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Implementation of Drainage Channel Planning as a Result of Determining the Priority Scale for Flood Management on Dr. Cipto Mangunkusumo Road, Samarinda Seberang, Samarinda City, East Kalimantan

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***Abstract*— This study is a continuation of previous research, namely the implementation of drainage channel dimension planning as a result of determining the priority scale for flood management on Dr. Cipto Mangunkusumo Road, Samarinda Seberang, Samarinda City, East Kalimantan. To achieve this objective, this study used the Modified Rational Method for hydrological analysis and the Manning Method for hydraulic analysis. The target of this study is to plan drainage channel dimensions that are in accordance with the characteristics of the Samarinda Seberang District. The results of the analysis show that the planned flood discharge (Q) with a 10-year return period is 7.79 m3/dt with drainage channel dimensions of a channel base width (b) of 0.77 m, a channel crest width (T) of 3.30 m, a channel wall slope of 1:1, channel depth (h) of 1.925 m, embankment height (f) of 0.6 m, and total channel depth (H) of 2.52 m.**

Keywords— priority scale, design flood discharge, drainage channel planning

I. INTRODUCTION

The city of Samarinda is divided into several sub-districts, one of which is Samarinda Seberang Sub-district. This area is an urban area that is undergoing rapid development, resulting in many changes in land use from water catchment areas to impervious areas, which has created new problems for the functioning of existing drainage channels, especially road drainage in the area. During the rainy season, the surface water discharge from surface water runoff areas increases every year because less water is absorbed into the ground due to changes in land use. In addition to the problem of flooding as a result of the existing drainage system not being properly organised, there are also drainage channels from swampy areas that flow into these drainage channels before being discharged into the Mahakam River as their outlet.

Given the vastness of the area and in order to make flood management more effective and efficient, a previous study assessed the priority scale for determining flood management, consisting of inundation parameters such as height, area, duration and frequency of flooding, economic losses, social disruption and government facilities. The purpose of this study is to plan drainage channel dimensions that are appropriate for the characteristics of the Samarinda Seberang District and provide the most optimal and efficient benefits from a technical perspective. This will ensure that flood control in the area meets or complies with technical standards and is effective and efficient.

The benefits of the research are the availability of drainage planning results as a flood control system that meets applicable planning standards and provides a tangible contribution to environmentally-friendly development programmes to minimise environmental and social impacts.

II. REVIEW OF LITERATURE

The preliminary study conducted here was an independent study on flood control that focused on the effectiveness of polder gates as an alternative flood control measure in the Sempaja River Basin, Samarinda City, East Kalimantan Province, as well as drainage channel planning in Sungai Kunjang District, Samarinda City, East Kalimantan. This research has been presented and published nationally at the Annual Scientific Week of the Indonesian Hydraulic Engineers Association (HATHI) in Malang City, and this has become the basis for the development stage of flood control research in the Samarinda Seberang area. The achievements of this research include the arrangement of the drainage system and the planning of flood control structures, using analyses employed in the current research, both hydrological and hydraulic analyses.

Urban drainage design criteria are specific, because for urban areas there are additional design variables such as the relationship with land use, the city drainage master plan and socio-cultural issues (lack of public awareness in helping to maintain the city's drainage function).

A. Hydrological Analysis

Hydrological analysis is intended to obtain the planned discharge to pass through the drainage channel for water disposal as soon as possible, so that there is no water accumulation in a long-time interval that will inundate the drainage channel area (Barus, Freddy. Sutarto, Tommy. Widiawati, Dhiana, 2025). The analysis is calculated using available rainfall data.

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Design rainfall is the maximum rainfall that may occur in an area with a certain recurrence interval or period, which is used as the basis for calculating the size of a building. One method that can be used to analyse design rainfall is Log Person Type III.

$$\text{Log } R_t = \text{LogX} + G.S_i \quad 1$$

B. Probability Distribution Test

The probability distribution test determines whether the selected probability distribution equation can represent the statistical distribution of the data sample being analyzed (Barus, Freddy. Sutarto, Tommy. Widiawati, Dhiana, 2025). The distribution suitability test aims to determine the suitability of the available data with the distribution used. There are two types of tests used, namely the Kolmogorov-Smirnov test and the Chi-square test.

The distribution fit test is carried out by testing the chi-squared and Smirnov-Kolmogorov parameters with the interpretation of the results if the chance is more than 5%, then the theoretical distribution equation is acceptable; if it is less than 1%, then the theoretical distribution equation is not acceptable; if the chance is between 1% and 5% cannot be made, or additional data needs to be added. In addition, a non-parametric suitability test was carried out using the Smirnov-Kolmogorov Test with the interpretation of the theoretical distribution value if the maximum deviation (ΔP max) is greater than the critical deviation (ΔP critical) (Dhiana, et all, 2025).

C. Catchment area

The drainage area in drainage channel planning is the area that receives rainfall during a certain period of time (rainfall intensity), resulting in runoff that must be collected by the drainage channel and discharged into a sewer or river. To determine the drainage area, the boundaries and length of the drainage area must first be determined.

D. Calculation of Plan Flood Discharge

We will use the Rational Modification Method to calculate the planned flood discharge. The cross-section of the channel is planned to be trapezoidal and calculated based on the formula

$$Q = 0.278 . C_s . C . I . A \quad 2$$

III. RESEARCH METHODOLOGY

The research location is in Samarinda City, East Kalimantan Province, specifically in the Samarinda Seberang District. This area is divided by the Mahakam River. The location is in the Samarinda Seberang District, specifically on Street Dr. Cipto Mangunkusumo and Street Bung Tomo.

