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Hydraulic Model Analysis of SITI Khadijah Retention Pond to Reduce Flooding In Palembang City

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Abstract
This research aims to obtain a hydraulic model for the Siti Khadijah retention pond which is located in the Sekanak Sub-watershed. The data used is rainfall data from rainfall stations taken from the BMKG of Palembang city. In this research, analysis is based on secondary data, namely rainfall data which will later be obtained by IDF curves and field surveys to obtain Siti Khadijah retention pond data as a basis for analysis with the help of the HEC-RAS ver. 6.1.0. The results of the research showed that the movement of flow entering from inlet channel 1 to the Siti Khadijah retention pond showed that its capacity was full with an average height of 4 m so that during high intensity rain, flooding occurred on part of the Demang Lebar Daun road (in front of the retention pond). Siti Khadijah). Meanwhile at inlet 2 there is a slight "overflow" at a distance of 250 m from the Siti Khadijah retention pond with flow movement patterns at both inlet when it rains there is an increase in the amount of sediment entering the Siti Khadijah retention pond where the thickness of the sediment (mud) is greater. less 0.75 - 1 meter.

***Keywords**: retention pond, IDF curve, HEC-RAS, full capacity, sedimentation*

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I. INTRODUCTION

In the current era of globalization, with the increasing development, the development of the world is also getting faster. This can directly or indirectly affect the condition of nature and the environment. The increasing development not only brings good influences but also brings bad influences on the condition of nature and the environment. One of the most significant environmental changes is the increasing number of areas in Indonesia that generally experience flooding, including the city of Palembang, South Sumatra province itself, which has experienced flooding in the past few years.

The city of Palembang has 108 tributaries. There are 4 large rivers that cross the city of Palembang, namely the Musi River, Komering River, Ogan River, and Keramasan River. Of the 4 large rivers above, the Musi River is the largest river with an average width of 504 meters and a maximum width of 1,350 meters which is located around Kemaro Island. (Syarifudin, A, et al, 2018)

Based on the division of river basins, there are 21 Sub-DAS, but only 18 Sub-DAS in the city of Palembang flow directly into the Musi River in the city of Palembang, namely the Rengas Lacak, Gandus, Lambidaro, Boang, Sekanak, Bendung, Lawang Kidul, Buah, Juaro, Batang, Sei Lincah, Keramasan, Kertapati, Kedukan Ulu, Aur, Sriguna, Jakabaring and Plaju Sub-DAS. (Palembang City PUPR Service, 2018) Most of the floods that occur in Indonesia are caused by, among others: high rainfall that lasts for a long duration, causing a lot of waterlogging in urban areas. In addition, floods are caused by the overflow of the main rivers that pass through residential and urban areas, due to the high intensity of rainfall in the upstream area or often referred to as flash floods or floods. (Syarifudin, A. et al 2018)

In the study of hydrology, fluctuations and the journey of flow discharge waves from one upstream point to the next downstream point can be known/estimated the pattern and time of travel. This method is commonly known as the flood routing method. According to Soemarto (1987) Flood tracing is a hydrograph forecast at a point in a stream or part of a river based on hydrograph observations at other points. Flood hydrographs can be traced through riverbeds or through reservoirs/retention ponds.

Based on the division of river basins, there are 21 Sub-DAS, but only 18 Sub-DAS in the city of Palembang flow directly into the Musi River in the city of Palembang, namely the Rengas Lacak, Gandus, Lambidaro, Boang, Sekanak, Bendung, Lawang Kidul, Buah, Juaro, Batang, Sei Lincah, Keramasan, Kertapati, Kedukan Ulu, Aur, Sriguna, Jakabaring and Plaju Sub-DAS. (Palembang City PUPR Service, 2018).

The floods that occurred in the city of Palembang caused problems for the government to evaluate the existing drainage channels and retention ponds as flood/inundation control.

In recent years, the Sekanak river has often overflowed because it is no longer able to accommodate the water discharge during the rainy season. In addition, the water discharge of the Musi River enters the Sekanak river when the tide is high. This is one of the causes of the area around the Sekanak river.

