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Study of Water Discharge in Way Sikabiry Watershed, Liliboy Village, West Leihitu District, Central Maluku Regency

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***Keywords*— Cross-sectional Area, Flow Rate, Water Discharge.**

***Abstract*—** *The problem of flooding often hits Liliboy Village every rainy season, the problem of flooding is generally caused by poor drainage systems and a bigger impact is the result of damaged watersheds, watersheds that are supposed to be water conservation have undergone land use changes due to human intervention. The result of land use change that can be seen directly is that unpredictable discharge often occurs in the rivers where the watershed is damaged. For this reason, this study aims to determine the scouring pattern that occurs and the amount of water discharge in the Way Sikabiry watershed. This research was conducted in October 2019 in the Way Sikabiry watershed using the Profile (Cross Section) method, which is to place an unsinkable object on the surface of the river for a certain distance and record the time it takes for the floating object to move from one point of observation to another point of observation. have been done. The data used in this research include primary data such as river discharge data and secondary data in the form of watershed maps, measurements and drainage area.The results showed that the scouring pattern that occurred in the Way Sakabiry watershed resulted in a large downstream water flow but high flow rate while in the upstream it produced a small flow rate but a low flow rate and the amount of water discharge in the Way Sakabiri watershed upstream was 0.53095 m3. / second while in the downstream it is 0.73981 m3 / second.*

I. INTRODUCTION

A river is a natural way for water to flow into the ocean, lake, sea, or into another river. The river consists of several parts, starting from a spring that flows into a tributary. Several tributaries will join to form the main river. This water flow is usually bordered by a channel whose bottom and cliffs are on the left and right. The end of a river where the river meets the sea is known as the river mouth.

River is a part of the hydrological cycle. Water in rivers is generally collected from precipitation, such as rain, dew, springs, underground runoff and in certain countries river water also comes from melting ice / snow. Apart from water, rivers also carry sediment and pollutants.

Hydrologyis a branch of civil engineering that studies the movement, distribution and quality of water throughout the Earth, including the hydrological cycle and water resources. (*www.wikipedia.com/air*). In meteorology, precipitation (also known as a class in hydrometeors, which is an atmospheric phenomenon) is any product of the condensation of water vapor in the atmosphere. It

occurs when the atmosphere (which is a solution of giant gases) becomes saturated and water then condenses and leaves the solution (precipitates).

Sedimentary rock or sedimentary rock is one of the three main groups of rocks (along with igneous and metamorphic rocks) formed in three main ways: weathering of other rocks (clastic) deposition due to biogenic activity and precipitation from solution.

Pollutantor polluting materials are materials / objects that cause pollution, either directly or indirectly, such as to the extent that the largest of a river is for irrigation. as a drainage for rainwater and waste water, in fact, it has the potential to be used as a river tourism object, one of which is the Way watershed Sikabiry of Liliboy Village. This has an impact on the decreasing water discharge of the WaiSikabiryriver, high sedimentation rates and is prone to flooding.

Through the brief description above, thena periodic incentive study and handling of sedimentation and garbage as well as riverbed characteristics is needed by periodically backfilling the Way Sikabiry watershed area. Therefore, the analysis of sedimentation and garbage in the Way Sikabiry watershed is necessary to carry out special handling to overcome the water overflows that occur every rainy season in Lilioboy Village. This study aims to determine how the scouring pattern that occurs in the Way Sikabiry watershed and the amount of water discharge in the Way Sikabiry watershed.

II. LITERATURE REVIEW

2.1. Definition of water discharge

Because the definition of discharge is very broad, in several studies several definitions are given so as not to get out of the predetermined topic, namely "water discharge", therefore only the discharge of river water is discussed.

In hydrology, it is stated that river water discharge is the height of river water as measured by river water level measuring instruments. Measurements are carried out every day, or in other terms, river discharge or flow is the rate of water flow (in the form of water volume) passing through a cross section of the river per unit time. In the SI system of units, the amount of discharge is expressed in units of cubic meters per second (m^3/ dt). In technical reports, flow rates are usually shown in the form of flow hydrographs. Flow hydrograph is a discharge behavior in response to changes in biogeophysical characteristics that are direct in a watershed (due to watershed management) and / or changes (seasonal or annual fluctuations).