This study uses secondary and primary data, including Primary data collection consisting of Rainfall data from the Meteorology, Climatology and Geophysics Agency (BMKG), Topographic maps from the National Coordination Agency for Surveys and Mapping (Bakosurtanal), RUTRK (General Urban Spatial Plan) in the form of land use maps, and population data (demographics). Secondary data collection, consisting of Direct measurement of channel dimensions in the field (existing drainage) and Collecting field information about flooded areas and flow direction.

Analysis or assessment stage, consisting of Hydrological analysis or assessment, namely and hydraulic analysis or assessment, consisting of Determination of watershed boundaries and catchment area, Design rainfall using the E.J. Gumbel Method and Log Person Type III, Frequency suitability test consisting of the Smirnov–Kolmogorov test and Chi-square test, Rainfall distribution using the Mononobe Equation, Runoff coefficient, Time of concentration, Rainfall intensity, Design flood discharge due to rainfall using the Modified Rational Method. In hydraulic analysis, this includes determining the geometric shape and dimensions of the channel to ascertain its capacity, with planning constraints on discharge, flow velocity, base and wall slope, channel roughness coefficient, headroom and embankment width.

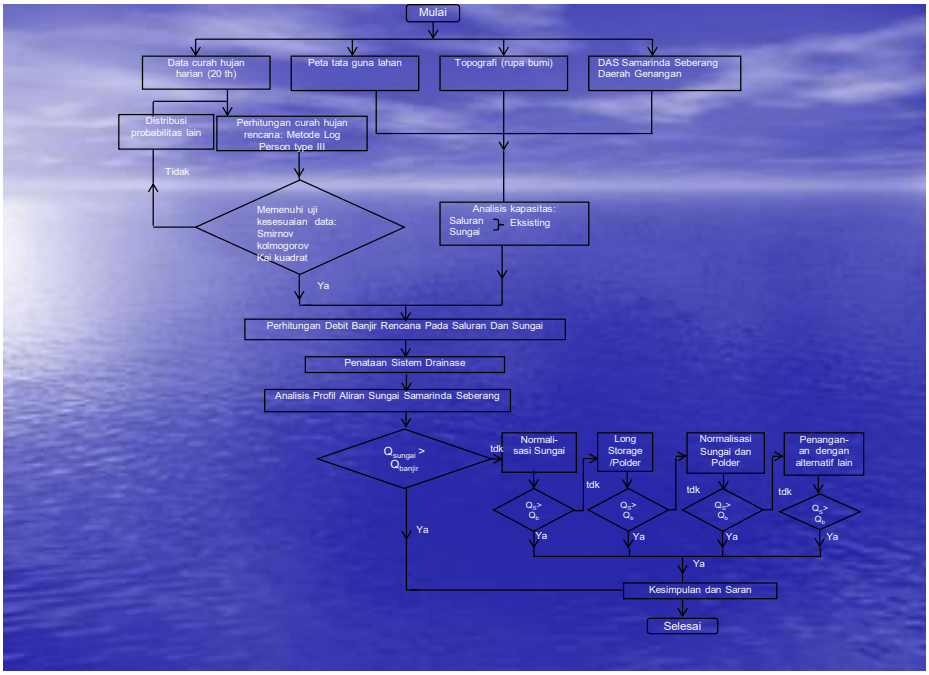

Figure 1. Drainage Channel Planning Flow Chart

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IV. RESULT

A. Hydrological Data Analysis

The hydrological data in this case is rainfall data, where this study uses rainfall data from the Temindung Rainfall Recording Station.

Table 1. Maximum Daily Rainfall (mm) Per Year from Temindung Airport Station, Samarinda

No	Curah hujan harian maksimum (mm)	No	Curah hujan harian maksimum (mm)	No	Curah hujan harian maksimum (mm)
1	115,80	12	82,00	22	108,00
2	105,60	13	79,10	23	132,10
3	85,70	14	94,60	24	94,40
4	80,50	15	85,00	25	73,00
5	108,90	16	117,10	26	60,20
6	97,30	17	83,80	27	86,50
7	89,40	18	101,60	28	105,50
8	105,30	19	66,30	29	98,90
9	94,30	20	39,00	30	96,00
10	90,00	21	118,20	31	102,50
11	141,80				

Table 2. Design Rainfall Calculation Using the Log Pearson Type III Method

Periode Ulang (tahun)	Probabilitas (%)	*Standard Normal Deviate z	Cs/6	Faktor Frequensi K	Log X (mm)	X (mm)
1.25	80.00	-0.79	-0.24	-0.626	1.899	61.299
2	50.00	-0.03	-0.24	0.206	1.987	78.885
5	20.00	0.80	-0.24	0.801	2.050	101.175
10	10.00	1.23	-0.24	1.011	2.073	114.131
25	4.00	1.70	-0.24	1.172	2.090	128.948
50	2.00	2.00	-0.24	1.245	2.098	138.293
100	1.00	2.30	-0.24	1.298	2.103	148.508
200	0.50	2.50	-0.24	1.324	2.106	155.358
1000	0.10	3.00	-0.24	1.362	2.110	172.893

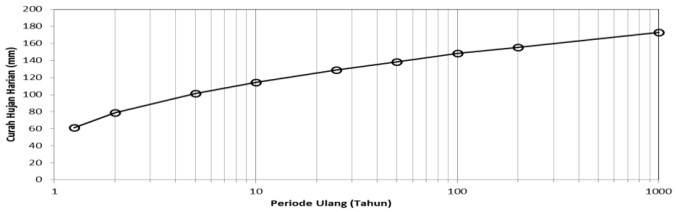

Figure 2. Rainfall Graph Design Using the Log Pearson Type III Method

B. Smirnov–Kolmogorov test

From the above data, it can be concluded that the Log Person Type III Method hypothesis is acceptable and meets the requirements. In other words, because the value of ΔP max < Δcr, it can be concluded that the annual maximum rainfall data analysed is in accordance with the Log Person Type III distribution.