Simulations using programs with different conditions, namely existing conditions, river channel normalization, diversion, combined retention ponds with pumping systems and embankment construction, show that in existing conditions there are seven areas that are inundated.

II. MATERIAL AND METHODS

This research is located in the Siti Khadijah retention pond, Sekanak Sub River Basin as shown in Figure 1.

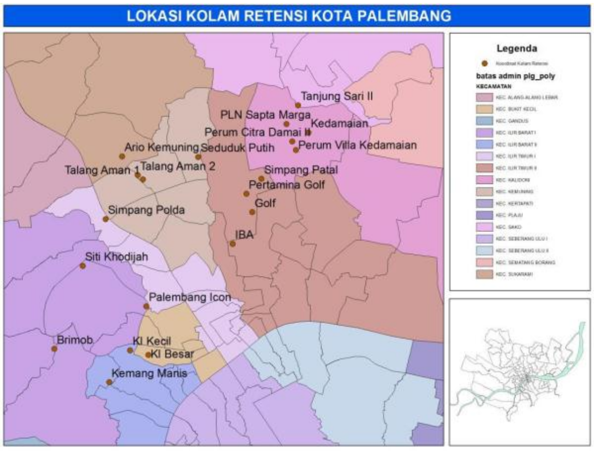

Figure 1: The research location is in Ilir Timur II sub-district, Palembang city.

In accordance with the objectives of the study, the following stages are required:

1. The first stage, conducting reference collection from journals, books, and other secondary data sources.
2. The second stage, conducting a field orientation survey to obtain the current (existing) conditions of the field, taking photos of the field (site) so that they can be the initial data for the study.
3. The third stage, conducting an initial simulation trial with the HEC-RAS program ver. 6.1.0 to see changes in water levels in the inlet channel consisting of 2 inlets located on Jalan Demang Lebar Daun.
4. The fourth stage, making a discussion of the results of observations that occur in the simulation model and making research conclusions and providing suggestions for further research by other researchers.

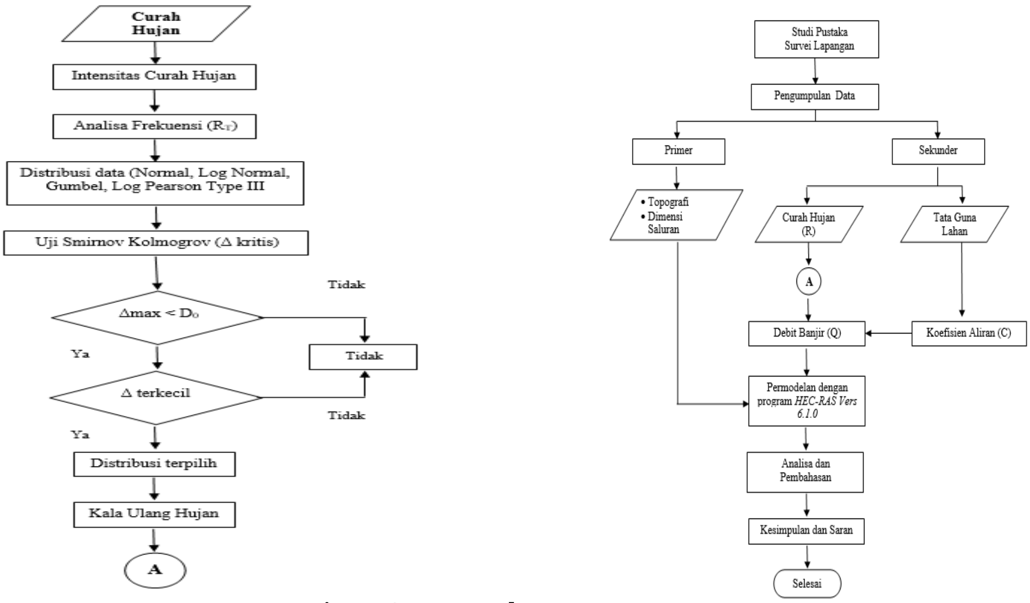

Figure 2: Researcher Flowchart

The research flowchart as in figure 2.2. can be described as follows:
The results of the analysis of the planned rainfall distribution with a return period of 2, 5, 25, 50 and 100 years as in table 1.

