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Analysis of Clean Water Needs in Soya Village, Sirimau District, Ambon City By Using EPANET 2.2 Software

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Abstract **- Clean water is one of the basic human needs that is needed on an ongoing basis. The use of clean water is very important for household consumption, industrial needs and public places. Because of the importance of the need for clean water, it is only natural that the clean water sector is given top priority for handling because it involves the lives of many people. Fulfilling the need for clean water is highly dependent on the availability of clean water sources, which can be obtained from groundwater and surface water, which can be provided from rivers, springs, weirs and reservoirs/reservoirs. The method of collecting and analyzing the data used in this study was to conduct a survey at the research location to review and see directly the conditions of the research location, then create a piping system that is suitable for the research location, after that calculate population projections and calculate the appropriate water requirements for the project. piping system, and using EPANET 2.2 software to analyze the feasibility of the piping system based on population and water demand. Based on calculations and modeling using Epanet 2.2 software for the distribution of piping network systems in Soya Village, Sirimau District, Ambon City, several conclusions can be drawn, namely the need for clean water needed by the residents of Waisamu Village is 44.45 liters/second, with the total water requirement then modeling the distribution of the piping network system is made using Epanet 2.2 software, and the results obtained are Run Successful, which means the distribution of the piping system runs 100%.**

Keywords **: Water, Hydrolysis, Epanet, Feasibility.**

INTRODUCTION

Clean water is one of the basic human needs that is needed on an ongoing basis. The use of clean water is very important for household consumption, industrial needs and public places. Because of the importance of the need for clean water, it is only natural that the clean water sector is given top priority for handling because it involves the lives of many people. Fulfilling the need for clean water is highly dependent on the availability of clean water sources, which can be obtained from groundwater and surface water, which can be provided from rivers, springs, weirs and reservoirs/reservoirs.

Considering that clean water is an unlimited and sustainable need that must be fulfilled at any time, not only regarding sufficient discharge but in terms of quality it meets applicable standards and in quantity and continuity it must be able to meet the needs of the community it serves. However, in reality what is happening in several regions in Indonesia, the availability of clean water has not been able to meet the needs of the community, this is due to the distribution system that has not been maximized, coupled with population growth which is increasing every year.

Several programs from the Ministry of Public Works and Public Housing have been carried out to assist PDAM in covering areas that have not received clean water to the fullest. As is also the case in Maluku Province, there are several areas on Ambon Island that are still experiencing limitations in the provision of clean water in their villages. Soya Village, Sirimau District is one of the villages whose needs for clean water have not been met properly, even though there has been a clean water program from the Ministry of Labor. Public and public housing which have also entered Soya Village but in reality what has happened has not been sufficient for the daily needs of the people in

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Soya Village. The problem of clean water distribution is also affected by the increasing population that occurs in Soya Village every year, hence the need for a re-evaluation to obtain sufficient water needs for the next few years in Soya Village. And the author also proposes an alternative solution to this problem by using Epanet 2.0 software.

Research Problem

The problems in this paper are:

1. How much clean water do the people in Soya Village, Sirimau District, Ambon City need based on population growth in the next 10 years ?
2. Is the distribution of the piping system able to meet the needs of clean water in Soya Village, Sirimau sub-district, Ambon City ?

Research Objectives

This research has objectives to be achieved, which is:

1. Analyzing the amount of clean water needs in Soya Village, Sirimau sub-district, Ambon City for the next 10 years.
2. Analyzing the distribution of the piping system in Soya Village, Sirimau sub-district, Ambon City.

Research Benefit

This research is expected to provide the following benefits:

1. Can find out the amount of clean water needed in Soya Village, Sirimau District, Ambon City.
2. Can analyze the distribution of the piping system in Soya Village, Sirimau District, Ambon City.

II. LITERATURE REVIEW

A. Water Demand.

Water demand is the amount of water needed for household, industrial and other needs. The priority of water needs includes domestic, industrial, and public service water needs (Pramono & Andana, 2019). Water demand is the amount of water that is reasonably needed for basic human (domestic) activities and other activities that require water. The water requirement determines the size of the system and is determined based on water usage. It is difficult to formulate exact water use by each component (group per house connection), so in planning and calculations assumptions or

Approaches based on city categories are used as shown in Table 2.1. Need Water will be categorized into domestic and non-domestic water needs. Domestic water needs are water needs that are used for household needs, namely for drinking, cooking, bathing, washing clothes and other needs, while non-domestic water needs are used for commercial activities such as industry, offices, and social activities such as schools, hospitals, places of worship and commerce.