C. Chi Square test

This test aims to determine the vertical deviation between the empirical distribution and the theoretical distribution. The test results are as follows: With α = 5% and degrees of freedom (V) = 6 – 1 = 5 from the Chi-square test table, the critical X2 value is obtained as 11.07. Because: ∑X2 hit < X2 critical, 5.78 < 11.07 – then the Log Person Type III distribution equation can be accepted or used in design rainfall calculations.

Before planning the drainage channels, calculations are made on the capacity of the existing channels. The aim is to compare the results between the existing discharge and the planned discharge, so that it can be determined whether it is necessary to build new drainage channels or whether it is sufficient to simply rehabilitate the old channels. The results of the calculations on the capacity of the existing channels can be seen below.

Table 3. Calculation of Existing Drainage Channel Capacity in Samarinda Seberang District

No	Kecamatan	Jalan/Ruas		Saluran existing			Kemiringan dasar saluran	A	P	R	V	Q (debit)
				Lebar atas (m)	Tinggi (m)	Lebar bawah (m)		m2	m	m	m/det	m3/det
1	Samarinda Seberang	Jl. Cipt. Mangunkusumo (1)	Kanan	1.5	1	0.8	0.00112	1.800	3.628	0.496	1.5	2.7
			Kiri	1.5	1	0.8	0.00112	1.800	3.628	0.496	1.5	2.7
2		Jl. Cipt. Mangunkusumo (2)	Kanan	1.5	1	0.8	0.00112	1.800	3.628	0.496	1.5	2.7
			Kiri	1.5	1	0.8	0.00112	1.800	3.628	0.496	1.5	2.7
3		Jl. Bung tomo	Kanan	-	-	-	-	-	-	-	-	-
			Kiri	-	-	-	-	-	-	-	-	-

D. Calculation of Planned Drainage Flow Rates for Urban Drainage Using the Modified Rational Method

The Modified Rational Method is used in the planning of drainage channels here. The planning steps are as follows: There is a main drainage system for the planned settlement with a design life of 10 years, with the drainage channels located in the Samarinda Seberang District, namely Jl. Bung Tomo (Jl. Reel, Jl. Padat Karya, Jl. H. Jahrah), Jl. Cipto Mangunkusumo.

Runoff coefficient (C) value land use in this area is: Residential with a C value of 0.83 , Channel length, Left and right = 741 m. So, The total Q of the Bung Tomo Channel Section (left) is 0.1278 m^3/s.

Table of Calculated Results for Planned Channel Discharge in Samarinda Seberang Subdistrict

Table 4. Calculation results for the Bung Tomo Road segment

BUNG TOMO								
No.	Segmen	Luas (Km2)	Elevasi Tinggi (m)	Elevasi Rendah (m)	Jarak (m)	% Kemiringan	C	Fungsi Lahan
1	Bung tomo 1	0.38	22	2	643	0.031	0.83	Pemukiman
2	Bung tomo 2	0.10	6	2	325	0.012	0.83	Pemukiman
3	Bung tomo 3	0.28	40	2	950	0.040	0.83	Pemukiman
4	Bung tomo 4	0.07	5	2	612	0.005	0.83	Pemukiman

Table 5. Results of traffic flow calculations for Jl. Bung Tomo (left) Continued

No.	Segmen	1/3.6	C	I (mm/jam)	Luas (Km2)	X10/R24 (mm/jam)	Q (m3/det)
1	Bung tomo 1	0.278	0.83	9.833	0.38	118.43	0.579
2	Bung tomo 2	0.278	0.83	9.986	0.10	118.43	0.154
3	Bung tomo 3	0.278	0.83	9.872	0.28	118.43	0.427
4	Bung tomo 4	0.278	0.83	11.562	0.07	118.43	0.118

Table 6. Results of Calculations for Bung Tomo Road (Right) Flow Rate Continued

No.	Segmen	1/3.6	C	I (mm/jam)	Luas (Km2)	X10/R24 (mm/jam)	Q (m3/det)
1	Bung tomo 1	0.278	0.83	9.833	0.38	118.43	0.579
2	Bung tomo 2	0.278	0.83	9.986	0.10	118.43	0.154
3	Bung tomo 3	0.278	0.83	9.872	0.28	118.43	0.427
4	Bung tomo 4	0.278	0.83	11.562	0.07	118.43	0.118

Table 7. Calculation Results for the Cipto Mangunkusumo Area Segment

CIPTO MANGUNKUSUMO								
No.	Segmen	Luas (Km2)	Elevasi Tinggi (m)	Elevasi Rendah (m)	Jarak (m)	% Kemiringan	C	Fungsi Lahan
1	CM 1	12.22	94	3	7500	0.012	0.83	Pemukiman
2	CM 2	0.29	94	3	7500	0.012	0.83	Pemukiman
3	CM 3	1.97	94	3	7500	0.012	0.83	Pemukiman
4	CM 4	0.02	94	3	7500	0.012	0.83	Pemukiman

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Table 8. Calculation Results for the Cipto Mangunkusumo Area

No.	Segmen	1/3.6	C	I (mm/jam)	Luas (Km2)	X10/R24 (mm/jam)	Q (m3/det)
1	CM. 1	0.278	0.83	4.110	12.22	118.43	7.785
2	CM. 2	0.278	0.83	24.365	0.29	118.43	1.138
3	CM. 3	0.278	0.83	4.157	1.97	118.43	1.262
4	CM. 4	0.278	0.83	26.521	0.02	118.43	0.082

E. Results of Channel Dimensioning in Samarinda Seberang Subdistrict

Table 9. Calculation results for the dimensions of Jl. Bung Tomo (left)