Table 1: Recapitulation of Planned Rainfall Distribution

		Method		
Return Period	**Normal (mm)**	**Log Normal (mm)**	**Log Pearson type III (mm)**	**Gumbel (mm)**
5	117.613	139.711	43.783	120.761
10	128.465	153.019	50.529	138.901
25	138.824	166.901	61.078	161.817
50	147.456	179.428	70.488	178.818
100	154.362	190.123	81.348	195.696

A recapitulation of the goodness-of-fit test calculations using Chi-Square for the four probability distributions can be seen in table 2 as below.

Table 2: Chi-Square Test Recapitulation

KELAS	**Pab**	**Nilai $(O_i-E_i)^2/E_i$**			
		Normal	**Log Normal**	**Log Pearson III**	**Gumbel**
1	0.001 ≤ Pab ≤ 0.100	0,4263	0,4263	0,4263	0,4263
2	0.100 ≤ Pab ≤ 0.200	1,9000	1,9000	0,0053	1,9000
3	0.200 ≤ Pab ≤ 0.300	1,9000	0,0053	0,4263	0,0053
4	0.300 ≤ Pab ≤ 0.400	0,6368	0,4263	0,0053	0,4263
5	0.400 ≤ Pab ≤ 0.500	0,4263	0,4263	2,3211	0,0053
6	0.500 ≤ Pab ≤ 0.600	2,3211	2,3211	0,0053	5,0579
7	0.600 ≤ Pab ≤ 0.700	0,6368	0,6368	1,9000	0,4263
8	0.700 ≤ Pab ≤ 0.800	0,0053	0,4263	0,4263	0,0053
9	0.800 ≤ Pab ≤ 0.900	0,4263	0,4263	1,9000	1,9000
10	0.900 ≤ Pab ≤ 0.999	1,9000	0,4263	0,4263	0,4263
Nilai c^2		**8,2526**	**6,5684**	**5,5158**	**8,2526**
Nilai c^2 Kritik		14,07	14,07	14,07	14,07
Uji Kecocokan		**DITERIMA**	**DITERIMA**	**DITERIMA**	**DITERIMA**

A recapitulation of the Smirnov-Kolmgorov goodness-of-fit test calculations for the four probability distributions can be seen in Table 3.

Table 3: Smirnov-Kolmogorov Test Recapitulation

No	**Selisih Untuk Nilai Kritis 5 %**			
	Normal	**Log Normal**	**Log Pearson III**	**Gumbel**
1	0,0359	0,0500	0,0500	0,0293
2	0,0524	0,1000	0,1000	0,0609
3	0,0838	0,1500	0,1500	0,1091
4	0,0314	0,2000	0,2000	0,0532
5	0,0124	0,2500	0,2500	0,1111
6	0,0634	0,3000	0,3000	0,0734
7	0,0366	0,3500	0,3500	0,1158
8	0,1237	0,4000	0,4000	0,0451
9	0,0800	0,4500	0,4500	0,1007
10	0,1165	0,4999	0,5000	0,0540
11	0,0914	0,5499	0,5500	0,0766
12	0,0602	0,5998	0,6000	0,1028
13	0,0102	0,6498	0,6500	0,1653
14	0,0279	0,6998	0,7000	0,1992
15	0,0689	0,7498	0,7500	0,2334
Selisih Maks	**0,1237**	0,7498	0,7500	**0,2334**
Di Kritik	0,3380	0,3380	0,3380	0,3380
Uji Kecocokan	**DITERIMA**	DITOLAK	DITOLAK	**DITERIMA**

Table 4: Recapitulation of Chi-Square and Smirnov-Kolmogorov Goodness-of-Fit Tests

Distribusi Frekuensi	Uji Kecocokan			
	Uji Chi-Square		Uji Smirnov-Kolmogorov	
	$\sum X^2$	X^2 kritik	Δmaks	Δkritik
Normal	8,2526	14,067	**0,1237**	**0,338**
Log-Normal	6,5684	14,067	0,7498	0,338
Log-Pearson Tipe III	5,5158	14,067	0,7500	0,338
Gumbel	8,2526	14,067	**0,2334**	**0,338**

