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COMPARATIVE ANALYSIS OF WATER NETWORK DEMAND AND DEVELOPMENT WITH THE AVAILABILITY OF CLEAN WATER IN THE REGIONAL DRINKING WATER COMPANY (RDWC) LEMATANG ENIM

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ABSTRACT

This study aims to analyze the projected demand for clean water and assess the existing condition of the clean water network in relation to the projected population growth in the next 10 years; Analyze the availability of water discharge from the Lematang Enim RDWC water source in meeting those needs; Analyze the development of clean water distribution networks. This research was conducted from August to December 2023. The research location is in Gelumbang Subdistrict, Muara Enim Regency. Data were collected through interviews using questionnaires related to performance, availability, and distribution of water. The results of the study show that the water demand from projection results increases every year from 2022 to 2041; the availability of water from the Lematang River is still sufficient for drinking water needs; The water needs of Gelumbang sub-district in 2032 from the calculation results obtained domestic needs of 165,403.6 m3/day, Non-domestic needs of 419.68 m3/day, and water loss of 33,164.656 m3/day; The total demand for discharge over the next 10 years (2022-2032) to meet 413,731 SL is 198,987.936 m3/day. Thus, there is an increase in the number of customers from 2022-2032 by 113,348 so that the additional distribution network needed by the Lematang Enim RDWC to meet the discharge is 45,339.2 m3/day from 2023 to 2032, totaling 113,348 so that the additional distribution network needed by the Lematang Enim RDWC to meet the discharge is 45,339.2 m3 from 2023 to 2032.

KEYWORDS *Needs, Development, Water Network, Company Water Availability*

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INTRODUCTION

Water is one of the most fundamental needs for human life, as humans cannot live without water. Water can also be considered as a resource that can be used for irrigation, power generation, and fulfilling human basic needs such as bathing, cooking, drinking, and so on. To meet the need for clean water, the quantity or availability of water is crucial (Argono, 2015).

The provision of clean water is a special concern, especially for water supply companies such as RDWC. Efforts to meet water needs can be obtained by RDWC from underground, surface water, directly from rain, and from rivers. Of these three sources, the one most commonly used by RDWC is river water. The demand for water by the community is increasing, but the quantity of water available with adequate quality for the community is becoming more limited. Increasing the number of customers ideally should be accompanied by an improvement in the provision of clean water distribution to meet the daily needs of customers. However, the reality is that the community still complains about the service provided by RDWC because the water distribution does not meet the expectations of the community and has not reached all parts of the region.

Based on government regulation no. 122 of 2015, in relation to the drinking water system, which is subsequently referred to as SPAM, is a unified physical (technical) and non-physical infrastructure and facilities for drinking water. Drinking water is household water, treated or untreated, that meets health requirements and can be directly consumed. The supply of clean water is a special concern, especially for water supply companies such as RDWC. RDWC can take water from groundwater, surface water, direct rain, and rivers to meet water needs. Of these three sources, RDWC mostly uses river water. The increasing demand for water by the community, however, is accompanied by a decreasing amount of quality water available for the community.

The Regional Drinking Water Company (RDWC) Lematang Enim is a State-Owned Enterprise (BUMD) of Muara Enim Regency established on May 9, 1986, with Regional Decision No. 4 of 1986, with registered office and headquarters in the city of Muara Enim. RDWC Lematang Enim Muara Enim Regency provides facilities for drinking water supply (IPA) in 5 (five) branches, namely Muara Enim Branch, Tanjung Enim Branch, Ujan Mas Branch, Teluk Lubuk Branch, and Gelumbang Branch with a total capacity of 757.5 liters per second and a total actual production capacity of 730 liters per second.

SPAM can be carried out through piped network systems and/or non-piped networks. SPAM with piped networks consists of raw water units, production units, distribution units, service units, and management units. Meanwhile, non-piped SPAM networks include shallow wells, hand pump wells, rainwater storage tanks, water terminals, water tank trucks, bottled water installations, or spring protection buildings (Mizwar, 2011). The development plan for water distribution networks requires the collection of information on the physical characteristics of the water network development system and determining the consumption level (Ratnaningrum dkk., 2021).

Gelumbang District is one of the districts in Muara Enim Regency consisting of 22 villages and 1 urban village. Gelumbang District covers an area of 658.5 km2

with a population of 57,120 people (Badan Pusat Statistik Muara Enim, 2023). The problems in the clean water distribution system of RDWC Lematang Enim Muara Enim Regency are diverse, ranging from problems in raw water units, transmission, production, distribution, and water availability. Many fundamental problems have decreased the performance and service of RDWC Lematang Enim, categorized as sick, such as decreasing raw materials due to decreasing Enim River drainage, contamination of raw water sources in C excavation, changes in raw water conditions, poor water distribution to residents' homes, frequent traffic jams, and not suitable for drinking (Permen PU PRNo.04,Tahun 2020). The increase in population followed by an improvement in the socio-economic conditions of the population in the Gelumbang area has caused an increase in the need for water both qualitatively and quantitatively. These problems need to be addressed to improve company performance, especially in the selection of pumping and water transfer equipment, this population growth must be adjusted to the availability of water in freshwater lakes.