No.	Kode saluran	Q(m³/det)	V (m/det)	A (m2)	h (m)	B (m)	P (m)	R (m)	S (%)	n (koef bahan)	T (m)	b:h	m	f (m)	m
1	Jl.Bung Tomo	1.278	1.5	0.852	0.780	0.312	2.519	0.338	0.0019	0.014	1.7	1 : 2.5	1	0.6	1 : 1
2	Jl.Perum Kelebang	1.006	1.5	0.670	0.669	0.334	2.225	0.301	0.0022	0.014	1.5	1 : 2	1	0.5	1 : 1

Table 10. Calculation results for the dimensions of Jl. Bung Tomo (right)

No.	Kode saluran	Q(m³/det)	V (m/det)	A (m2)	h (m)	B (m)	P (m)	R (m)	S (%)	n (koef bahan)	T (m)	b:h	m	f (m)	m
1	Jl.Bung Tomo	1.006	1.5	0.670	0.669	0.334	2.225	0.301	0.0022	0.014	1.5	1 : 2	1	0.5	1 : 1
2	Jl.Perum Kelebang	1.006	1.5	0.670	0.669	0.334	2.225	0.301	0.0022	0.014	1.5	1 : 2	1	0.5	1 : 1

F. Results of Channel Dimension Planning on Jl. Dr. Cipto Mangunkusumo, Samarinda Seberang District

Tabel 11. Calculation of the dimensions of Cipto Mangunkusumo Road (left)

No.	Kode saluran	Q(m³/det)	V (m/det)	A (m2)	h (m)	B (m)	P (m)	R (m)	S (%)	n (koef bahan)	T (m)	b:h	m	f (m)	m
1	Jl.Cipto mangunkusumo (hijau)	7.785	1.5	5.190	1.925	0.770	6.226	0.835	0.0006	0.014	3.3	1 : 2.5	1	0.6	1 : 1
2	Jl.Cipto mangunkusumo (pink)	1.138	1.5	0.759	0.711	0.356	2.367	0.320	0.0020	0.014	1.6	1 : 2	1	0.5	1 : 1

Table 12. Results of calculations for the dimensions of Cipto Mangkusumo Road (right)

No.	Kode saluran	Q(m³/det)	V (m/det)	A (m2)	h (m)	B (m)	P (m)	R (m)	S (%)	n (koef bahan)	T (m)	b:h	m	f (m)	m
1	Jl.Cipto mangunkusumo (hijau)	7.785	1.5	5.190	1.925	0.770	6.226	0.835	0.0006	0.014	3.3	1 : 2.5	1	0.6	1 : 1
2	Jl.Cipto mangunkusumo (pink)	1.138	1.5	0.759	0.711	0.356	2.367	0.320	0.0020	0.014	1.6	1 : 2	1	0.5	1 : 1

G. Hasil Perencanaan Box Culvert Kecamatan Samarinda Seberang

Table 13. Results of Box Culvert Planning for Samarinda Seberang Subdistrict

No	Kecamatan	Jalan / Ruas	Sta.	Eksisting Gorong2	Keterangan	Rencana Gorong2	Foto Dokumentasi	Usulan gorong-gorong
1	Kec. Samarinda Seberang	Jln Cipto Mangkusumo	0+000	Panjang 1.5 Lebar 1.2 Dalam 0.5	Gorong2 Box Jalan Aspal Buntu	Double Box Culvert		Tebal 30 cm Lebar 300 cm Dalam 250 cm Panjang 150 cm
		Sungai Perum Pinang Bahari	0+400	Panjang 1.2 Lebar 1 Dalam 0.7	Gorong2 Ulin Jalan Tanah	Box Culvert		Tebal 30 cm Lebar 300 cm Dalam 250 cm Panjang 120 cm
2		Jln Bung Tomo Depan SPBU	4+765	Panjang 2 Lebar 1.2 Dalam 1.2	Gorong2 Box Jalan Beton Buntu	Box Culvert		Tebal 20 cm Lebar 150 cm Dalam 120 cm Panjang 200 cm