Table 5: Rain Intensity with Rain Return Period and Duration

Return Period (Year)	R_{24} (mm)	I (mm/jam)
5	120.761	45,0343
10	138.901	60,9973
25	161.817	71,8987
50	178.818	83,5867
100	195.696	86,1431

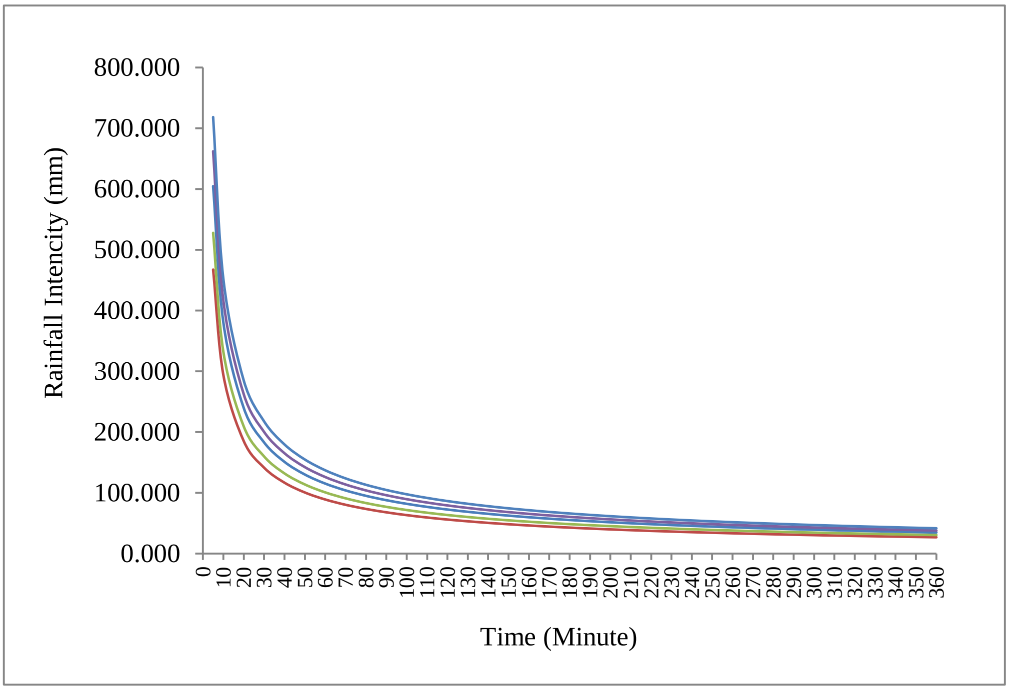

Figure 3: IDF curve (Intensity Duration Frequency-curve)

The delineation of the catchment area of the research location was carried out based on the analysis of the digital elevation model (DEM), which is a topographic map in 3-dimensional format with a grid resolution of 10 m x 10 m made from high point data. The resolution of 10 m x 10 m is good enough for flood analysis (Apirumanekul and Mark, 2001).

Using the DEM, the catchment area analysis was then carried out, so that the boundaries of the catchment area were obtained as given in Figure 4

The boundaries of the catchment area and the flow pattern obtained from the results of the analysis are in accordance with the existing flow pattern in the field. In Figure 4, the area of the catchment area is 9,373 km2. The lowest elevation is +3.212 76 m, while the highest elevation is +20.00 m. Based on the land slope analysis, it was found that the average land slope is 2.33 ° or 4.06%. (Baitullah Al Amin, 2016)