B. Terms of Clean Water

In planning a clean water distribution system, of course there are water requirements (Maksum, 2021). these are:

1. Quantity

   The quantity requirement in the supply of clean water is in terms of the amount of raw water available. This means that raw water can be used to meet regional needs and the number of people to be served.

2. Continuity

   Raw water for clean water must be taken continuously with relatively constant debit fluctuations, both during the dry and rainy seasons. Continuity can also mean that clean water must be available 24 hours per day, or whenever needed, water needs are available. However, these ideal conditions can hardly be met in every region in Indonesia, so as to determine the level of continuity water usage can be done by approaching consumer activities towards priority water use. The priority for water use is for a minimum of 12 hours per day, namely during the hours of life activities, namely at 06.00 – 18.00

C. Population Projection

According to the Regulation of the Minister of Home Affairs of the Republic of Indonesia Number 40 of 2012 Population Projection is a scientific calculation of the population in the future based on assumptions about the components of population growth at a

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certain level, the results of which will show the characteristics of the population, births, deaths and migration. Predictions of population in the future are based on the rate of urban development and trends, land use directions and the availability of land to accommodate population growth. It is necessary to know the prediction of the population in the 20-year planning period to determine the clean water needs of the planning area (Taptajani, 2020). By taking into account the rate of development of the population in the past, the statistical method is the closest method for estimating the population in the future.

D. Hydraulic Analysis.

Flow in a pipe or flow in which the entire pipe section is filled with water. If water flows in a pipe but there is a free water surface in the pipe, then the flow is not included in the definition of flow in a pipe (Bratawijaya, 2019).

1. Major Energy Loss

There are several empirical equations that are used each with its own advantages and disadvantages. The Darcy Weisbach equation is most widely used in fluid flow in general. For flows with relatively unchanged viscosity, the Hazen Williams equation is used. Darcy Weisbach's mathematical equation is:

$$Hf = f\,(L.v2 / D.2g)$$

2. Secondary Energy Loss

Local energy loss due to cross-section enlargement, cross-section reduction, diaphragms and pipe bends. Minor energy loss in mathematical language is written as follows:

$$hf = k\,(v2 / 2g)$$

E. Water Pressure Requirements.

According to the DPU (Department of Public Works) standards, water that is channeled to consumers through transmission pipes and distribution pipes is designed to be able to serve consumers to the furthest, with a drinking water pressure of 10mka or 1atm. This pressure figure must be maintained, ideally evenly distributed on each distribution pipe. If the pressure is too high, it will cause the pipe to burst and damage the plumbing tools. The pressure is also kept not too low, because if the pressure is too high (Khotibul, 2021).

1) Brocaptering (Spring Catcher Tub)

Protecting and capturing water from springs to be collected and channeled using transmission pipes to reservoirs.

2) Reservoir (Storage Tub) The function of the reservoir is:
3) As a reserve of clean water when there is damage or repair of the distribution network.
4) As a reserve to meet usage fluctuations.
5) Can function as a pressure relief tub.
6) As a water reserve for fire fighting.

The dimension of power depends on the service reservoir in general, ranging from 17.5% -20% of the average daily water demand. The greater the tamping capacity of the service reservoir, the safer the system is against system damage/repair and fire fighting.

F. Apply Epanet 2.0.

1.Introduction to EPANET 2.0 Software

EPANET is a computer program that provides hydraulic simulations and trends in the quality of water flowing in pipelines. The network itself consists of pipes, nodes (pipe connection points), pumps, valves, and water tanks or reservoirs. EPANET tracks the flow of water in each pipe, the condition of the water pressure at each point and the condition of the concentration of chemicals flowing in the pipe during the flow period. In addition, water age and source tracking can also be simulated (Safitri et al., 2021).