The availability of water from freshwater lakes must exceed the capacity of population growth to meet these water needs. The need for clean water increases every year in line with the increasing population in the area (Wesli dkk., 2021). The above problems can be explained by comparing the needs and development of the clean water network of RDWC Lematang Enim. Therefore, this research examines the estimated condition of water needs, distribution pipe networks with water availability in RDWC Lematang Enim and can simulate projections of population growth and clean water needs for the next ten years.

The technical service coverage in the service area of RDWC Lematang Enim has only reached 50%. The low coverage of this service is due to limitations in raw water sources, water treatment plant (IPA) capacity, transmission and distribution networks, RDWC funding, and the existence of other alternative water sources that make people less interested in becoming RDWC customers. The high physical water loss rate, reaching more than 20%, is caused by leaks that occur in system components, namely reservoirs, transmission pipes, distribution pipes, house connections, and public taps. This demands an evaluation of the performance of RDWC Lematang Enim services so that efforts can be made to increase production capacity and services to the community. Studies on performance assessment and customer satisfaction evaluation are quite numerous. However, performance assessments related to network development with service level studies at RDWC Lematang Enim still need to be done to optimize RDWC capacity and reach customers who have not been reached by communities who have not yet obtained access to clean water, thus an evaluation is needed related to pipeline network development by optimizing RDWC performance at operational points and can improve performance evaluation values.

Clean water networks have been widely discussed by previous researchers. This is evident in (Rachman & Yansah, 2020) which only focuses on clean water needs analysis, while the study (Pradestama dkk, 2022) also focuses on determining the diameter of distribution pipes for drinking water, then the research (Silvia, 2016) also focuses on the amount of water flow and water loss in its analysis. In addition,

(Anton, 2014), his research is also related to the design of distribution pipe networks, but only focuses on irrigation systems.

In general, previous research focuses on clean water networks, but only focuses on water quantity, water loss, and distribution pipe design. This is based on Permen PUPR No. 04,Tahun (2020) regarding the drinking water system. Therefore, this study compares the needs and development of clean water networks and projections of population growth with water availability for the next ten years.

This study aims to analyze projections of clean water needs, availability of water source discharge, and distribution network development by RDWC Lematang Enim. The problem formulation includes questions about the projected amount of clean water needs, availability of water source discharge, and distribution network development strategies. The research objectives include analyzing the projected amount of clean water needs, availability of water discharge, and distribution network development. The benefits of this research include understanding the need for clean water, comparing water discharge availability with needs, and the ability to plan distribution network development. The scope of the study includes the research location in Gelumbang District, Muara Enim Regency, projection of clean water needs and population growth for the next 10 years, availability of water source discharge for the same period, and analysis of the development of clean water distribution networks by RDWC Lematang Enim.

RESEARCH METHOD

This research outlines an analysis of water needs by the RDWC in the Gelumbang area, which includes population and customer projections, availability and distribution of clean water, household networks, and non-domestic water needs. Data collection methods include the use of primary data from RDWC customers and secondary data from internal RDWC sources. The research was conducted from August to December 2023 in the Gelumbang District, Muara Enim Regency.

The research variables include calculations of population numbers, projections of customer numbers, water availability, water surplus, distribution network development plans, customer water needs, and additional pipeline network requirements. Data analysis methods include literature review, analysis of the relationship between factors influencing water demand projections, and drawing conclusions and recommendations.

Water demand analysis is conducted by calculating population, population growth projections, domestic and non-domestic water needs, water loss, total water demand, maximum daily requirements, and peak hour demands. Distribution pipeline network planning takes into account technical planning criteria such as maximum day factors, water pressure in pipes, and dimensions of transmission and distribution pipelines.

Steps in data analysis include calculating water source discharge, recording population and customer numbers, measuring the distance from water sources to reservoirs, projecting population numbers and water needs, and designing schematic water distribution plans.

RESULT AND DISCUSSION

Overview of the Research Object

Gelumbang District is one of the districts in Muara Enim Regency consisting of 22 villages and 1 urban village. Gelumbang District has an area of 658.5 km2 with a population of 57,120 people (Statistik Muara Enim, 2022). Gelumbang District, which is headquartered in Gelumbang District, can be reached by public transportation in approximately 45 minutes to one hour southward from Karya Jaya Palembang terminal, or about 30 minutes northward from Prabumulih city. The indigenous population of this sub-region is Belida, with 98% of its inhabitants being Muslims. Mosques are found in every village, and small prayer halls (musholas) are scattered throughout the villages. The area of Gelumbang sub-region has shrunk several times, as it has been expanded into several representative sub-regions, thus becoming separate sub-regions independent of Gelumbang sub-region.