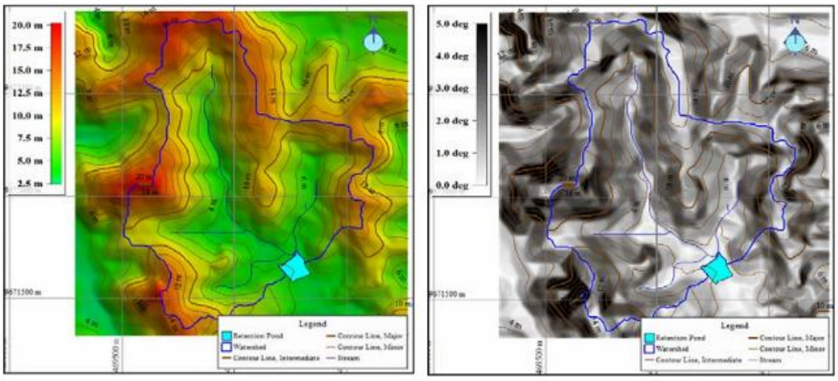

Figure 4: DEM Map and Land Slope Overlaid with Catchment Area Boundaries (Baitaullah, 2016)

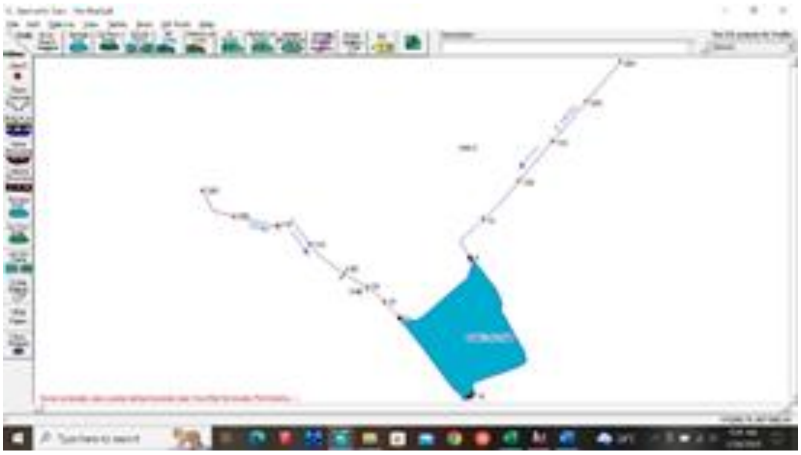

Figure 5: Situation of inlet channel and retention pond

For return periods of 2, 5, 10, 20 and 50 can be seen in the following table:

Table 6: Results of runoff discharge calculations

Periode Ulang (tahun)	C	I (mm/jam)	A (km^2)	Q (m^3/det)
2	0,8689	48,2397	9.373	10,92
5	0,8689	55,4837	9.373	5,230
10	0,8689	64,6379	9.373	6,093
20	0,8689	71,4289	9.373	6,733
50	0,8689	78,1707	9.373	7,368

III. RESULTS AND DISCUSSION

3.1. Inlet Channel 1

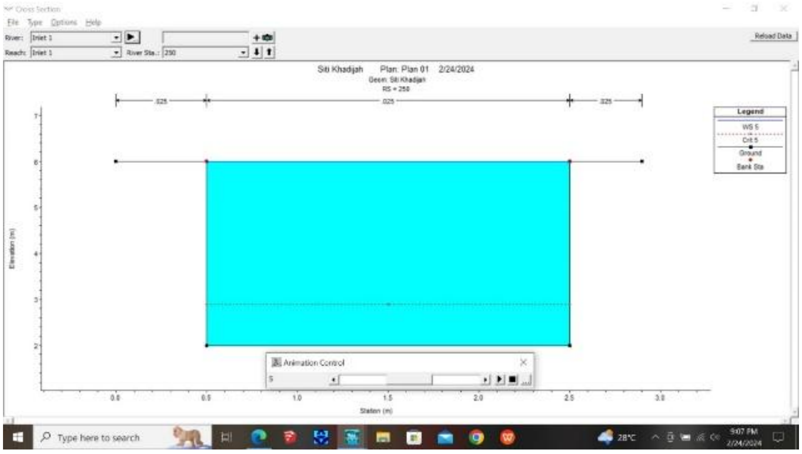

Figure 6: Flow simulation results at a distance of 25 m from the retention pond inlet.