EPANET is designed as a tool to achieve and realize understanding of the movement and fate of drinking water content in distribution networks. Also can be used for various analysis of various distribution network applications. For example for designing, calibrating hydraulic models, residual chlorine analysis, and customer analysis. EPAnet can assist in setting strategies to realize water quality in a system. These include:
Rossman (2000), explains that Epanet is a computer program that describes hydraulic simulations and trends in the quality of water flowing in pipelines. The network itself consists of pipes, nodes (pipe connection points), pumps,

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valves, and water tanks or reservoirs. EPANET tracks the flow of water in each pipe, the condition of the water pressure at each point and the condition of the concentration of chemicals flowing in the pipe during the flow period. In addition, water age and source tracing can also be simulated.

Rossman (2000) also explained that EPANET was designed as a tool to reach and realize an understanding of the movement and fate of drinking water content in distribution networks. Also can be used for various analysis of various distribution network applications.

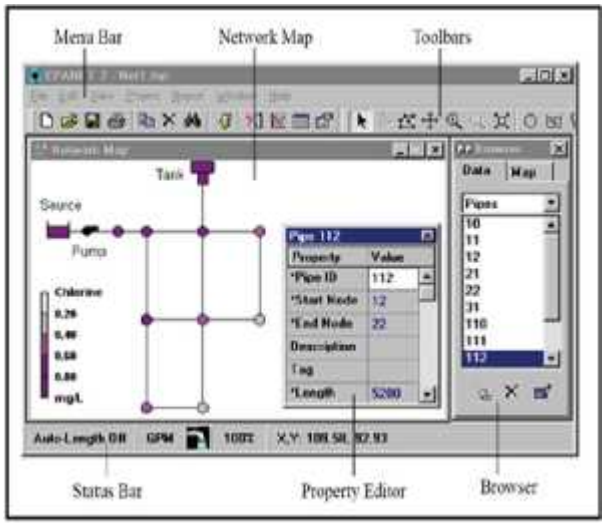

Figure 1. Appearance
(source : Epanet Application 2.0)

The use of software tools makes it easier to analyze the existing conditions of clean water pipelines so as to assist in restructuring existing clean water pipelines.

III. RESEARCH METHODOLGY

A. Data Analysis Techniques

Data analysis was carried out by utilizing methods obtained from literature studies. The steps taken are as follows:

Calculate population projection data for 10 years over the next 10 years.

1. Analyze the demand for clean water for the next 10 years.
2. Analyze piping data using Epanet 2.2 software.

B. Data Collection Techniques

The data collection method used for this purpose includes two parts, namely:

1. Primary Data

Observation, namely data collection by observing the research location directly. Data taken directly at the research location include data, Existing Pipes.

2. Secondary Data

Secondary data, namely data obtained at the village office in the form of population data for the last five years, village maps and other data that supports the research process.

Figure 2. Research Location Map (Source : Google Earth Pro)

IV. RESULTS AND DISCUSSION

A. Pipeline Network Map

Piping Network is a network map that carries water from a reservoir or reservoir to the service network. The following is a map of the pipeline network from Soya Village, Sirimau District, Ambon City

Figure 3. Pipeline Network Map of Soya Village with Background
(Source : EPANET 2.2 Software)

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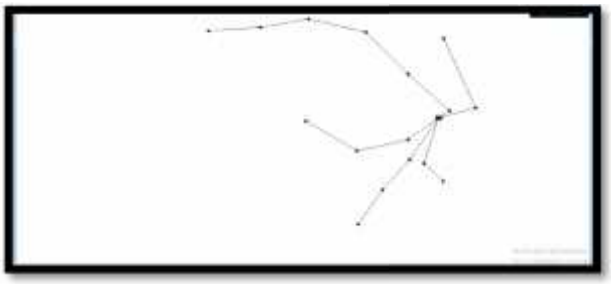

Figure 4. Pipeline Network Map of Soya Village Without Background
(Source : EPANET 2.2 Software)

B. Analysis of Water Needs

Analysis of clean water needs for the future using predetermined calculation standards. Water requirements for socio-economic facilities must be differentiated according to PDAM regulations and taking into account the production capacity of existing sources, level of leakage and service. The main factor in the water demand analysis is the population in the study area. To analyze projections for the following years, Arithmetic and Geometric methods can be used. From this projection, the amount of water demand from the domestic and non-domestic sectors is calculated based on the criteria of the 1996 Directorate General of Cipta Karya.

C. Population Projection

Population projections are scientific calculations based on assumptions about the components of the population growth rate, namely births, deaths and migration. The method used to calculate the projected population for the next 15 years uses the geometric method.