Picture 3. Field Survey Results, Long Section and Cross Section Images

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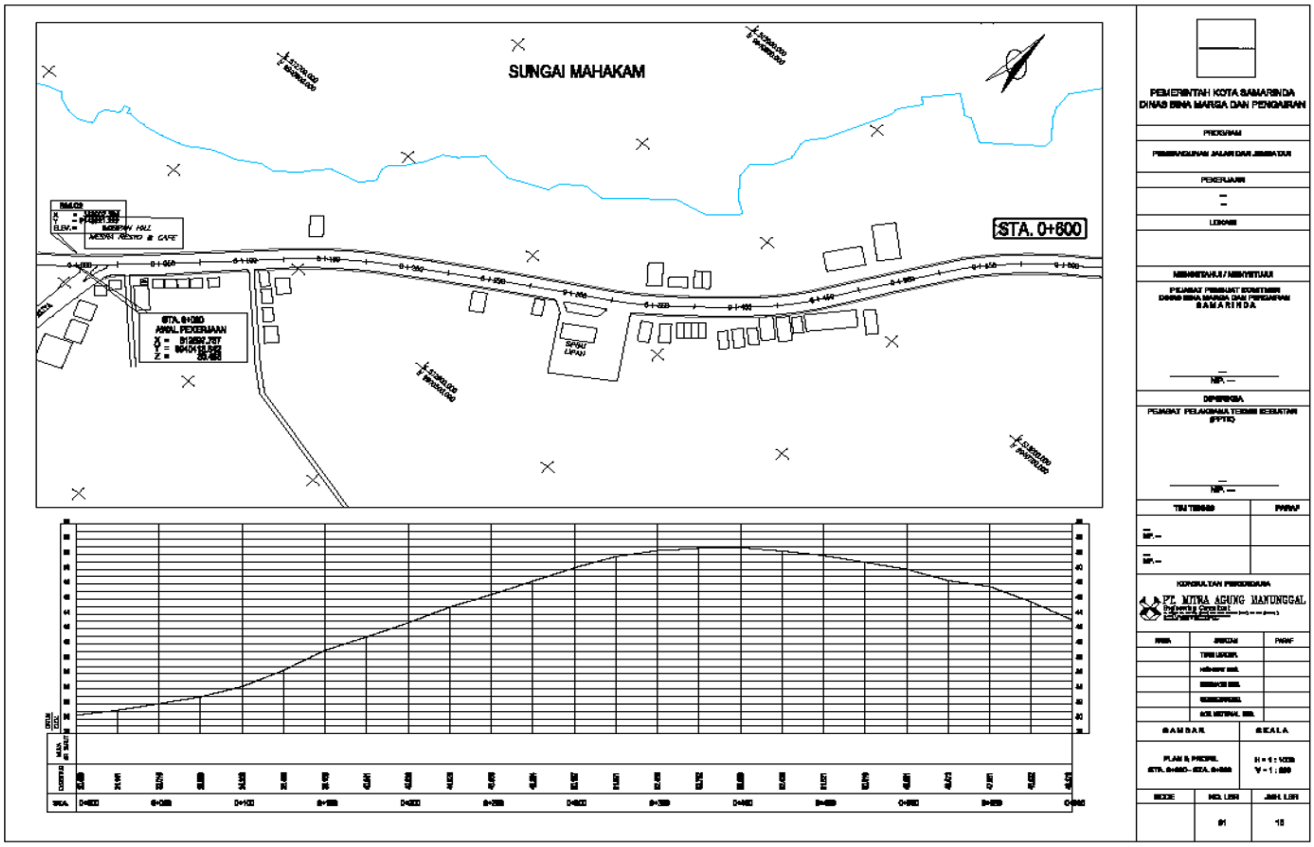
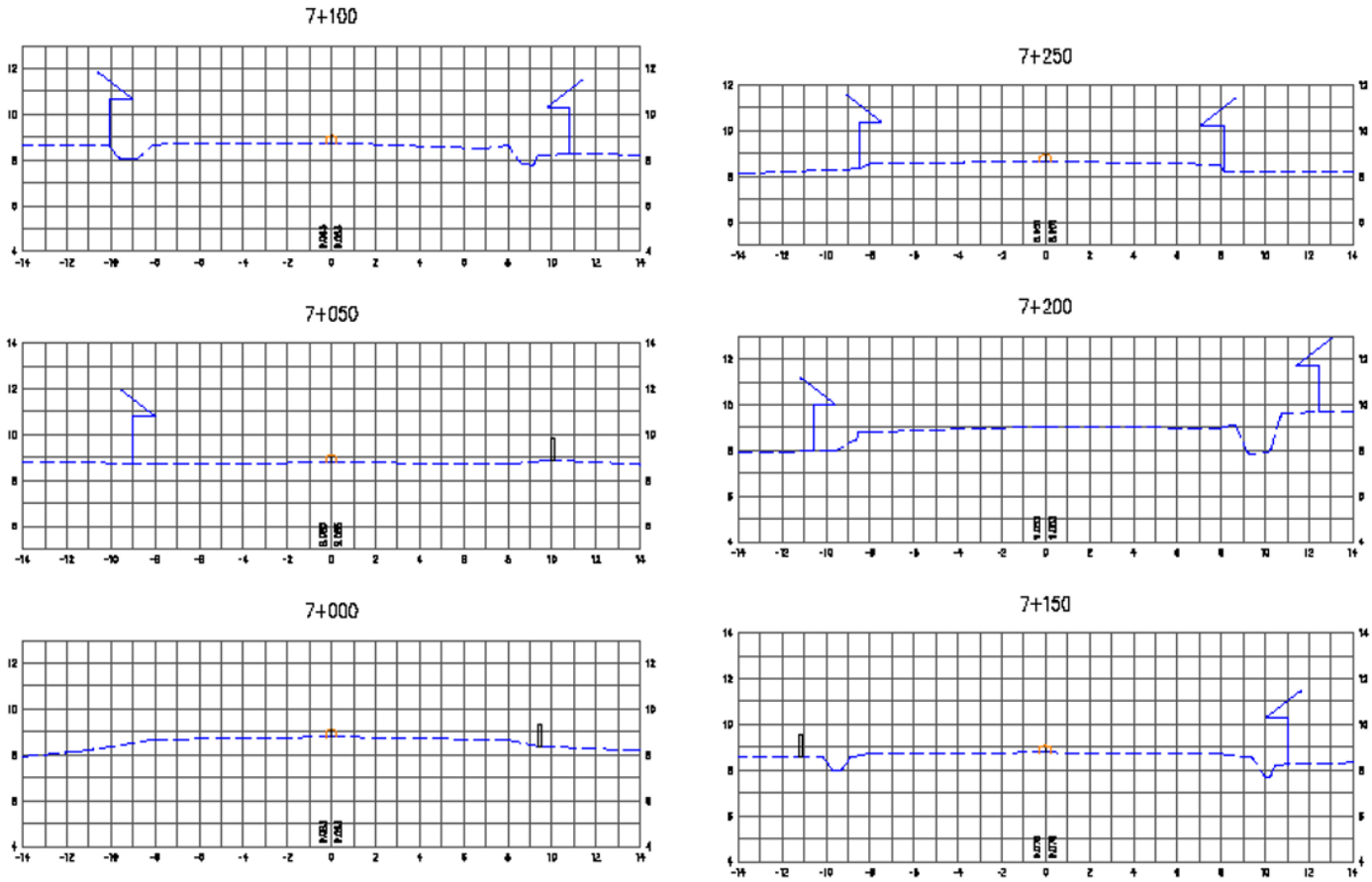