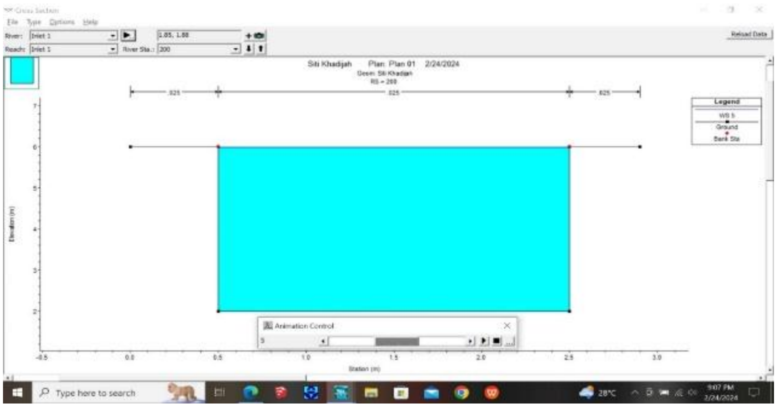

Figure 7: Flow simulation results at a distance of 200 m from the retention pond inlet.

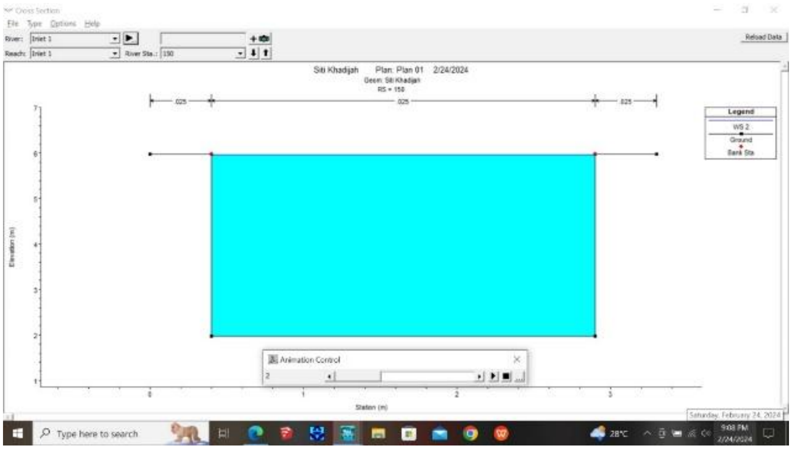

Figure 8: Flow simulation results at a distance of 150 m from the retention pond inlet.

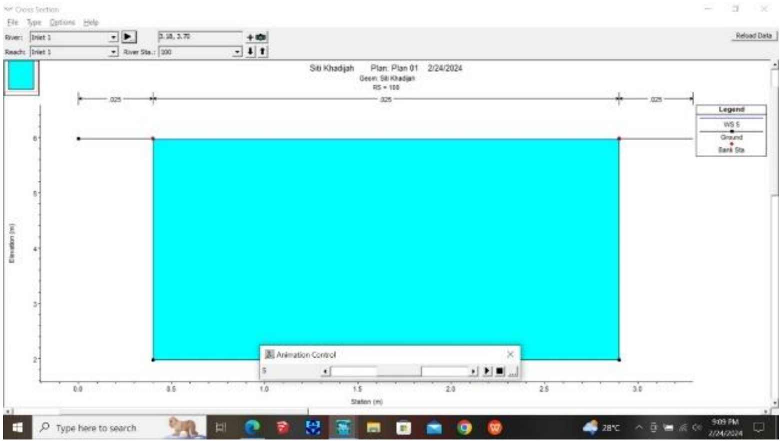

Figure 9: Flow simulation results at a distance of 100 m from the retention pond inlet.