The ability to measure flow rate is needed to determine the potential of water resources in a watershed area. Flow discharge can be used as a tool to monitor and evaluate an area's water balance through the approach of potential surface water resources.

2.2. Debit Formation Process

A river is formed by the flow of water from one or several water sources that are at an altitude, for example on a hilltop or high mountain, where a lot of rainwater falls in the area, then collects in a sunken part, over time it is too full, finally flows out through the lip of the basin that is most easily eroded by water, then the water will flow over the lowest ground surface, maybe at first evenly, but because there are parts on the surface of the ground that are not so hard, it is easily eroded, so that it becomes the channel created is getting longer and longer, along with the heavier and more frequent water flows in the channel, the longer and deeper the channel will bend, or branch,If the water flowing there is blocked by a rock as big as the channel, or a lot of stones, as well as a river below the surface of the ground, it occurs from water flowing from above, then it finds the parts that can be penetrated below the ground surface and flow into the direction of the lowlands over time the river will get wider.

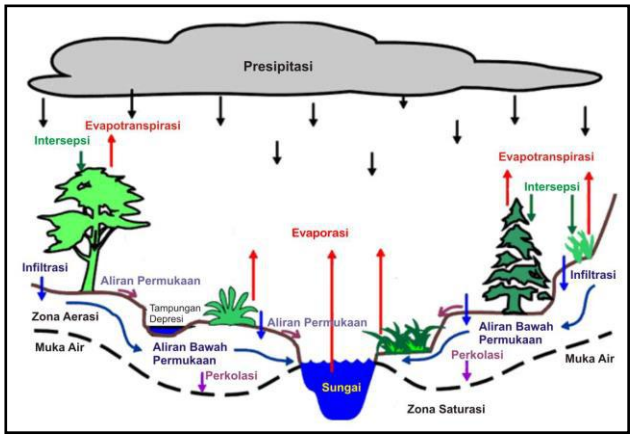

Fig.1: Hydrological cycle

2.3. Determinants of Water Discharge

1. Rain intensity

Because rainfall is one of the main factors that has a seasonal component that can quickly affect water discharge, and an annual cycle with the characteristics of a long rainy season (short dry) or long dry season (short rainy season). Which causes an increase in water discharge.

2. Deforestation

The main function of forests in relation to hydrology is to retain soil that has a high slope, so that the rainwater that falls in the area is retained and seeps into the ground to become groundwater. Groundwater in the upstream area

is a water reserve for river water sources. Therefore, a well-preserved forest will provide benefits in the form of availability of water sources during the dry season. It is better if the deforested forest will be disastrous for the people upstream and downstream. In the rainy season, rainwater that falls on barren land will erode the land with high slopes. Most of the rainwater will be runoff and very little infiltration. The result is landslides and / or flash floods that carry mud deposits.

3. Forest conversion into agricultural land

The risk of clearing forest for agricultural land is as great as deforestation. A decrease in river water discharge can occur due to erosion. In addition to increasing suspended solid content in river water as a result of sedimentation, increased water fertility will also be followed by increasing nutrient content in river water. Most of the forest areas that are converted into agricultural land have a slope of above 25%, so if you don't pay attention to soil conservation factors, such as cropping patterns, making terraces and others.

4. Interception

Is the process when rainwater falls on the surface of the aboveground vegetation, is held for a while, to be evaporated back into the atmosphere or absorbed by the vegetation concerned. The interception process occurs during rainfall and after the rain stops. Whenever rain falls in a vegetated area, there is some water that never reaches the ground surface and thus, although interception is considered not an important factor in determining the water discharge factor, watershed managers must still take into account the size of the interception because the amount of water lost as interception water can affect regional water balances. Changing from one type of vegetation to another, a different type of vegetation, for example, can affect water yield in the area.

5. Evaporation and Transpiration

Transpiration evaporation is also one of the components or groups that can determine the size of the water discharge in a watershed area, why is it said to be a determining component of water flow, because through these two processes it can create new water, because these two processes evaporate water from the water surface , soil and leaf surfaces, as well as plant branches so that they form moisture in the air. With the presence of water vapor in the air, rain will occur, with this rain, the water discharge in the watershed will also increase. Little by little.