Picture 4. Long Section of Dr. Cipto Mangunkusumo Road



Picture 5. Cross Section of Dr. Cipto Mangunkusumo Road

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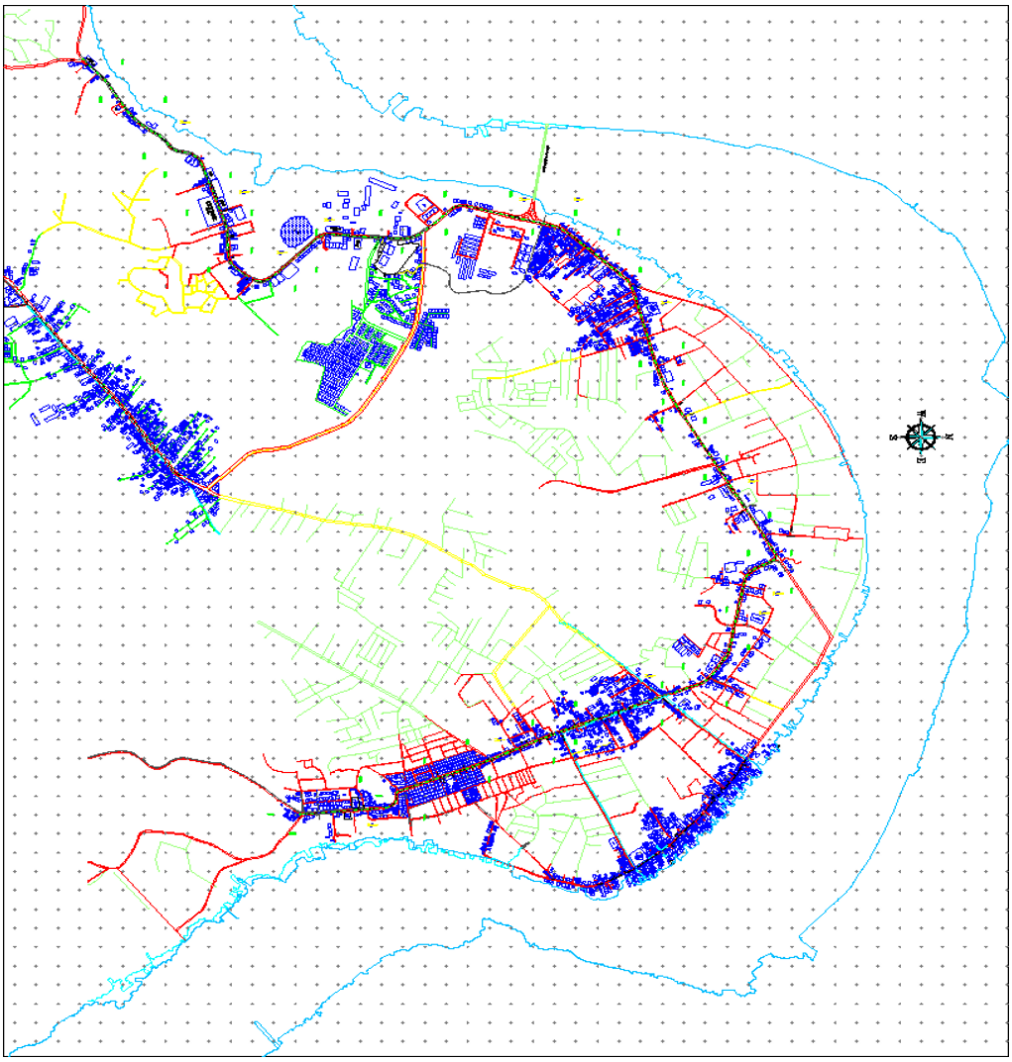
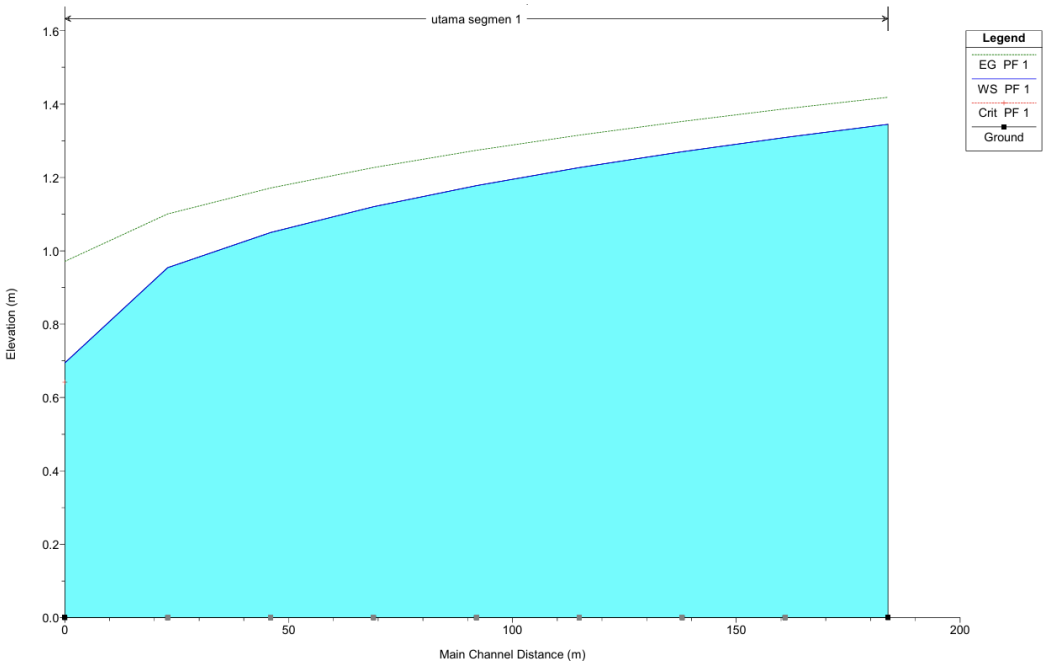