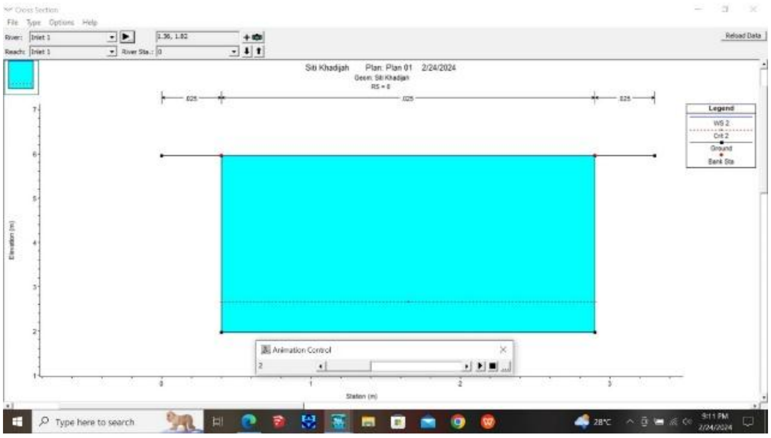

Figure 10: Flow simulation results at a distance of 50 meters from the retention pond inlet.

3.2. Saluran Inlet 2

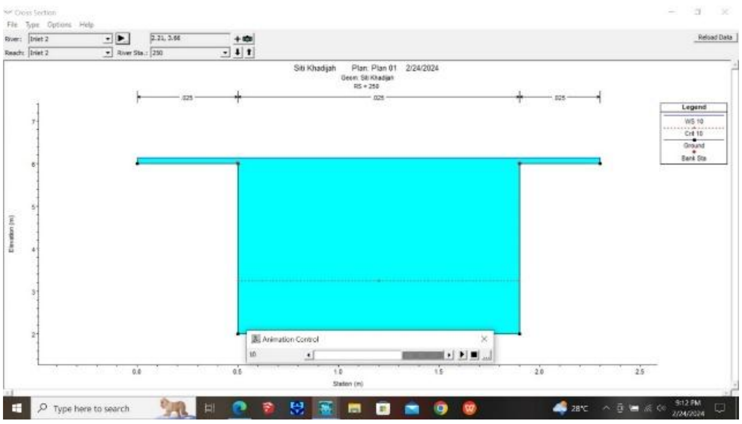

Figure 11: Flow simulation results at a distance of 25 meters from the retention pond inlet.

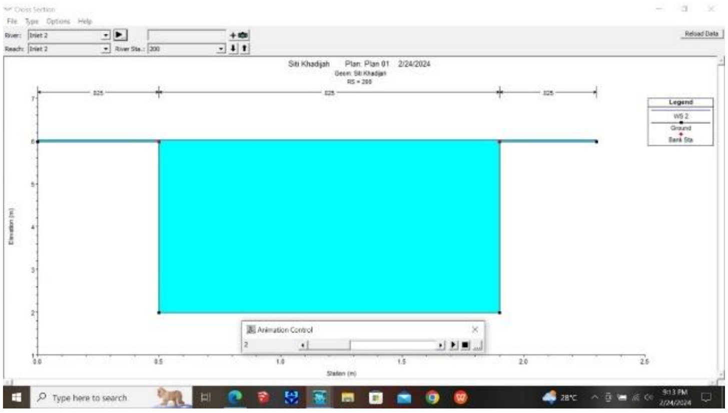

Figure 12: Simulation results of the flow entering the retention pond at a distance of 0

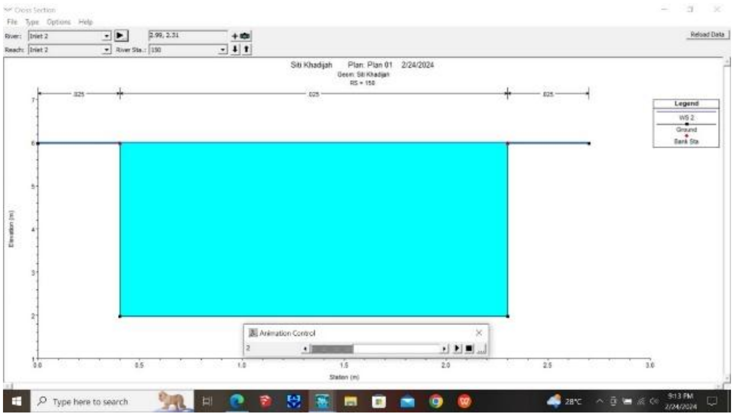

Figure 13: Simulation results of inlet flow 2 at a distance of 250 m.