2.4. Normalization of Streams and Embankments

River normalization is an attempt to increase the drainage capacity of the river itself. Flood handling in this way can be done in almost all rivers downstream. The factors that are necessary in this method of handling are the use of a double section with a dominant discharge for the lower section, planning a stable channel against the process of riverbed erosion and sedimentation as well as cliff erosion and flood water level.

2.5. Flood Control Flow Making (Flood Way)

The creation of a Flood Way is intended to reduce flood discharge in the old river channel and flow it through the flood way. Making a flood way can be done if the local conditions are very supportive, for example the availability of a river channel that will be used for the flood way. The factors that need to be considered in planning a flood way include:

a. Whether it is difficult to carry out normalization in accordance with the discharge design on the old channel that passes through the city.
b. Whether land acquisition is difficult or not if the normalization or floodway is carried out.
c. The condition of the old channel which turns too far to go out to sea is very unfavorable from a hydrological point of view.
d. There is a path for a new, shorter channel to the sea using the existing small river.
e. There is no disruption in the use of existing water resources.
f. The size of the negative impact on the social and economy caused.

2.6. Retarding Basin Creation

In the making of the Retarding Basin, the depression area is needed to accommodate the volume of flood water that will come from the upstream, temporarily and then release it again when the flood recedes. Flood handling in this way is highly dependent on field conditions. Meanwhile, areas of basins or depressions that can be used for flood ponds must consider the following:

1. The basin area that will be used as a retention area must be an area that is not effectively utilized and has low productivity.
2. Utilization of the retarding basin must be beneficial and effective for the areas downstream.
3. The area must have the potential and be effective as a retention area.
4. The area must have a large storage area or volume, as for the buildings required to handle floods in this way, namely:
5. Reservoir embankment
6. Pool door

2.7. River Normalization

River normalization is mainly carried out in relation to flood control, which is an effort to increase river

drainage capacity. This is intended to accommodate the flood discharge that occurs and then be channeled into a larger river or directly to the estuary / sea, so that there is no runoff from the river. River flow normalization work basically includes activities consisting of:

1. Flood discharge calculation plan
2. Analysis of the initial capacity of the river (existing capacity analysis)
3. Calculation of the cross section and longitudinal design of the river
4. Doing a sudan on the meander river flow
5. Determine the height of the guard
6. Stabilizes the groove against erosion, landslides
7. Embankment Planning
8. Overview of the effect of back water due to tides

2.8. Calculation of Planned Flood Discharge

There are several methods for estimating the peak flow rate (flood discharge). The method used at a location is more determined by the availability of data. In practice, the flood discharge estimation is carried out by several methods and the planned flood discharge is determined based on technical considerations (engineering judgment). The calculated flood discharge plan results will later be used to dimension the river cross section to be normalized. The calculation of the flood discharge plan is divided into two, namely:

a. Planned Flood Discharge based on Rainfall

The amount of river flood discharge is determined by the amount of rainfall, the time of rain, the area of the river basin and the characteristics of the river basin. To calculate the planned flood discharge based on rainfall, the Java-Sumatra, Rational, Melchior, Weduwen, Haspers, and Gama I FSR methods can be used.

b. Planned Flood Discharge Based on Discharge Data

The amount of river flood discharge is determined by the amount of discharge, rain time, and the area of the river basin. To calculate the planned flood discharge based on the discharge, the Unit Hydrograph and Passing Capacity Method can be used. In the event that the discharge data is obtained which is long enough statistically and probabilistically, the frequency analysis method can be directly used without observing the rainfall event However, if the discharge data is not available or is not long enough, it is necessary to collect rainfall data.

c. Distribution Parameters

In statistics, there are several parameters related to data analysis, including the average, standard deviation, coefficient of variation, and skewness coefficient (skewness). The Flood Discharge Distribution parameter is used to calculate the estimated flood discharge with a certain return period from the existing annual maximum flood discharge data.

d. Frequency Distribution for Flood Discharge Data Analysis

In statistics there are several types of frequency distribution, four types of distribution that are widely used in the field of hydrology are:

1). Normal Distribution

2). Normal Log Distribution

3). Log-Person Distribution III

4). Gumbel distribution

1. Normal Distribution

The normal distribution or normal curve is also called the Gauss distribution. The best known probability density function (PDF) is the bell form and is known as the normal distribution.

