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Analysis of The Puncak Tumada Drinking Water Network System Using Epanet Software

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ABSTRAK

Tumada village is a village located in kapontori district of buton regency, with a population of 630 people where clean water needs are obtained from access to water sourced from springs by the method of flowing using pipes by gravity so that water needs can be met. The height of the tank source is at the high point of Elv = ± 24.27 MDPL while the highest place for water use is Elv = ± 50 MDPL. Those who do not get this water source are those who are located in sma and in the peak area of tumada where the number of KK = 7 To improve water management, the water is first accommodated in the tank and flowed by gravity, where the elevation elevation of the Elv tank placement = ± 63. With the analysis obtained pipe sizes of 12.5 mm, 25 mm, 50 mm with a tank capacity of 6000 liters and pump power can be used with a head of 50 m and flow of 0.5 LPS in addition to that a minimum press of 9.5 m and speed respectively for the main pipe of 0.28 m / s and pipe Divider of 0.16 m / s and discharge in the pipe flow of 0.56 LPS for the main and for divisors of 0.03 LPS and 0.02 LPS.

SEJARAH ARTIKEL
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KATA KUNCI
Water, Irrigation; Epanet; Tumada Peak

1. Introduction

Tumada village is a village located in kapontori district of buton regency, with a population of 630 people where clean water needs are obtained from access to water sourced from springs by the method of flowing using pipes by gravity so that water needs can be met. For areas passed by piping irrigation networks. Those who do not get this water source are those who live in high schools and in the peak area of tumada where the number of KK = 7 with the number of souls approximately 28 people and 3 food stalls. For access to clean water, it is usually used to use cergen and carried by vehicle because the Elevation of the area cannot be flowed by piping irrigation by Gravity. So for conditions in order to be younger to access clean water, a piping irrigation system is used with the help of a pump.

The height of the tank source is at the high point of Elv = ± 24.27 MDPL while the highest place for water use is Elv = ± 50 MDPL. To improve water management, the water is first accommodated in the tank and flowed by gravity, where the elevation of the Elv tank placement = ± 63

2. Theoretical Foundations

Regulation of the Minister of Health Number 492 of 2010 explains that drinking water is water that goes through a treatment process or without a treatment process that meets health requirements and can be directly drunk(Ramadan, 2014)

According to Apriadi, raw water for clean water is water that must be able to be used continuously with relatively fixed discharge fluctuations, both in the dry and rainy seasons. The continuity requirement for the provision of clean water is closely related to the quantity of water available, namely raw water in nature. Ideally, people should get clean water and even drinking water whenever needed for 24 hours. Water use is prioritized, which is at least 12 hours per day during peak hours, namely at 06.00 – 18.00 (Zamzami, et.al., 2018).

2.1 Water Requirements

Moegijantoro explained that water needs are the amount of water needed for household, industrial, urban pouring and others. Priority water needs include domestic water needs, industry, public services and water needs to replace leaks in addition to the need for water categorized in domestic and non-domestic water needs. Domestic water needs are water needs that are used for household purposes, namely for drinking, cooking, bathing, washing clothes and other purposes, while non-domestic water needs are used for offices, places of worship, commerce and others (Asta, 2018).

Sedangkan Kimpraswil menjelaskan bahwa Kebutuhan air domestik adalah kebutuhan air bersih bagi para penduduk untuk kepentingan kehidupan sehari-hari. Kebutuhan air domestik dihitung berdasarkan pada besarnya kebutuhan air dari setiap pelayanan sambungan (Naway dkk, 2013).

Kebutuhan Air domestik :

Qd = Sd* Pn

Kimpraswil dalam Naway dkk, (2013) also explained that non-domestic water needs are clean water needs for regional facilities and infrastructure that are identified as existing or will exist based on spatial plans. Facilities and infrastructure in the form of social / public interests such as for education, places of worship, health, and also for commercial purposes such as for hospitality, offices, restaurants and others. In addition, it is also for industrial purposes, tourism, ports, transportation and others. Non-domestic water requirements:

Domestic Water Needs:

Qn = Sd* Pn

Sutrisno and Suciastuti explained that water loss is generally caused by water leakage in the transmission and distribution pipes as well as errors in meter readings. Determination of water leakage/loss is carried out with the assumption of 20%(Naway dkk., 2013)

Qa =(Qd + Qn) r_a

Total water demand is the total water needs both domestic, non-domestic plus water loss.

Qt = Qd + Qn + Qa

R. Sahmbar explained that efforts to meet the needs of clean water can be done in various ways, this is adjusted to the available facilities and infrastructure (Diyanti & Fani Yayuk Supomo, 2021).

The distribution of clean water can be done by piping and non-piping. In Indonesia, piping systems are managed by PDAMs and non-piping systems are usually managed by the communityindependently (Selintung, 2012).