Table 1. Population Data for 2011 – 2021 (Source: Calculation Results)

No	Years	Total Population	Head of Population
1	2011	8049	1829
2	2012	8112	1844
3	2013	8175	1858
4	2014	8238	1872
5	2015	8301	1887
6	2016	8364	1901
7	2017	8427	1915
8	2018	8490	1930
9	2019	8553	1944
10	2020	8616	1958
11	2021	8679	1973

Table 2. Population Growth Projections for 2, 5 and 10 Years (Source: Calculation Results)

No.	Point	Population Projection Geometrik : Pn = Po.(1+r)^n			
		Years 2021	2 Years	5 Years	10 Years
1	MA - A5	3013	3135	3327	3673
2	MA - B1	2126	2212	2347	2592
3	MA - C2	1202	1251	1327	1465
4	MA - D2	1236	1286	1365	1507
5	MA - E1	1102	1147	1217	1343
6	Amount	8679	9030	9582	10580

Table 3. Population Calculation Projection for 10 Years of Soya Village for Each Pipeline and Node (Source: Calculation Results)

No	Pipeline	Node	Total population served (person)	Total population 10 year projection (person)
1	MA-A	A	103	126
2	A-A1	A1	145	177
3	A1-A2	A2	476	580
4	A2-A3	A3	586	714
5	A3-A4	A4	721	879
6	A4-A5	A5	982	1197
	ammount		**3013**	**3673**
7	MA-B	B	934	1139
8	B - B1	B1	1192	1453
	ammount		**2126**	**2592**
9	MA-C	C	26	32
10	C - C1	C1	331	403
11	C - C2	C2	845	1030
	ammount		**1202**	**1465**
12	MA-D	D	56	68
13	D - D1	D1	378	461
14	D - D2	D2	802	978
	ammount		**1236**	**1507**
15	MA-E	E	267	1139
16	E - E1	E1	835	1453
	ammount		**1102**	**2592**
	Total ammount		**8679**	**11828**

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D**.** Calculation of Water Needs

Water demand is the amount of water needed for household, industrial and other needs. Priority water needs include domestic water needs, industry, public services. Water demand is the amount of water that is reasonably needed for basic human (domestic) activities and other activities that require water. The water requirement determines the size of the system and is determined based on water usage.

In calculating the demand for domestic and non-domestic water, peak hour water demand, and the planned volume of the reservoir for the 10th year, you can see the calculation example below:

Table 4. Example of Calculation of Projected Needs for Clean Water in Soya Village for 10 Years

No	Uraian	Satuan	Tahun 2019	2 Tahun	5 Tahun	10 Tahun	Analisa Perhitungan		Kete
							Kode	Cara Hitung	
1	Jumlah penduduk	jiwa	8.679	9.030	9.582	10.580	1		rata2 kenaika
	Pelayanan penduduk	%	100	100	100	100	2		ijuklak 100%
		jiwa	8.679	9.030	9.582	10.580	3		
2	Pelayanan SR	%	90	100	100	100	4		ijuklak / surve
		jiwa	7.811	9.030	9.582	10.580	5	(5)= ((4)*(3))/100	
		jiwa/sb	5	5	5	5	6		ijuklak
		Jmlh. Sb	1.562	1.806	1.916	2.116	7	(7)= (5) / (6)	
	Pemakaian Air	Lt/org/hr	90	90	90	90	8		ijuklak
		Lt/sb/hr	450	450	450	450	9	(9)= (8) x (6)	
		Lt/det	8,14	9,41	9,98	11,02	10	(10)=(5)x(8)/86400	
3	Pelayanan KU / HU	%	10	-	-	-	11	(11)= 100 - (4)	
		jiwa	868	-	-	-	12	(12)=(11)/100*(3)	
		jiwa/HU	100	100	100	100	13		ijuklak
		Jmlh. HU	9	-	-	-	14	(14)=(12)/(13)	
	Pemakaian Air	Lt/org/hr	60	60	60	60	15		ijuklak
		Lt/HU/hr	6.000	6.000	6.000	6.000	16	(16)=(13)*(15)	
		Lt/det	0,60	-	-	-	17	(17)=(12)*(15)/86400	
4	Total Domestik	Lt/det	8,74	9,41	9,98	11,02	18	(18)=(10)+(17)	
5	Total Non Domestik	%	0	0	0	0	19		
		Lt/det	-	-	-	-	20		
6	Total Kebutuhan Air	Lt/det	8,74	9,41	9,98	11,02	21	(21)=(18) + (20)	
7	Kehilangan Air	%	20	20	20	20	22		ijuklak
		Lt/det	1,94	2,09	2,22	2,45	23	(23)=(21)*(22)/90	
8	Kebutuhan Air								
	- Rata-rata	Lt/det	10,68	11,50	12,20	13,47	24	(24)=(21)+ 23)	
	- Harian Puncak	Faktor	1,1	1,1	1,1	1,1	25		ijuklak
		Lt/det	11,75	12,65	13,42	14,82	26	(26)=(24)* (25)	
		M^3/hari	42,30	45,52	48,31	53,34	27	(27)=(26)x3600/1000	
		M^3/hari	1.015,15	1.092,59	1.159,46	1.280,14	28	(28)=(27)*24	
	- Jam Puncak	Faktor	1,5	1,5	1,5	1,5	29		ijuklak (minir
		Lt/det	16,02	17,24	18,30	20,20	30	(30)=(24)*(27)	
9	Kebutuhan Air Baku	Faktor	3,0	3,0	3,0	3,0	31		faktor keama
		Lt/det	35,25	37,94	40,26	44,45	32	(32)=(26)*(31)	Besarnya del
									3X kebutuha
10	Volume Resevoir	M^3	203,03	218,52	231,89	256,03	33	(30)=(0.2)*(28)	Minimum 20
									Kriteria peret