2. Log-Person Distribution III

In certain situations, although the data estimated to follow the distribution has been converted into a logarithmic form, it turns out that the closeness between data and theory is not strong enough to justify the use of the Log Normal distribution. Person has developed a series of probability functions that can be used for almost any empirical probability distribution. Unlike the concept behind using the Log Normal distribution for peak floods, this probability distribution is hardly theory based. This distribution is still used because of its flexibility

2.9. River Initial Capacity Analysis (existig)

To analyze the initial capacity of a river, a program called HEC-RAS (Hydrologic Engineering Center - River Analysis System) is used. It is a program package from USCE (United State Corps of Engineer). This software can be used to perform Fixed Flow and Unstable Flow calculations (SteadyFlow and Unsteady Flow).

The Tuntang River is a natural river with a cross section of the river that is irregular (non uniform) and meandering river. In connection with the flow that occurs is in the form of non-uniform flow, and to speed up the calculation process the HEC-RAS program is used. Whereas for artificial rivers or channels with uniform cross-sections, the flow that occurs is in the form of uniform flow and can be solved using the Continuity Equation and the Manning formula.

The main components covered in this HEC-RAS analysis are:

- Calculation of the steady flow water surface profiles computations
- Unsteady flow simulation and water level profile calculation These components calculate the water level profile by an iterative process from input data that has been processed according to the criteria and standards required by this program package. While the output of this program can be in the form of graphs or tables. Among them are plots of river flow schemes, cross sections, profiles, rating curves, hydrographs (stage and flow hydrograph), as well as other hydraulic variables. Besides that, it can also display a combination of cross sections that form a three-dimensional river flow complete with its flow.

2.10. Planning River Cross Section Plan

River cross sections need to be planned to obtain ideal and efficient cross sections in land use. The ideal cross section which is meant to be a section that is stable to changes due to the influence of erosion and the influence of the flow pattern that occurs. While efficient land use is intended to pay attention to available land, so as not to cause problems with land acquisition.

Factors that must be considered in designing river normalization cross-sectional shapes are:

• River sediment transport

• Comparison of dominant discharge and flood discharge

In general, the downstream river channel has a very low ratio of water level to river width (h / B), double cross-section shape, very gentle riverbed slope and low drainage capacity. So that to increase the drainage capacity during a flood, a double section is made, by increasing the wet cross-sectional area of the riverbank utilization. The cross-sectional shape of the river is strongly influenced by the cross-sectional shape factor based on the flow capacity, namely the cross-sectional capacity will remain even though the shape changes.

It should be noted that the cross-sectional shape of the river is the most stable. The cross-sectional plan of the TuntangHilir River is planned to be in the form of a trapezoid with a bank. The sectional plan with the following considerations:

- The river channel is able to pass the planned flood discharge
- Riverbeds also need to be considered against scouring hazards

2.11. Making Short Cut

Shading is only carried out on very critical winding river channels and is intended so that floods can reach the downstream or sea quickly by considering a stable river flow. The thing that really needs to be considered in making a sudetan is that the result of the sudetan does not cause a problem of flooding in the downstream part because there will be an increase in the amount of the flowrate and when the flood arrives because there will be an increase in the flow rate and when the flood arrives is shorter, so that it will lower the water level. flooding upstream and adding to flooding in the downstream. Based on the aforementioned considerations, the work of the sudetan is carried out in the river channel downstream of the protected area and must be balanced with river normalization in the downstream side of the sudetan.

1. The purpose of doing this is sudetan
2. The direction of the groove
3. Cross section of the Sudetan river
4. Attempts to maintain the sudan function
5. The effect of lowering the water level in the upstream corner of the environment
6. Effect of reduced flood retention function
7. An overview of the socio-economic aspects

2.12. Effect of Back Water Due to Tides

In flood control, it is necessary to pay attention to the water level during floods along the river and the flood water level due to back water. This is based on the consideration that the presence of runoff on some of the embankments will result in the collapse of the embankment, which is a failure of the flood control system. The method commonly used in calculating the effect of back water is the steady non-uniform flow hydraulic analysis method, especially for rivers that have irregular cross-sectional shapes and varying riverbed slopes.