Each flow of water in the pipe must meet the principle of continuity, where the discharge entering within side 1 is equal to the discharge that comes out on side 2 that is Q1=Q2, with the discharge equation as below

Q = V.A

Where:

Q : Discharge (m^3/s)

V : Flow Speed (m/s)

A : Cross-Sectional Area (m^2)

2.2 Water Pressure Requirements

Menurut Hau'Oni water pressure is the force that urges water within the wall/container that loads it (pipe wall, tub wall or water storage area). Therefore, pressure is categorized into two types, namely static / hydrostatic pressure and dynamic / hydrodynamic pressure. Static/hydrostatic pressure is the thrust force by water on the walls of the pipe when all faucets are closed (water does not flow in the pipe). Dynamic/hydrodynamic pressure is the thrust force by water on the pipe walls when the faucet is opened (Zamzami dkk., 2018).

Anonim menjelaskan for water flowed to consumers through transmission pipes and distribution pipes is designed to be able to serve consumers to the farthest place, with a minimum water pressure of 10 mka or 1 atm. In the distribution of water, to be able to reach the entire service area and to maximize the level of service, the mandatory thing that must be considered is the remaining water pressure. The remaining water pressure is the lowest is 5 mka (water column meter) or 0.5 atm (one atm = 10 m) and the highest is 8 atm or equivalent to 80 m (Zamzami dkk., 2018).

2.3 Piping Network Design

Triadmodjo explained that in Piping Network Design The flow in a pipe on a piping network can generally be classified as turbulent flow. The Hazen –Williams formula is one of the empirical and simple formulas and is very commonly used in the piping industry

2.4 Epanet

Lewis A. explains that EPANET is a computer program that describes hydrolyzing simulations and quality tendencies of water flowing inside pipelines. thecoupling itself consists of a Pipe, a Node (pipe connection point), a pump, a cathode, and a water tank or reservoir. EPANET explores the flow of water in each pipe, the condition of the water at each point and the condition of the concentration of chemicals flowing in the pipe during the jetting period. In addition, water age and source tracing can also be simulated. In addition, EPANET is designed as a tool to achieve and realize an understanding of the movement and fate of drinking water content in the distribution network. It can also be used for various analysis of various distribution network applications. For example, for design making, calibrating hydraulic models, analyzing chlorine residues, and customer analysis. EPANET can assist in the management of strategies to realize thequality of water in a system (Ramadhan, 2014).

Nelwan Explained that Epanet Software 2.0 is one of the software that can simulate the distribution system of a raw / clean water network or drinking water in a certain area. mentions that epanet is a komputer program that describes the quality of water flowing in a pipeline network and hydrolysis simulation. The data needed when going to perform the simulation, namely pipeline data, customer data, elevation, discharge, and pressure. The hasil output of the epanet 2.0 simulation is a distribution pattern of the discharge flowing in the pipe as well as the water pressure in the pipe (Diyanti & Fani Yayuk Supomo, 2021).