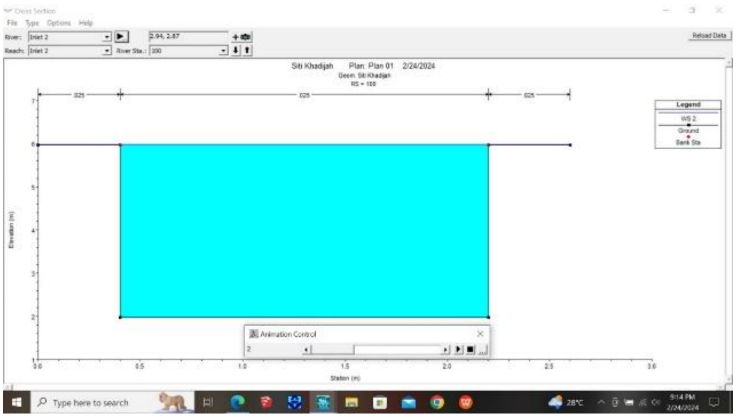

Figure 14: Simulation results of inlet flow 2 at a distance of 200 m.

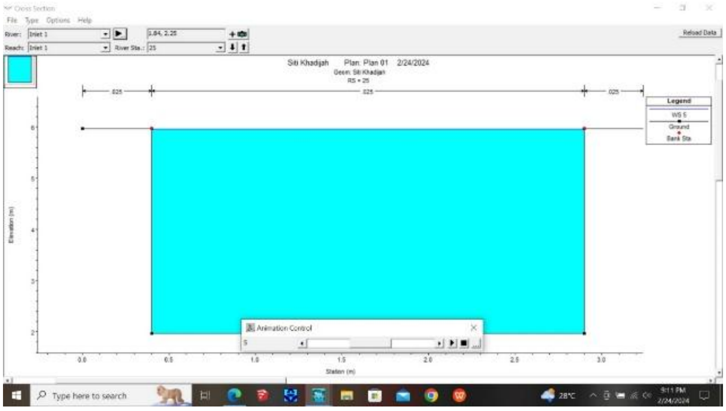

Figure 15: Simulation results of inlet flow 2 at a distance of 150 m.

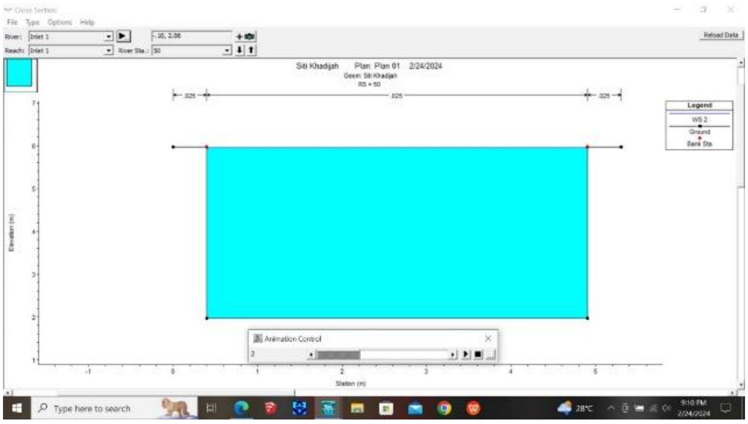

Figure 16: Simulation results of inlet flow 2 at a distance of 100 m.

IV. CONCLUSION

The results of the study showed that the flow movement entering from inlet channel 1 to the Siti Khadijah retention pond showed that its capacity was full (full capacity) with an average height of 4 m so that when it rained with high intensity there was a puddle in part of Jalan Demang Lebar Daun (in front of the Siti Khadijah retention pond). While at inlet 2 there was a slight "overflow" at a distance of 250 m from the Siti Khadijah retention pond with a flow movement pattern both at inlet 1 and inlet 2 when it rained there was an increase in the amount of sediment entering the Siti Khadijah retention pond where the thickness of the sediment (mud) was approximately 0.75 - 1 meter**.**

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