III. METHODOLOGY

3.1. Time and Location

1. Research time
   The research was carried out in October 2019.
2. Research sites
   This research was conducted in Lilioboy Village, West Leihitu District, Central Maluku Regency

3.2. TechniqueData analysis

Analysis of the development of the availability of water sources in Lilioboy Village using the following analysis techniques:

Various data were collected, then processed and grouped towards the development of the availability of water sources in order to determine alternative solutions to problems related to the topic being carried out

3.3. Tools and Materials

The tools and materials used in this study are as follows: Current meter, meter, stop watch, writing instruments, buoys and measuring tubs

Fig.2: Map of the Research Location

3.4. Research Methods

The method used in this research is the profile method (cross section) by placing an unsinkable object on the surface of the river flow for a certain distance and recording the time required for the floating object to move from one point of observation to another observation point that has been carried out.

3.5. Data Retrieval Technique

a. Preparation phase

Literature study to find preliminary information related to the focus to be studied

b. Implementation Stage

- secondary data collection from related agencies in the form of land change development, social life, public service facilities, instructors and various government policies in the form of documents related to research problems.
- Primary data collection is obtained from direct observation or observation in research

3.6. Research Flowchart

Schematically the methodology is presented visually in the form of a flow chart as follows:

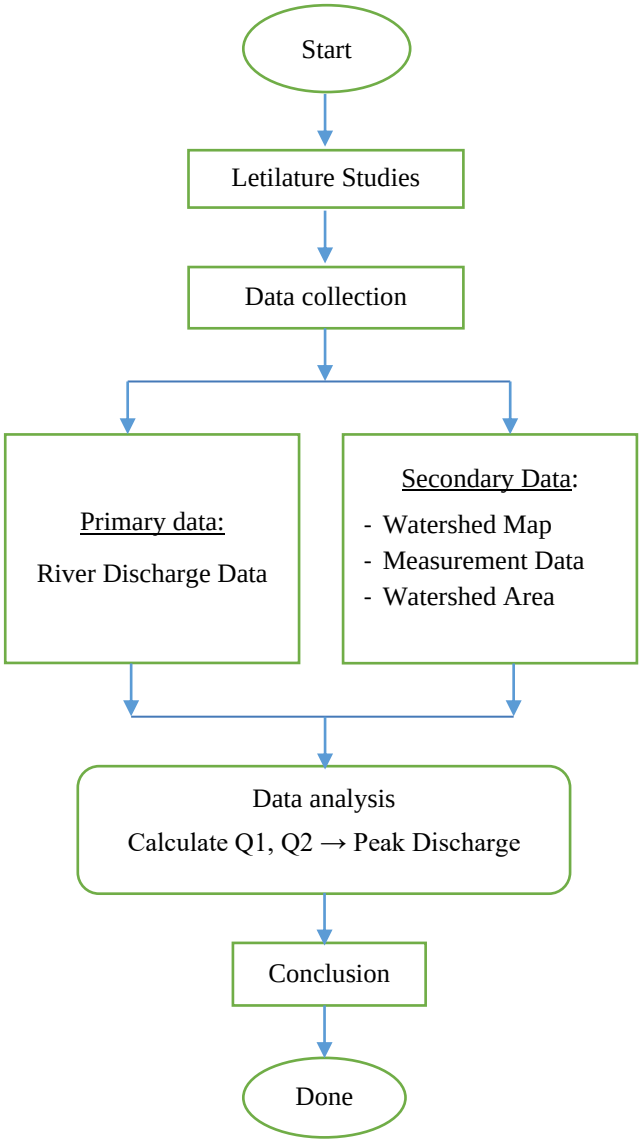

Fig. 3: Research Flowchart

IV. ANALYSIS AND DISCUSSION

4.1. Measurement of Flow Speed with Current Meter

Flow velocity measurement with Current meter can produce an adequate flow velocity estimate. The principle with measurement with this method is to measure the flow velocity of each depth at a certain interval point with the following measurement steps:

1. Choose a measurement location on a part of the river that is relatively straight and not much eddy.
2. Divide the cross-section of the same river by certain intervals.
3. Measure the flow rate at a certain depth according to the river depth at each point of the interval.
4. Calculate the average flow velocity.