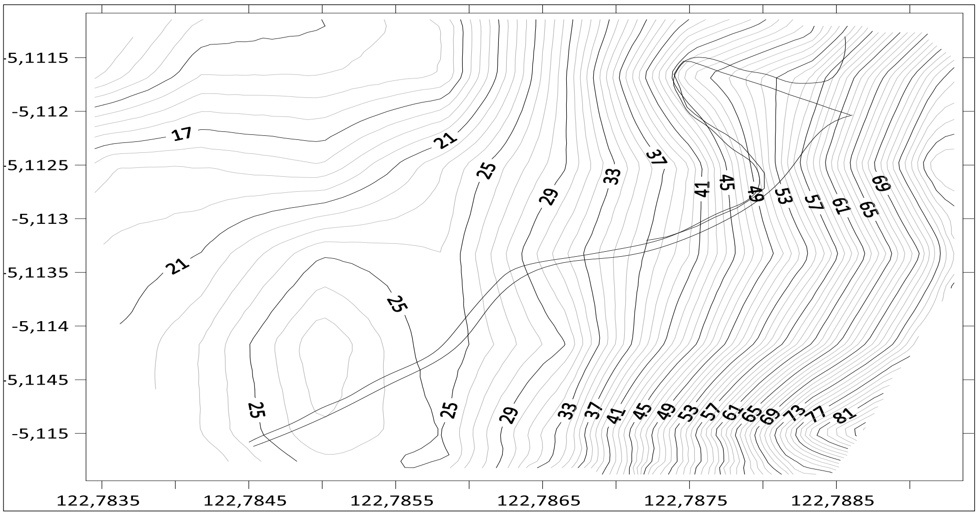
3. Implementation Methods

3.1 Research Location

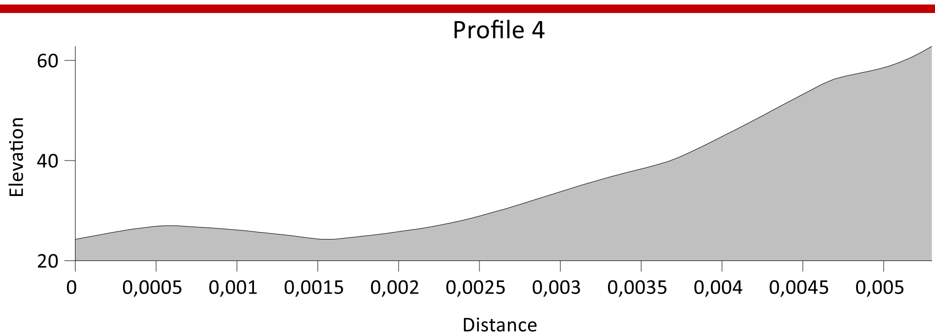
Research on the distribution network system was carried out in tumada village, Kapontori district, at the coordinates of -5.111590, 122.787428 with the following location description:

Picture 1. Peak Location

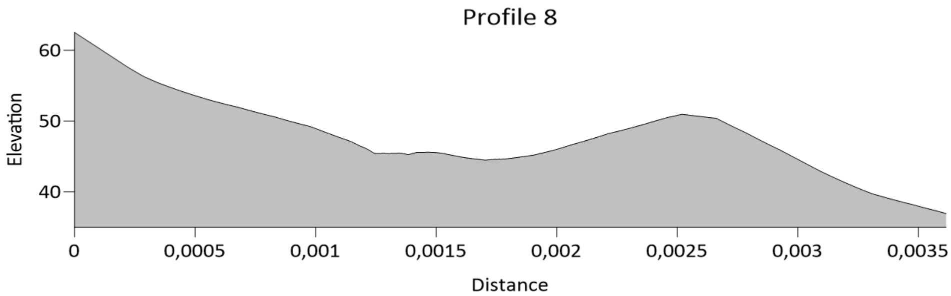
In determining the piping points, we first know the contours to make the piping network flow as for the contours of the map model above as follows:



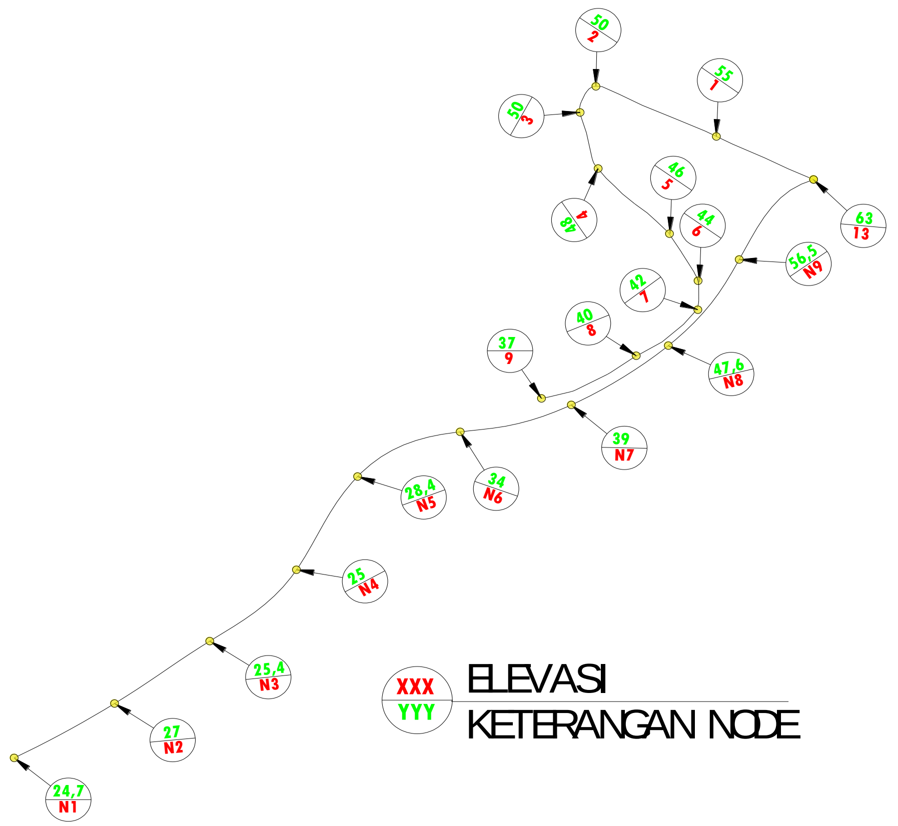
Picture 2. Geometry of the top of the tumada