E. Network Modeling E – PANET 2.2

EPANET (Environmental Protection Agency Network) is a computer program (model) that performs hydraulic simulations and water quality behavior in a network of drinking water distribution pipelines (pressure pipes). A drinking water distribution network consists of pipes, nodes (branching pipes), pumps, water tanks or reservoirs and valves. The output generated from the EPANET program includes debit flowing in the pipe (lt/s), water pressure from each point/node/junction which can be used as an analysis in determining installation, pump and reservoir operations.

After the data is entered into the EPANET software, the following results are obtained :

Table 5. Network Table Nodes
(Sumber : Software EPANET 2.2)

Network Table - Nodes							
	Elev	BD	In Q	D	Head	Press	Q
Node ID	m	LPS		LPS	m	m	
Junc J1	144	0.13	0	0.13	154.9	0,479	0
Junc J2	141	1.19	0	1.19	154.85	0,601	0
Junc J3	141	0.03	0	0.03	154.95	0,608	0
Junc J4	140	0.07	0	0.07	154.92	0,647	0
Junc J5	138	0.28	0	0.28	154.96	0,733	0
Junc J6	142	0.18	0	0.18	154.51.00	12.51	0
Junc J7	137	0,042	0	0,042	154.12.00	17.12	0
Junc J8	135	0,051	0	0,051	153.86	0,810	0
Junc J9	132	0,064	0	0,064	153.73	0,926	0
Junc J10	128	1.25	0	1.25	153.68	25.68	0
Junc J11	135	1.51	0	1.51	154.75	0,844	0
Junc J12	138	0.42	0	0.42	154.88	0,728	0
Junc J13	135	1.07	0	1.07	154.84	0,85	0
Junc J14	138	0.48	0	0.48	154.87	0,727	0
Junc J15	137	1.02	0	1.02	154.84	0,767	0
Junc J16	135	0,060	0	0,060	154.95	0,858	0
Resvr MA	155	#N/A	0	- 10.76	155.00.00	0	0

From the results of the analysis of the distribution of the piping network using the EPANET 2.2 software, the result is that the distribution of the piping network gets 100% results.

V. CONCLUSION

The results of data analysis on the distribution of pipeline networks, the following conclusions can be drawn:

The need for clean water for the residents of Soya Village, Sirimau District, Ambon City for the next 10 years is 44.45 liters/second. The distribution of the piping system has been able to meet the needs of clean water in Soya Village, Sirimau District, Ambon City because it has met the water needs of the residents of Soya Village.

For the Government and residents in Soya Village, Sirimau District, Ambon City to pay attention to meeting water needs, and distribution of piping networks for Soya Village residents so that the distribution of water can be maximized, also always check the piping system to avoid the occurrence of factors that can affect the lack of distribution of water demand in the pipeline network.

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