4.2. River Flow Discharge Calculation Analysis

In this study, 2 (two) sample segments of the location representing a typical river channel with varying widths

and depths of the river represent their respective characters, as for the flow rates in each river flow segment, namely:

$Q = A. V$

Where: Q = Flow Discharge (m^3 / s)

A = Cross-sectional Area (m^2)

V = Flow Velocity (m / s)

4.3. Water discharge measurement data in the Way Sikabiry watershed

Upstream:

- River width 73.00 meters
- Cross-sectional area 1.75 $meter^2$

Downstream:

- River width 87.00 meters
- Cross-sectional area of 1.89 $meters^2$

Table.1: Upstream Discharge Measurement Data

Rai (m)	Width (m)	In (m)	In Wheel (m)	Number of Turns	Time (seconds)	Speed On Point
0.00	MA. LEFT	0				
1.00	1.00	0.22	0.6	88	40	0.563
2.00	1.00	0.28	0.6	89	40	0.568
3.00	1.00	0.25	0.6	81	40	0.518
4.00	1.00	0.18	0.6	22	40	0.152
5.00	1.00	0.06	0.6	0	40	0
6.00	1.00	0.02	0.6	0	40	0
7.00	1.00	0.1	0.6	0	40	0
8.00	1.00	0.1	0.6	33	40	0.216
9.00	1.00	0.1	0.6	6	40	0.055
10.00	1.00	0.08	0.6	57	40	0.369
11.00	1.00	0.1	0.6	45	40	0.289
12.00	1.00	0.09	0.6	11	40	0.084
12.50	MA. RIGHT	0.00				

(Source: Analysis Results)

Table.2: Downstream Discharge Measurement Data

Rai (m)	Width (m)	In (m)	In Wheel (m)	Number of Turns	Time (seconds)	Speed On Point
0.00	MA. LEFT					
1.00	1.00	0.17	0.6	13	40	0.095
2.00	1.00	0.24	0.6	62	40	0.397
3.00	1.00	0.26	0.6	86	40	0.549
4.00	1.00	0.26	0.6	40	40	0.516
5.00	1.00	0.24	0.6	80	40	0.51
6.00	1.00	0.2	0.6	61	40	0.394
7.00	1.00	0.15	0.6	50	40	0.321

8.00	1.00	0.1	0.6	48	40	0.308
9.00	1.00	0.14	0.6	62	40	0.401
10.00	1.00	0.07	0.6	33	40	0.217
11.00	0.75	0.02	0.6	0	40	0
11.50	MA. RIGHT	0.00				

(Source: Analysis Results)

4.4. Results of Water Discharge Analysis in the Way Sikabiry Watershed

Table 3: Analysis Results of Upstream Discharge Measurement

Average Speed (m)	Area (m^2)	Discharge (m^3 / s)
0.563	0.22	0.12386
0.568	0.28	0.15904
0.518	0.25	0.12950
0.152	0.18	0.02736
0	0.06	0.00000
0	0.02	0.00000
0	0.1	0.00000
0.216	0.1	0.02160
0.055	0.1	0.00550
0.369	0.08	0.02952
0.289	0.1	0.02890
0.084	0.0675	0.00567
Total 2,295	1.56	0.53095

(Source: Analysis Results)

Table 4: Analysis Results of Downstream Discharge Measurement

SpeedAverage (m)	Area (m^2)	Discharge (m^3 / s)
0.095	0.17	0.01616
0.397	0.24	0.09428
0.549	0.26	0.14274
0.516	0.26	0.13416
0.51	0.24	0.12240
0.394	0.2	0.07880
0.321	0.15	0.04815
0.308	0.1	0.03080
0.401	0.14	0.05614
0.217	0.07	0.01519
0	0.015	0.00000
Total	1.85	0.73981

(Source: Analysis Results)

Note :

If the measurement is made at 1 point (0.5 or 0.6 d) sample (vertical 2) then V - average = V at that point.