Picture 1. Elevation of water source to tank



Picture 2. Elevation from Tank to User



Picture 3. Elevation Model and Node Naming

3.2 Calculation of Water Requirements

As for the water requirements for at the top as follows

Total Population = 28 inhabitants

Water Needs = 144 Liters / Person / day

Domestic Water (Qd) = 28*144 = 4032 Liters/Day

Non dosmetic 5% (Qn) = 201 Liters/Day

Water Loss 20% (Qa) = 20% * 4032 = 807 Liters/Day

Total Requirement (Qt) = 4032 + 201 + 807 = 5040 Liters/day or 0.058 or

= 0.06 Liters/second

3.3 Pipe Dimension Calculation

For the determination of the dimensions of the pipe then it is used

Q = V * A where V is limited Speed of at least 0.3 m/s

A = Q / V

= 0.06 *10e-3 /0.3

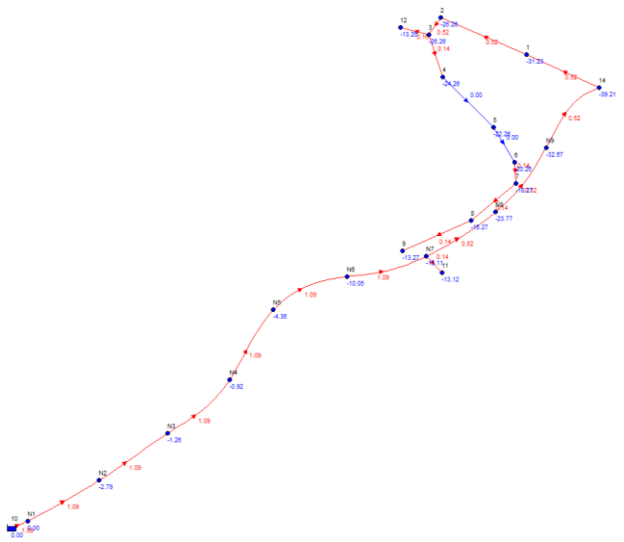
= 0,002 m^2

D = (0.02*4/3.14)$^{0.5}$

= 0.0252 m or usable

= 25 mm then pipe D = 25 mm is used and for the Main pipe 50 mm

3.4 Initial Simulation Without Pump



Network Table - Nodes

Node ID	Demand LPS	Head m	Pressure m	Quality
Junc N1	0.00	24.27	0.00	0.00
Junc N2	0.00	24.20	-2.79	0.00
Junc N3	0.00	24.14	-1.26	0.00
Junc N4	0.00	24.08	-0.92	0.00
Junc N5	0.00	24.01	-4.36	0.00
Junc N6	0.00	23.95	-10.05	0.00
Junc N7	0.00	23.89	-15.11	0.00
Junc N8	0.00	23.86	-23.77	0.00
Junc N9	0.00	23.83	-32.67	0.00
Junc 1	0.00	23.77	-31.23	0.00
Junc 2	0.00	23.74	-26.26	0.00
Junc 3	0.00	23.74	-26.26	0.00
Junc 4	0.00	23.74	-24.26	0.00
Junc 5	0.00	23.74	-22.26	0.00
Junc 6	0.00	23.74	-20.26	0.00
Junc 7	0.00	23.73	-18.27	0.00
Junc 8	0.00	23.73	-16.27	0.00
Junc 9	0.02	23.73	-13.27	0.00
Junc 11	0.02	23.88	-13.12	0.00
Junc 12	0.02	23.74	-13.26	0.00
Junc 14	0.00	23.79	-39.21	0.00
Resvr 10	-0.06	24.27	0.00	0.00

