JURNAL ARSITEKTUR*, *9*(2), 89–104.

Brunner, G. W. (2024). HEC-RAS HEC-RAS Hydraulic Reference. In *U.S. Army Corps of Engineers: Vol. 6.5* (Issue May). https://www.hec.usace.army.mil/confluence/rasdocs/ras1dtechref/latest/introduction

Hamdani. (2021). *Pemkot Banjarmasin Berbenah dalam Antisipasi Bencana Banjir*. IDN Times KALTIM. https://kaltim.idntimes.com/news/indonesia/hamdani-15/pemkot-banjarmasin-berbenah-dalam-antisipasi-bencana-banjir?page=all

Soewarno. (1995). *Hidrologi Aplikasi Metode Statistik Untuk Analisa Data Jilid 1*. Nova.

Tanudjaja, D. F. A. L., & Sumarauw, J. S. F. (2018). Analisis Debit Banjir dan Tinggi Muka Air Sungai Talawaan di Titik 250 m Sebelah Hulu Bendung Talawaan. *Jurnal Sipil Statik*, *6*(5), 269–276.

Triatmodjo, B. (2008). Hidrologi Terapan. In *Beta Offset Yogyakarta*. Beta Offset.