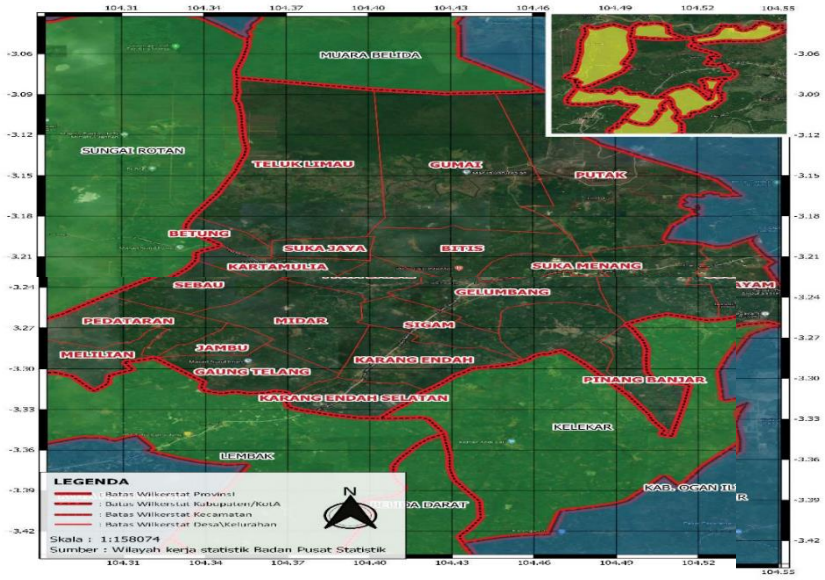


Figure 1. Muara Enim Regency
Source: Muara Enim Regency Central Statistics Agency, 2023

Water Needs Analysis

The analysis of clean water needs is based on customer consumption needs; therefore, calculations of the number of customers are necessary (Ridwan, 2019). Calculating the number of customers can be used to determine the number of people to be served, resulting in relative service coverage estimates of the population. Piped Water Supply Systems (SPAM JP) according to (Permen PUPR No . 04, 2020) regarding the Provision of Drinking Water Supply Systems, are a unit of facilities and infrastructure distributed to customers through a piping system. SPAM JP is organized to ensure the quantity and quality of the produced drinking water as well as the continuity of flow. The requirements of SPAM JP include:

1. The quantity of drinking water produced must be at least sufficient to meet the Basic Daily Drinking Water Needs.
2. The quality of the produced drinking water must comply with the provisions of the laws and regulations.
3. Continuity of drinking water flow for 24 (twenty-four) hours a day. SPAM JP includes raw water units, production units, distribution units, and service units.

Service coverage is used as an indicator of meeting the clean water needs in Gelumbang District. This water demand is then used in capacity planning. This analysis is conducted to measure the amount of demand that must be met in the future to plan how much clean water production is needed (Nofrizal & Saputra, 2021).

Population Projection Analysis

In the population data used in this study, the population data of Gelumbang District is used according to the area of research. Gelumbang District demographics from 2010-2019. The data used is secondary data from the Gelumbang District Central Statistics Agency (BPS).

Gelumbang District has a population of 1,662,893 in 2022 (Statistik & Enim, 2022). The population has been increasing every year in population data from 2013 to 2022. The population growth of Gelumbang District was 1.03% in 2021.

This population data analysis is conducted to determine the projection of the future population for the next 10 years. This population projection will be used to determine the coverage of clean water services to determine the clean water needs in Gelumbang District. Several methods are used in population projections, including arithmetic, geometric, and linear regression methods.

The method chosen is based on the correlation test (R). A correlation coefficient approaching or equal to zero indicates a weak correlation. A method with a correlation coefficient close to or equal to one is chosen. This indicates that the calculated projection results have a strong correlation. The correlation test calculation of multiple methods (R) is as follows:

a. Arithmetic Method

The correlation coefficient (R) for the arithmetic method can be seen in Table 1 below:

Table 1. Arithmetic Method Correlation Values for Population

No	Year	Population (people)	Ln Population Growth (y)	x	x^2	x*y	y^2
1	2013	1468007	14,19941626	1	1	14,19942	201,623422
2	2014	1481814	14,20877757	2	4	28,41756	201,88936
3	2015	1503485	14,2232963	3	9	42,66989	202,302158
4	2016	1535900	14,24462709	4	16	56,97851	202,909401
5	2017	1558494	14,25923053	5	25	71,29615	203,325655
6	2018	1580517	14,27326257	6	36	85,63958	203,726024
7	2019	1602071	14,28680773	7	49	100,0077	204,112875

8	2020	1623099	14,29984784	8	64	114,3988	204,485648
9	2021	1643488	14,31233137	9	81	128,811	204,842829
10	2022	1662893	14,32406941	10	100	143,2407	205,178965
Total			142,6316667	55	385	785,6592	2034,39634
R	0,997610601						

$$R = \frac{n(\sum XY) - (\sum X)(\sum Y)}{\{n(\sum Y^2) - (\sum Y)^2\}^{0.5} . \{n(\sum X^2) - (\sum X)^2\}^{0.5}}$$

$$= \frac{10(969162) - (45)(194886)}{\{10(4405516126) - (194886)^2\}^{0.5} . \{10(285) - (45)^2\}^{0.5}}$$

$$= 0{,}4117$$

The result of the correlation test for the arithmetic method on the population of Gelumbang District from 2010 to 2019 is 0.4117.

b. Geometric Method

The correlation coefficient (R) for the geometric method can be seen in Table 2 below:

Table 2. Geometric Method Correlation Values for Population

No	Year	Population (people)	Ln Population Growth (y)	x	x^2	x*y	y^2
1	2013	1468007	14,19941626	1	1	14,19942	201,623422
2	2014	1481814	14,20877757	2	4	28,41756	201,88936
3	2015	1503485	14,2232963	3	9	42,66989	202,302158
4	2016	1535900	14,24462709	4	16	56,97851	202,909401
5	2017	1558494	14,25923053	5	25	71,29615	203,325655
6	2018	1580517	14,27326257	6	36	85,63958	203,726024
7	2019	1602071	14,28680773	7	49	100,0077	204,112875
8	2020	1623099	14,29984784	8	64	114,3988	204,485648
9	2021	1643488	14,31233137	9	81	128,811	204,842829
10	2022	1662893	14,32406941	10	100	143,2407	205,178965
Total			142,6316667	55	385	785,6592	2034,39634
R	0,997610601						

$$R = \frac{n(\sum XY) - (\sum X)(\sum Y)}{\{n(\sum Y^2) - (\sum Y)^2\}^{0.5} . \{n(\sum X^2) - (\sum X)^2\}^{0.5}}$$

$$= \frac{10(785{,}6592) - (55)(142{,}6317)}{\{10(2034{,}3963) - (142{,}6317)^2\}^{0.5} . \{10(385) - (55)^2\}^{0.5}}$$

$$= 0{,}9976$$

The result of the correlation test for the geometric method on the population of Gelumbang District from 2013 to 2022 is 0.9976.

c. Linear Regression Method

The correlation coefficient (R) for the linear regression method can be calculated with the help of Ms. Excel. The correlation coefficient (R) can be seen in Figure 4.4 below:

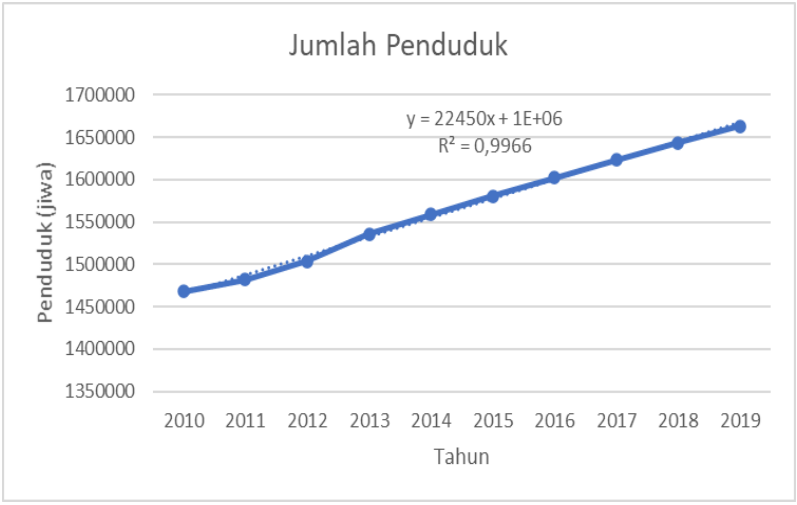


Figure 2. Correlation Figure

The result of the correlation test for the linear regression method on the population of Gelumbang District from 2013 to 2022 is 0.9966. The summary of the correlation test calculation results from the arithmetic, geometric, and linear regression methods can be seen in Table 3 below:

Table 3. Summary of Correlation Values

Method	Correlation Value
Arithmetic	0,4117
Geometric	0,9976
Linear	0.9966

The summary of the correlation test calculation results above shows that the geometric method has a correlation value closest to one, indicating that this method has the strongest correlation. Therefore, the geometric method is chosen as the method used in calculating the population projection of Gelumbang District until the year 2036.

The geometric method assumes that population growth follows a geometric sequence. Growth is assumed constant for a certain period (Lestari dkk., 2016). Population projection calculations using the geometric method can be formulated with the following equation:

Pn = P0 (1 + r)^n where r = $\frac{\sum_{i=1}^{n} \frac{P_i - P_{(i-1)}}{P_i}}{N}$

The calculation of "r" can be seen in Table 4 below::

Table 4. Calculation of r Value

No	Year	Population (People)	Growth rate	Average Growth Rate
1	2013	1468007	0	
2	2014	1481814	0,009405269	
3	2015	1503485	0,014624642	
4	2016	1535900	0,021559909	
5	2017	1558494	0,014710593	0,013951462
6	2018	1580517	0,014130949	
7	2019	1602071	0,01363731	
8	2020	1623099	0,013125511	
9	2021	1643488	0,012561772	
10	2022	1662893	0,011807205	

Growth Rate $= \frac{1481814 - 1468007}{1468007}$ Growth Rate = 0,0094

The calculation is continued for the following year as shown in Table 4.6 above. Next, the average growth rate (r) is obtained as follows:

$r = \frac{(0{,}0094+0{,}0146+0{,}0215+0{,}0147+0{,}0141+0{,}0136+0{,}0131+0{,}0125+0{,}0118}{9}$

$r =$ 0.0139

Next, the population projection calculation is carried out until the planned year as follows:

P2020 = P2019 . (1+r)1
P2020 = 1662893 x (1+0.0139)^1
P2020 = 1686093

The summary of the population projection calculation results for Gelumbang District from 2023 to 2036 can be seen in Table 5 below:

Table 5. Summary of Population Projection

Year	Year to -	Population (People)
2023	1	1.686.093
2024	2	1.709.616

2025	3	1.733.468
2026	4	1.757.652
2027	5	1.782.174
2028	6	1.807.038
2029	7	1.832.249
2030	8	1.857.811
2031	9	1.883.731
2032	10	1.910.011

Analysis of Customer Projection

The calculation of customer projections is carried out using the same method as the population projection, namely using arithmetic, geometric, and linear regression methods. The next step is to perform a correlation test (R) for each method. The data used in the customer projection uses historical data on the addition of customers to the Lematang Enim Water Supply Company (RDWC) in the last 5 years during the period from 2018 to 2022 as follows:

Table 6. Addition of RDWC Lematang Enim Subscribers

Year	**Number of Subscribers**	**Addition of Subscribers**
2018	264.839	7.650
2019	273.580	8.741
2020	281.462	7.882
2021	290.990	9.528
2022	300.838	9.848

The summary of the correlation test calculation results above shows that the geometric method has a correlation value closest to one, indicating that this method has the strongest correlation. Therefore, the geometric method is chosen as the method used in calculating the projection of the number of customers of RDWC Lematang Enim until the year 2036.

The geometric method assumes that population growth follows a geometric sequence. Growth is assumed to be constant for a certain period. Population projection calculations using the geometric method can be formulated with the following equation:

$$Pn = P0\,(1 + r)^n \quad \text{where} \quad r = \frac{\sum_{i=1}^{n} \frac{P_i - P_{(i-1)}}{P_i}}{N}$$

The calculation of "r" can be seen in Table 7 below:

Table 7. Calculation of r Value

No	Year	Subscriber (SL)	Growth Rate	Average Growth Rate
1	2018	264.839	0	
2	2019	273.580	0,033004958	
3	2020	281.462	0,028810586	0,032377612
4	2021	290.990	0,033851817	
5	2022	300.838	0,033843087	

$$Laju\ pertumbuhan = \frac{273580-264839}{264839}$$

Growth rate = 0,033004958

The calculation is continued for the following year as shown in Table 4.10 above. Next, the average growth rate (r) is obtained as follows:

$$r = \frac{(0{,}033004958+0{,}028810586+0{,}033851817+0{,}033843087)}{4}$$

r = 0,0324

Furthermore, the calculation of the projected population up to the plan year is carried out as follows:
P2021 = P2020 . (1+r)1
P2021 = 300838 x $(1+0.0324)^1$
P2021 = 310578

A recapitulation of the calculation of the projected number of customers from 2023 to 2036 can be seen in Table 8 below:

Table 8. Customer projection recapitulation

Year	Year to-	Subscriber (SL)	Addition of subscriber (SL)
2023	1	310.578	9.740
2024	2	320.634	10.056
2025	3	331.016	10.381
2026	4	341.733	10.717
2027	5	352.798	11.065
2028	6	364.220	11.423
2029	7	376.013	11.793
2030	8	388.187	12.174
2031	9	400.756	12.569
2032	10	413.731	12.976

Analysis of Water Availability Based on Clean Water Needs

Analysis of Lematang River Water Availability

Water availability is determined from the results of calculating the average for a certain period of time or the calculation of the main flow volume associated with a certain probability. The main flow itself is the expected river flow to exist throughout the year (Saputra & Gunawan, 2022). In this study, the data obtained for the analysis of water availability are obtained from secondary data owned by the River Basin Management Agency (BBWS) VIII. The data used is the flow rate of the Lematang River under normal conditions. The tabulation of the Lematang River flow rate to the Gelumbang intake under normal conditions in 2022 is shown in Table 9. below:

Table 9. Lematang River Flow Rate at Muaraenim Intake under Normal Conditions in 2022

No	Month	Score	Monthly Average Value	Unit
1	January I	11.690.784	13.747.104	m³/day
2	January II	15.803.424		m³/day
3	February I	15.239.232	14.118.624	m³/day
4	February II	12.997.152		m³/day
5	March I	16.284.672	14.659.488	m³/day
6	March II	13.033.440		m³/day
7	April I	12.307.680	10.778.400	m³/day
8	April II	9.248.256		m³/day
9	May I	7.841.664	7.041.600	m³/day
10	May II	6.241.536		m³/day
11	June I	3.806.784	3.924.288	m³/day
12	June II	4.041.792		m³/day
13	July I	2.086.560	1.898.208	m³/day
14	July II	1.708.992		m³/day
15	August I	1.009.152	818.208	m³/day
16	August II	626.400		m³/day
17	September I	475.200	509.760	m³/day
18	September II	543.456		m³/day
19	October I	551.232	1.380.672	m³/day
20	October II	2.209.248		m³/day
21	November I	3.281.472	5.793.984	m³/day
22	November II	8.306.496		m³/day
23	December I	10.671.264	11.377.152	m³/day
24	December II	12.082.176		m³/day

25	**Yearly Average**	7.170.336	m³/day

Source: River Basin Management Agency VIII, 2022

According to (Badan Standardisasi Nasional (BSN), 2015), in finding the reliable discharge for drinking water supply or raw water, the probability value used is 90%, taken from the river discharge data for the last 10 years. Table 10. below shows the probability of the Lematang River discharge