Picture 6. Initial Simulation of Epanet Without Pumps and tanks

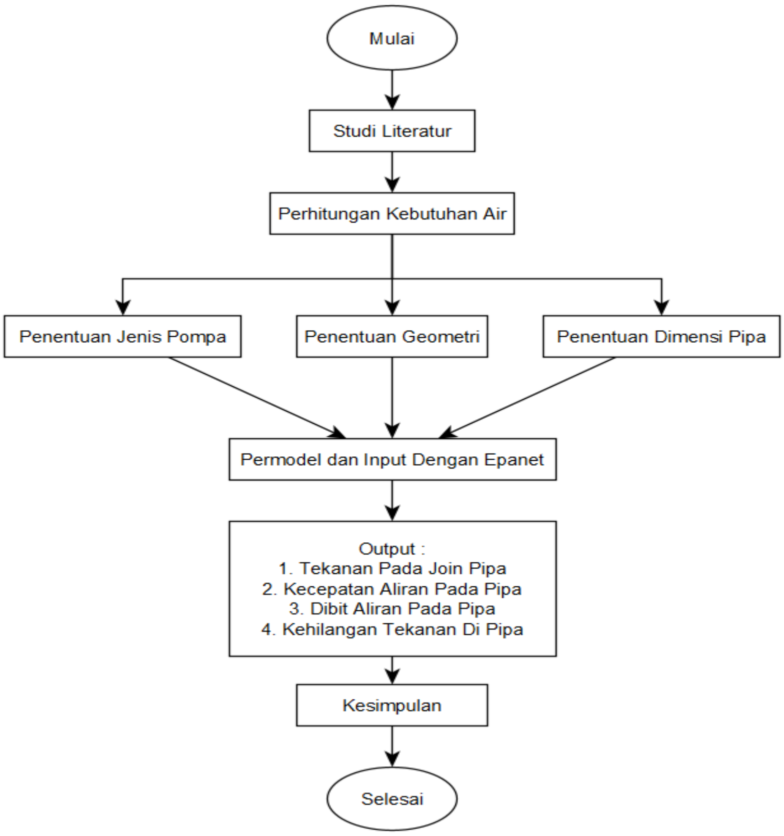
From the data above, the smallest pressure was obtained, namely at Junc 14 in the tank position with a value of -39.21 m and for the required discharge 0.06 LPS

3.5 Pump Determination

The pump used, based on the results of the epanet analysis without a pump, obtained the largest pressure, namely -39.21 to get a pressure above 10, the pump capacity must be 39.21 + 10 = 49.21 or 50m with a minimum pressure of 0.5 LPS, then a pump with the following specifications is used

Picture 4. Dip Pump Model

The research flow chart is as follows:

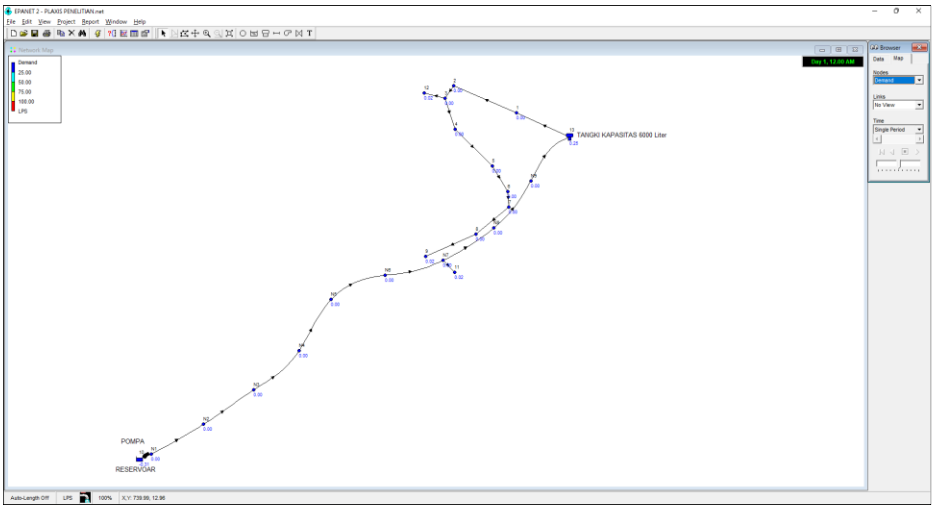


Picture5. Research FlowChart

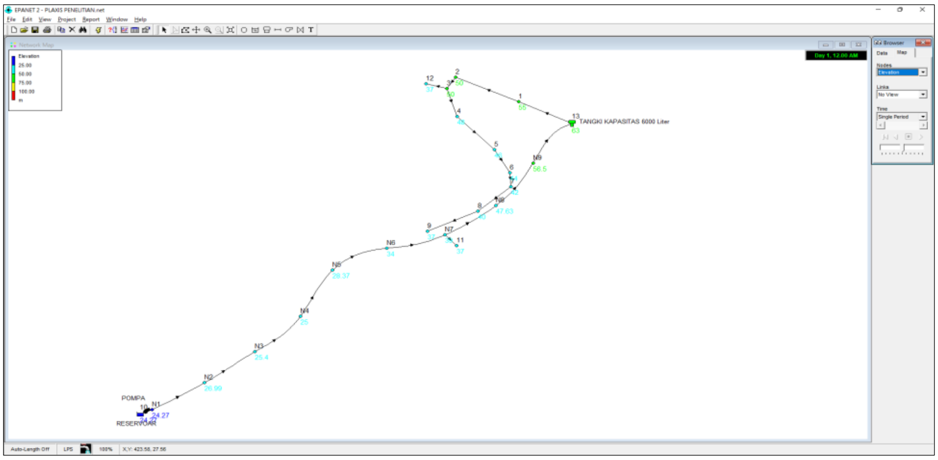
4. Result and Discussion

4.1 Modeling and Data Input

In piping network modeling, in addition to modeling, the value of water needs is inputted with the following demand values:

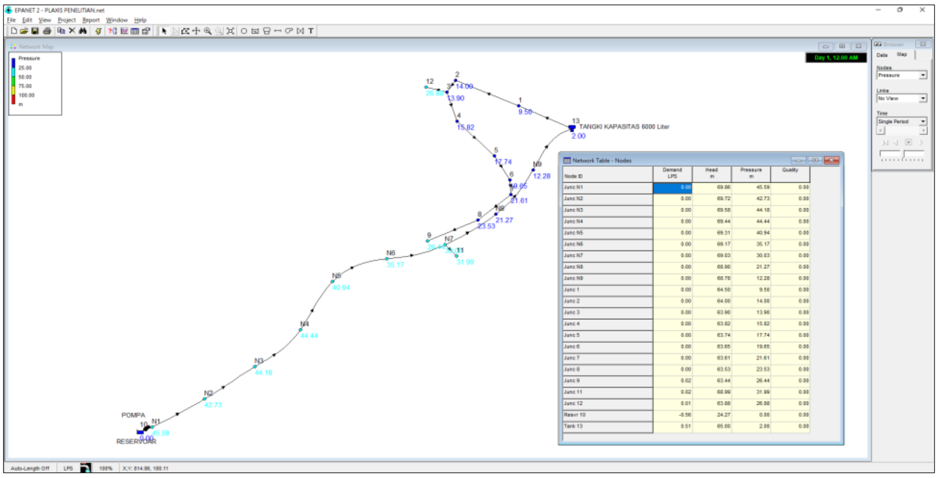


Picture 6. Base Demandx

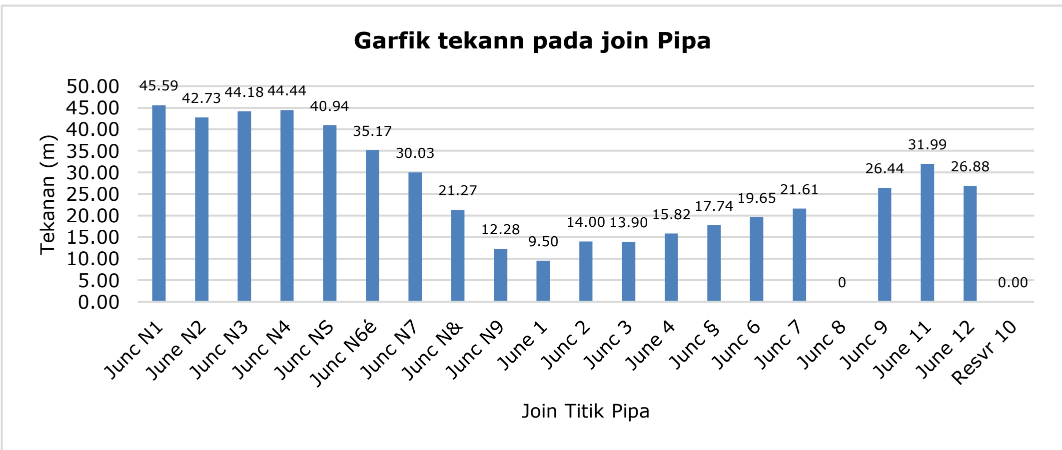


Picture7. *Piping System* Elevation

4.2 Pressure on joins



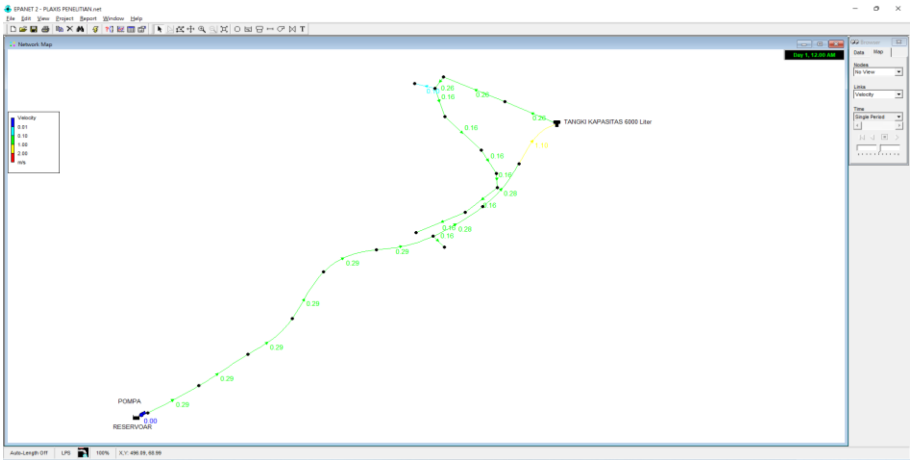
Picture 8. Pressure on the Pipe join



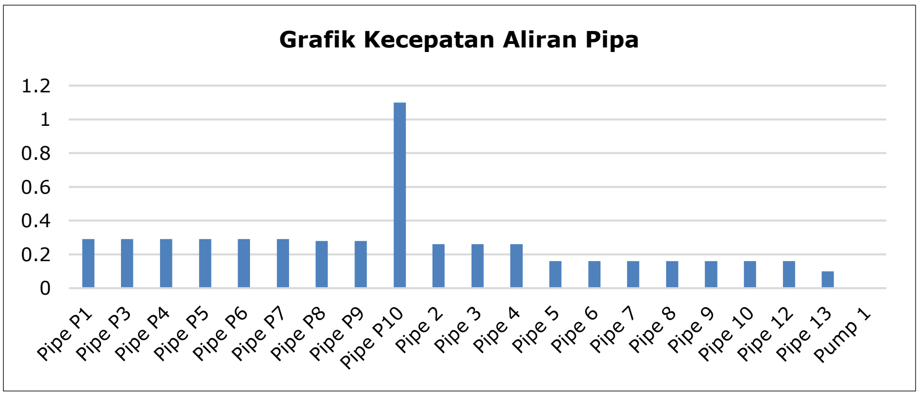
Picture 9. Pressure on the pipe join

Based on the chart above the minimum pressure that occurs at the join point 1 with a value of 9.5m