Current meter register number: 348235 (C31) & 339968 (C2)

Current meter formula:

n <1.01 V = 0.2397. n + 0.018

1.01 n <8.06 V = 0.2556. n + 0.002

8.06 ≤ n <9.82 V = 0.2494. n + 0.052

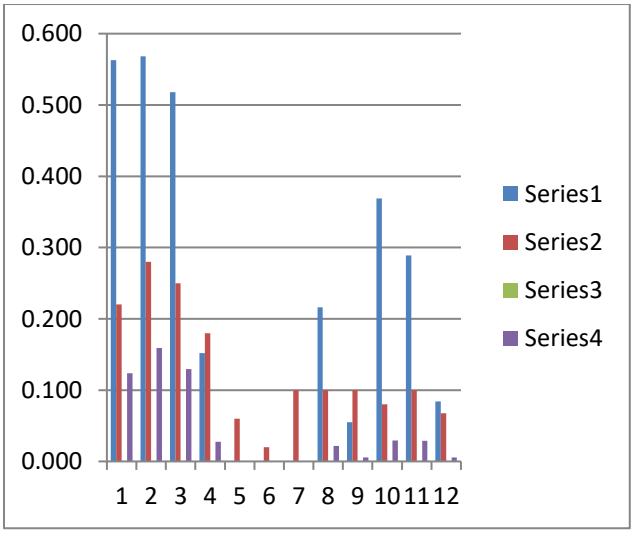

*Fig.4: Depth Measurement Data Graph*Upstream

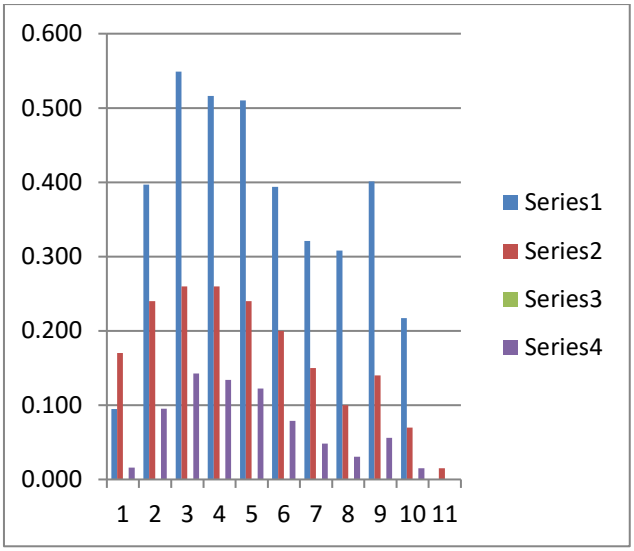

*Figure 5: Depth Measurement Data Graph*downstream

Table 5: Comparison of Analysis Results for Flow Velocity, Upstream and Downstream Water Discharge.

Flow Typical	Depth (m)		Tilt (degree)	Cross-sectional Area (m^2)	Kec. Flow (m / s)	Discharge (m^3 / s)
	Minimum	Maximum				
Upstream	0.10	0.28	15 s / d 20	1.75	0.34090	0.53095
Downstream	0.10	0.26	30 to 35	1.89	0.40098	0.73981

(Source: Analysis Results)

V. CONCLUSION AND SUGGESTION

5.1. Conclusion

Based on the results of the analysis of water discharge calculations based on the cross-sectional area and flow velocity of the two typical / character watersheds upstream and downstream as follows:

1. The scouring pattern that occurs in the Way Sakabiry watershed results in large downstream water flows but high flow rates while in the upstream it produces small flow rates but low flow rates.
2. The amount of water discharge in the Way Sakabiri watershed upstream = 0.53095 m^3 / second while in the downstream = 0.73981 m^3 / second.

5.2. Suggestion

In planning the water structure (river talud) it is necessary to take into account the potential for scouring, especially in the watershed, to the next researcher.

REFERENCES

[1] Arsyad, S. 2006. Soil and Water Conservation. IPB Press. Bogor
[2] ChayAshdak. 2002. Hydrology and Watershed Management. GadjahMada University Press. Yogyakarta
[3] Effendi, Hefni. 2003. Study of Water Quality for Management of Aquatic Resources and Environment. Kanisius, Yogyakarta.
[4] Rayes. L. 2007. Management of Soil and Water Resources. Andi.Yogyakarta.
[5] Soewarno. 2000. Hydrology. Nova. Bandung
[6] Suwandi, 2000. Assignments of Hydrology Subject Papers. Faculty of Forestry UGM. Yoyakarta.
[7] Soeseno, Slamet. 1971. Integrated Watershed Management. Kanesius, Yogyakarta.