Table 10. Probability of Reliable Discharge of the Lematang River

Data Ranking	**Monthly Discharge (**m³/day**)**	**Ordered Discharge (**m³/day**)**	**Probability (%)**
1	13.747.104	14.659.488	8
2	14.118.624	14.118.624	15
3	14.659.488	13.747.104	23
4	10.778.400	11.377.152	31
5	7.041.600	10.778.400	38
6	3.924.288	7.041.600	46
7	1.898.208	5.793.984	54
8	818.208	3.924.288	62
9	509.760	1.898.208	69
10	1.380.672	1.380.672	77
11	5.793.984	818.208	85
12	11.377.152	509.760	92

Source: Analysis Results, 2022

In calculating the probability of the reliable discharge of the Lematang River, the data used is the average discharge for each month, which is then arranged from the largest to the smallest value. Below is an example of calculating the probability of the reliable discharge of the Lematang River for ranking data one.

Surplus Analysis of Lematang Enim Water Supply Company Availability

In this analysis, a comparison of the surplus availability of the Lematang River water in 2022 and the projection of the needs of the Lematang Enim Water Supply Company (RDWC) in 2041 is conducted. Table 11 below is an analysis of the availability calculation compared to the needs of the Lematang Enim RDWC.

Table 11. Analysis of availability calculation compared to the needs of the Lematang Enim SPAM per five years

Description	**Unit**	**year**				
		2022	2026	2031	2036	2041
Lematang River Availability	m3/day	602.208	602.208	602.208	602.208	602.208
Projected Needs						

RDWC	m3/day	7.128	10.368	15.552	20.736	23.976
River Maintenance	m3/day	25.920	25.920	25.920	25.920	25.920
Total needs	m3/day	60.480	64.800	71.712	78.624	82.944
Remaining Availability	m3/day	541.728	537.408	530.496	523.584	519.264
Difference	m3/day	22.464				

Source: Analysis Results, 2023

Based on the analysis of the projection data of the water needs of the Lematang Enim RDWC service area from year to year, it continues to increase until finally in 2041, the total water demand reaches 0.96 m³/second. This is influenced by factors such as the increase in the population and service improvement. Furthermore, from the analysis, it is also known that the availability of Lematang River water is still sufficient for the drinking water needs of RDWC Lematang Enim until 2041. There is an increase in the demand for drinking water for RDWC Lematang Enim in 2041 by 0.26 m³/second or 260 liters/second. Thus, the remaining availability of Lematang River water in 2041 is 6.01 m³/second. Below, Figure 3 shows the water balance of the availability and needs of the Lematang River in 2041.

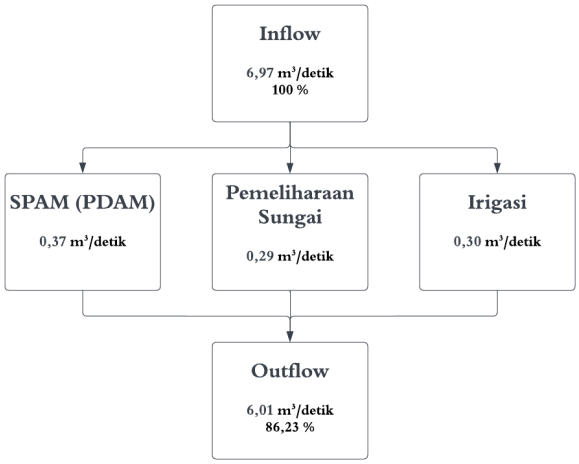


Figure 3. Water balance of the availability and needs of the Lematang River in 2041
Source: Analysis Results, 2023

Analysis of Clean Water Distribution Network Development

Analysis of the development of the Distribution Network of RDWC Lematang Enim in Gelumbang sub-district was carried out based on basic procedures for distribution network techniques based on (National Standardization Agency, 2011) concerning procedures for distribution network techniques and service units of drinking water supply systems, network development, development carried out based on image maps of the existing network of RDWC Lematang Enim.