4.3 Flow Speed on Pipes



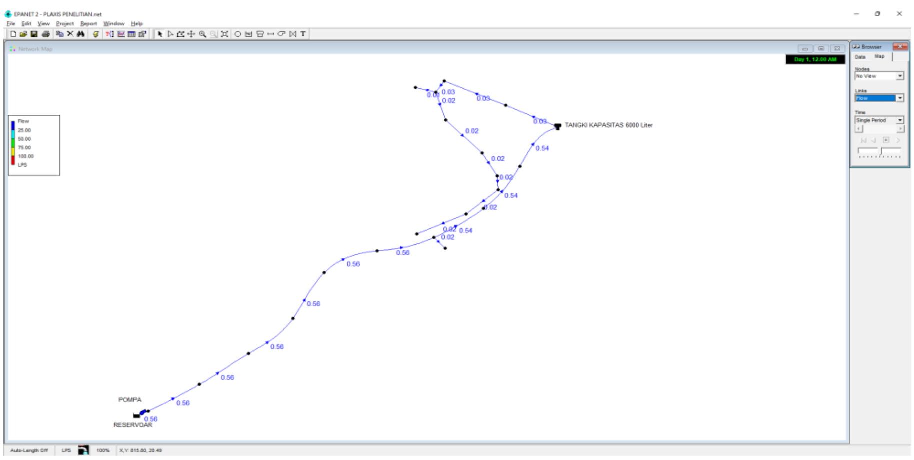
Picture10. Flow Speed in The Pipe



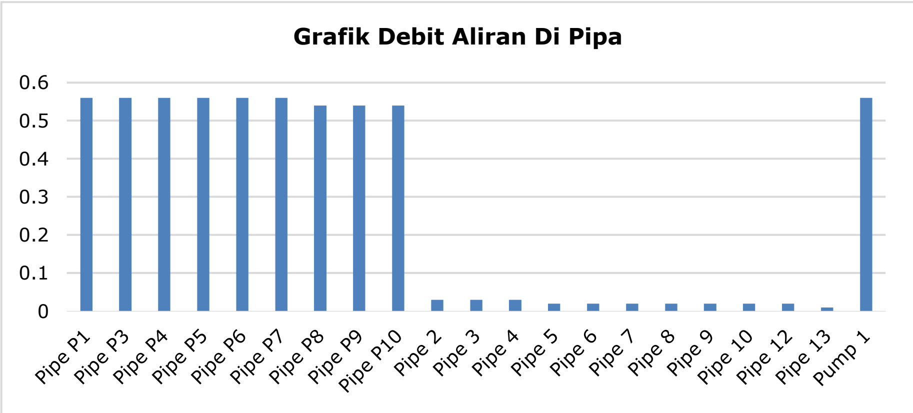
Picture 11. Flow Speed on the Pipe

Based on the values and graphs above, the maximum flow speed occurs in the pipe P10 = 1.1 m / s and is the main pipe, besides the smallest speed in Pipe 13 = 0.16 m / s and is the Dividing pipe