Picture 6. Layout of the Dr. Cipto Mangunkusumo – Bung Tomo Road



Picture 7. Profile Plot HEC-RAS Software

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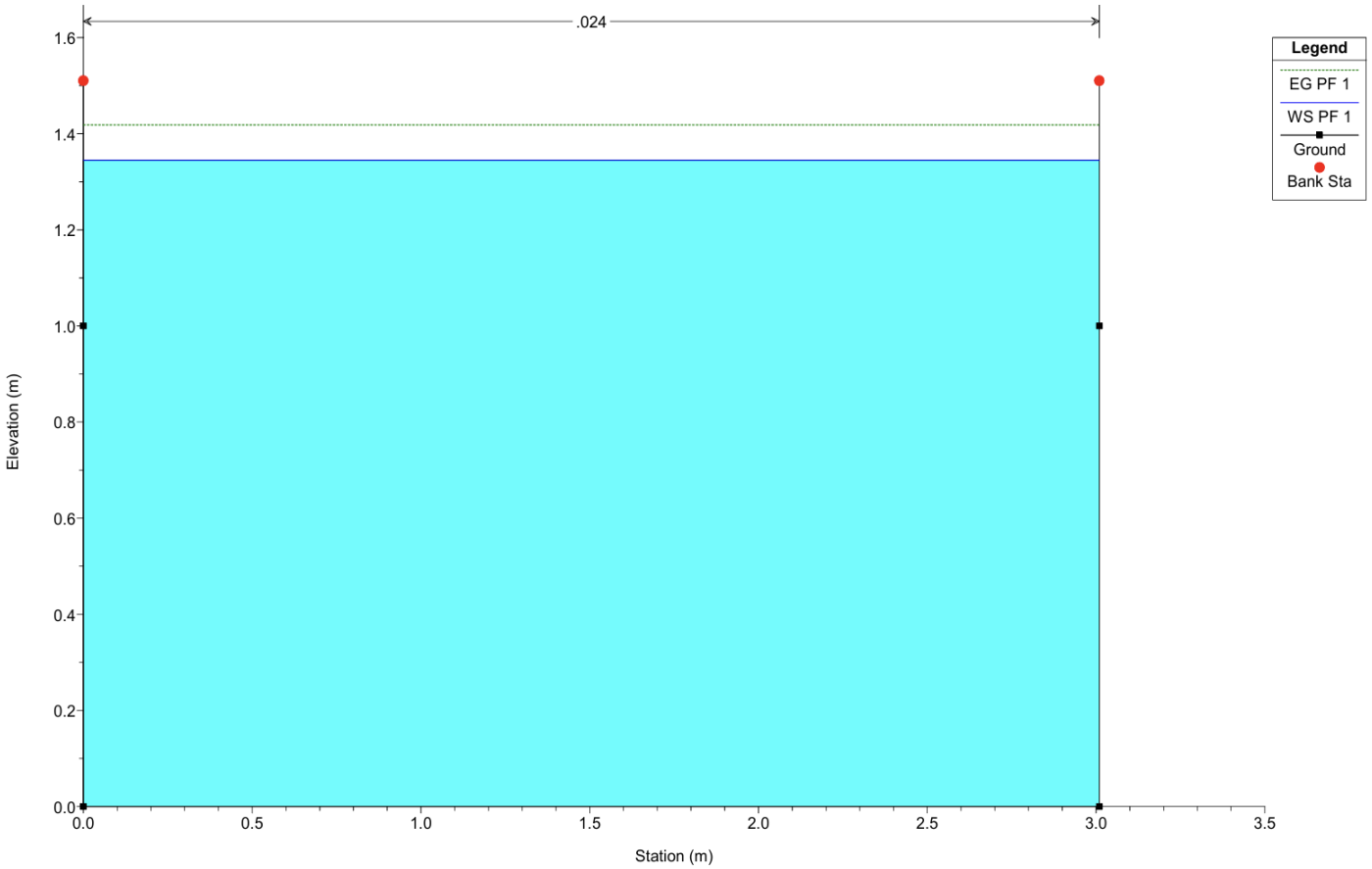
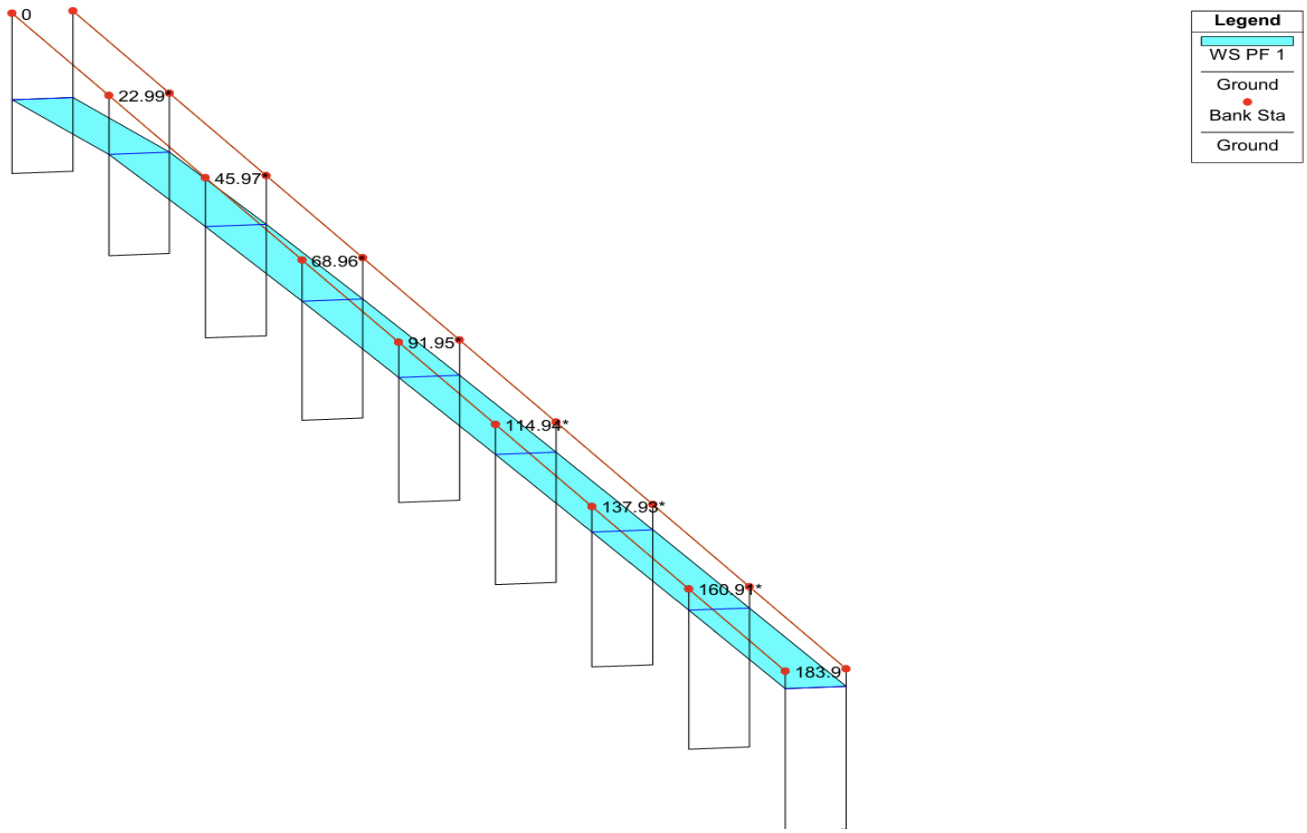