4.4 Flow Discharge In Pipes



Picture12. Pipe Flow Discharge

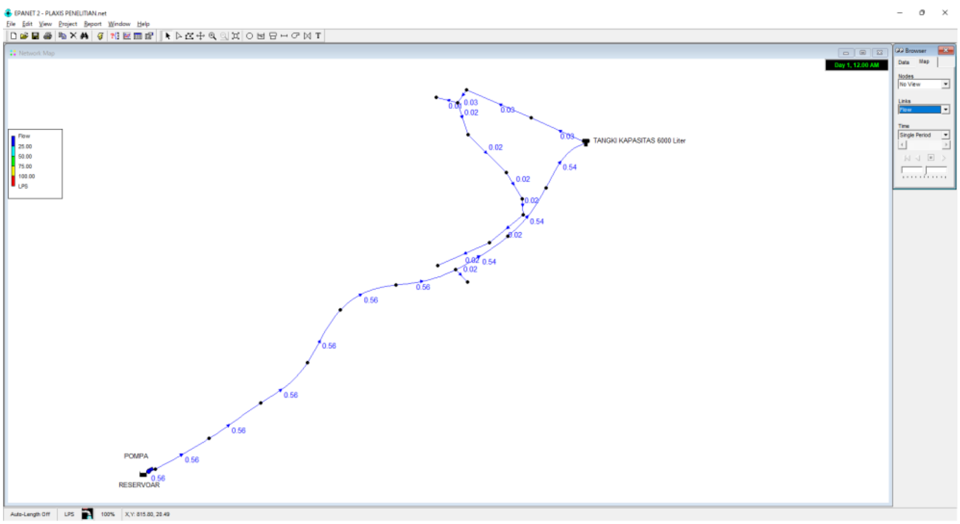


Picture13. Pipe Flow Discharge Diagram

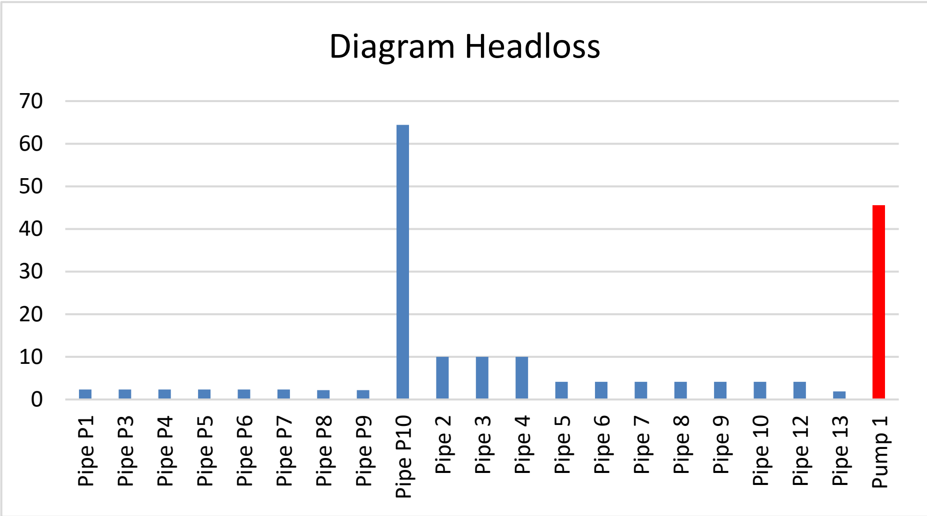
Based on the Graph above the maximum water discharge occurs In Pipes where the maximum discharge i.e. on the maximum pipe

4.5 Loss of Speed On The Pipe (HeadLoss)

In every installation of pressure water pipes, it will definitely experience head loss. Head loss is a pressure drop in the fluid flowing inside the pipe. Head loss in pipe installations is caused by several things, broadly speaking, it is divided into 2, namely major head loss and minor head loss. Major head loss is caused by friction between fludia flowing with the pipe wall and minor head loss caused by several things, including fluid inflow into the pipe (inlet), fluid outflow from the pipe (outlet), pipe connection / fitting or pipe connection without fitting / butt fusion, and finally valve / valve. Below is a picture that explains the position of head loss in a piping installation.



Picture14. HeadLoss Scheme



Picture15. Headloss Scheme Diagram

Based on the Diagram above the largest headloss occurs in the P10 pipeline with a Value of 64.4 m/km

5. Conclusion

Based on the results of the analysis with Epanet and the use of pipe dimensions measuring 2 inches (50 m), size 1 inch (25cm), size 1/2 inch (12.5mm) with a dip pump power of 0.5 LPS and Head 50 m, pressure is obtained on the join for the minimum pressure, which is obtained pressure of 9.5 m, then a minimum speed of 0.16 for the distribution area while 0.26 for the main piping.

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