Picture 8. Cross Section Profile Plot HEC-RAS Software



Picture 9. XYZ Perscpective Plot HEC-RAS Software

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V. RESULT

Based on the results of research on the implementation of drainage channel planning as a result of determining the priority scale for flood management on Jalan Dr. Cipto Mangunkusumo Samarinda Seberang, Samarinda City, East Kalimantan Province, in the form of flood management or control that can be carried out in this study is in the form of arranging and planning the dimensions of drainage channels by carrying out management according to priority scales based on parameters of flooding, economic studies, social disturbances, losses and transportation disruptions, as well as losses in residential areas and property rights, with the main priority for handling being on Jalan Cipto Mangunkusumo. The results of the analysis show that the planned flood discharge (Q) with a 10-year return period is 7.79 m3/dt with drainage channel dimensions of a channel base width (b) of 0.77 m, a channel crest width (T) of 3.30 m, a channel wall slope (m) of 1:1, channel depth (h) of 1.925 m, embankment height (f) of 0.6 m, and total channel depth (H) of 2.52 m.

As for suggestions that can be given regarding efforts that can be made in relation to flood control in the Samarinda Seberang sub-district, apart from technical measures, non-technical measures can also be taken, one of which is in the form of education from the local government and encouraging community participation to jointly socialise the importance of maintaining and caring for drainage channels, at least in their respective neighbourhoods.

ACKNOWLEDGMENT

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REFERENCES

[1] Anonymous, 1986, KP-03. Channel Planning Criteria. Public Works Agency Publishing House. Jakarta

[2] Anonymous. 2000. Regression Analysis and Correlation of Hydrological Data, Centre for Research and Development of Water Resources Technology, Hydrology Centre, Department of Settlement and Regional Infrastructure.

[3] B. Triatmodjo, Applied Hydrology. Yogyakarta: Beta Offset, 2009.

[4] Barus, Freddy. Sutarto, Tommy. Widiawati, Dhiana. (2025). “Evaluation of Drainage System Performance in Urban Areas at Risk of Flooding: A Case Study on Prima Street to Sungai Buun, West Kotawaringin Regency”. Civil and Environmental Science Journal (CIVENSE).

[5] Barus, Freddy. Pitojo Tri Juwono. Runi, Asmaranto. (2021). “Evaluation of Paku Beto Reservoir Performance to Fulfill Irrigation Water Needs in Rain Funded Area in Paku Beto Village, East Barito Regency, Central Kalimantan Provinces”. International Research Journal of Advanced Engineering and Science (IRJAES).

[6] Barus, Freddy. Pitojo Tri Juwono. Runi, Asmaranto. (2021). “Optimization of the Pattern of Reservoir Operating to Fulfill the Need for Irrigation Water in Rain Funded Area in Paku Beto Village, East Barito Regency, Central Kalimantan Province”. International Research Journal of Advanced Engineering and Science (IRJAES).G. Eason, B. Noble, and I.N. Sneddon, “On certain integrals of Lipschitz-Hankel type involving products of Bessel functions,” Phil. Trans. Roy. Soc. London, vol. A247, pp. 529-551, April 1955. (*references*)

[7] I. M. Kamiana, Calculation Techniques for Planned Water Structure Flow Rates. Yogyakarta: CV Graha Ilmu Yogyakarta, 2010.

[8] L. M. Limantara, Practical Hydrology. Bandung: Lubuk Agung, 2010.

[9] Soemarto, CD. 1986. Technical Hydrology. Usaha Nasional. Surabaya

[10] Subarkah, Imam, 1980. Hydrology for Water Structure Planning. Idea Dharma. Bandung

[11] Suripin, Sustainable Urban Drainage Systems. Yogyakarta: Andi Offset, 2004.

[12] Widiawati, Dhiana. Barus, Freddy. Kamil, Insan. 2025. Scouring Analysis on the Sub Structures of the Bridge, in the Construction Plan for Iron Bridge 2, Tenggarong Regency, East Kalimantan. Teknika, Semarang University Scientific Journal. Semarang.