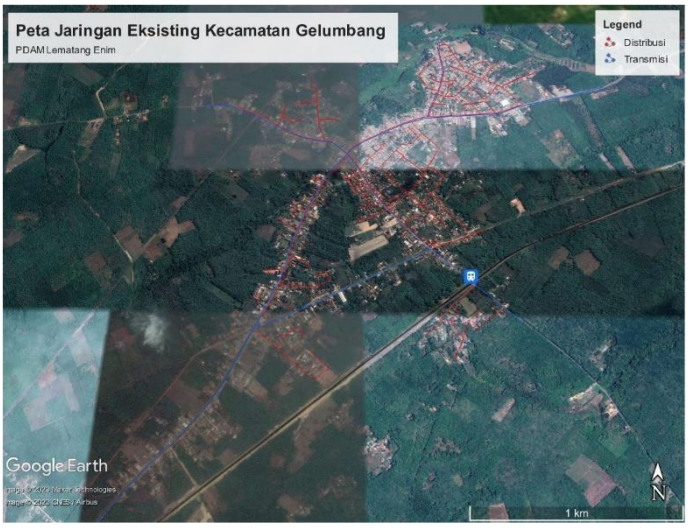
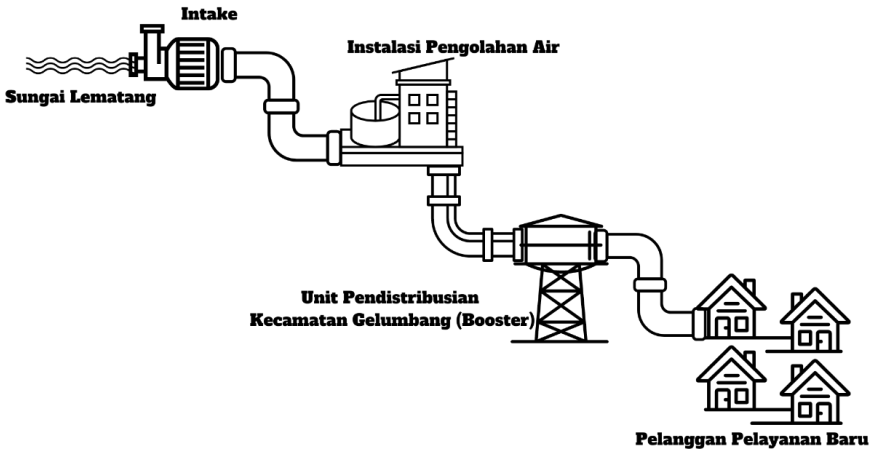


Figure 4. Existing Network of Gelumbang RDWC Lematang Enim District

Before carrying out network development in Gelumbang District by RDWC Lematang Enim, Lematang Enim Regency uses surplus water availability, and in accordance with the results of customer projections that have been carried out, the operational support of RDWC Lematang Enim must be adequate and need to make adjustments to service capacity. The required service capacity such as increasing pump capacity or *auxiliary boosters* in the Gelumbang District area so that it is able to serve new customers based on projection results.



Gambar 5. Illustrasi Pelayanan Kecamatan Gelumbang

Based on (National Standardization Agency, 2011) concerning the procedures for distribution network techniques and service units of drinking water supply systems in point 10 (Distribution Pipes) explained as follows:

a. Distribution pipeline lay-out planning is determined based on The distribution pipeline should consist of several components to facilitate the control of water loss

From the above standards, a distribution network development plan is carried out based on potential areas as settlements in the Gelumbang sub-district, Muara Enim Regency.

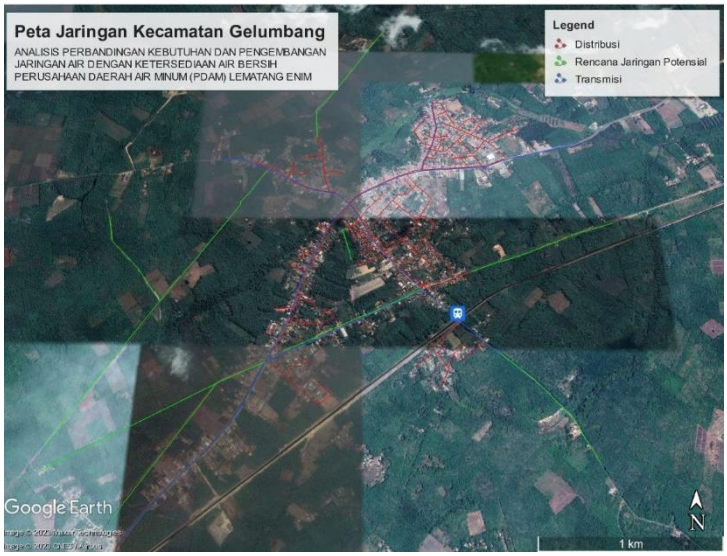


Figure 6. Gelumbang Sub-District Network Map

The Network Plan formed in Gelumbang District is the main distribution network (JDU) as a potential settlement area from the road area. After planning the distribution network, the calculation of water needs will be carried out based on the results of projections of residents, customers and water needs in Gelumbang sub-district, Muara Enim Regency.

Water Demand Calculation

The development of the distribution network in the Gelumbang sub-district by RDWC Lematang Enim, Muara Enim Regency, is analyzed until the year 2032. The analysis is conducted in stages, focusing on service improvements obtained from the customer recapitulation until 2032 in Table 4.11, which projects an increase of 154,395 SL (service lines) from 2023 to 2032, and the data on the increase in customer service is to be presented as a percentage.

$$\text{Service Percentage} = \frac{Target\ Pelayanan\ SL}{Jumlah\ Target\ Pelayanan\ SL\ Total}\ x\ 100\%$$

$$2035 = \frac{113.348}{413.724}\ x\ 100\% = 27{,}40\%$$

The total service percentage until 2032 is 27.40% of the increase from 2023 to 2032, or over 10 years. Meanwhile, the service improvement percentage based on the projection results in 2032 is as follows:

$$\text{Service Improvement Percentage} = \frac{SL\ Terlayani\ 2032 - SL\ Terlayani\ 2022}{SL\ Terlayani\ 2022}\ x\ 100\%$$

$$= \frac{413.348 - 300.838}{300.838}\ x\ 100\% = 37{,}73\%$$

a. Domestic Water Demand

After calculating the service percentage of RDWC Lematang Enim, Muara Enim Regency, the projection of domestic water demand will be calculated by examining the projected population data:

- Population in 2022 = 1,662,893
- Population in 2032 = 1,910,011

Estimation of Subscription Calculation	
Number of SL in 2022	300.838 SL
Service Percentage in 2022	72%
Target Service Estimate in 2032	86,6%
Consumption Unit	100 Liters/person/day
Served Population	1.654.036 people
Average Consumption	165.403.600 liters/day

b. Non-Domestic Water Demand

In addition to calculating domestic water demand, non-domestic water demand is also calculated in the Gelumbang sub-district, Muara Enim Regency, according to the Gelumbang Dalam Angka 2022 report. The calculation is based on the number of institutions and public facilities in the Gelumbang sub-district according to the Directorate General of Human Settlements, Ministry of Public Works, in 2000.

- School

There are 78 schools in the Gelumbang sub-district, from kindergarten to high school, with a total of 16,434 students and 1,091 teachers. The calculation of water demand in schools is based on the Directorate General of Human Settlements, Ministry of Public Works, in 2000, which states a domestic water demand in schools of 10 liters/person/day.

- Hospitals

The Gelumbang sub-district has 1 class D hospital, with a calculation of the water demand of 200 liters/bed/day. The calculation is based on the maximum water demand according to the total number of beds in the Gelumbang sub-district general hospital, which is 58 beds.

- Health Centers

The Gelumbang sub-district has 1 Health Center,

Health Center Water Demand	
Number of Health Centers	1 Unit
Water Demand (Number of Health Centers x 2000 Liters/day)	2000 Liters/day

- Mosques

According to the Gelumbang Dalam Angka 2022 report, there are 73 mosques in the Gelumbang sub-district.

Mosque Water Demand	
Number of Mosques	73 Unit
Water Demand (Number of Mosques x 3000 Liters/day)	219.000 Liters/day

- Churches

The Gelumbang sub-district has 2 Protestant churches and 1 Catholic church.

Church Water Demand	
Number of Churches	3 Unit
Water Demand (Number of Churches x 1000 Liters/day)	3000 Liters/day

- Offices (Village/Government)

Based on the Directorate General of Human Settlements, Ministry of Public Works, in 2000, the domestic water demand in offices is 10 liters/employee/day. The Gelumbang sub-district has 883 officials.

Office Water Demand	
Number of Officials	883 people
Water Demand (Number of Officials x 100 Liters/day)	8830 Liters/day

- Total Non-Domestic Water Demand

Non-Domestic Water Demand Total	
School	175.250 Liters/day
Hospital	100.600 Liters/day
Health care	2000 Liters/day
Masjid	219.000 Liters/day
Church	3000 Liters/day
Offices	8830 Liters/day
Total	419.680 Liters/day (419,68 m3/day)

c. Total Service Requirement

The total service requirement is the sum of domestic and non-domestic water demand.

Total Service Requirement	
Domestic Demand	165.403,6 m3/day
Non-Domestic Demand	419,68 m3/day

Total Service Requirement	165.823,28 m3/day

d. Water Loss

The national standard tolerance for clean water leakage according to the Ministry of Public Works Regulation Number 20/PRT/M/2006 is a maximum water loss of 20%.

Water Loss = 20% x Total Service Requirement

Water Loss Total	
Tolerance Water Loss	20%
Total Service Requirement	165.823,28 m3/day
Water Loss	33.164,656 m3/day

e. Total Water Requirement

The total water requirement in the Gelumbang sub-district is calculated by adding the service requirement and water loss.

Total Water Requirement	
Total Service Requirement	165.823,28 m3/day
Water Loss	33.164,656 m3/day
Water Requirement	198.987,936 m3/day

Addition of Pipe Needs Based on the Number of Additional Discharge

a. Estimated Flow of Gelumbang District in 2032

This pipeline planning refers to the total amount of Domestic, Non-Domestic, and Water Loss water needs, the planning is adjusted to the development of 413,731 SL which is assumed to be 1,654,036 people with domestic water needs of 165,403.6 m3 / day, non-domestic water needs of 419 m3 / day, and water losses of 33,164,656 m3 / day. For piping network planning area in Muara Enim District.

In the calculation of Idle Capacity, a systematic calculation is used using customer estimation data for the next 10 years (2022-2032)

Table 12. Estimated flow by 2032

Estimated Usage	**Water Usage (m3/day)**
Estimated customers and domestic water usage based on projections in 2032	165.403,6
Estimation of Non-Domestic Water Usage of Gelumbang District	419,68
Water Loss	33.164,656
Total	**198.987,936**

b. Estimated increase in piping network needs based on the increase in the number of customers in 2032

With an estimated customer of 413,731 SL in 2032, RDWC Lematang Enim which in the projected results in 2022 is 300,838 SL. This means that there will be an additional 113,348 SL customers.

After obtaining an addition in 2032 based on the projected results of 113,348 SL, the estimated water flow needed for 113,348 SL will be calculated.
Increase water demand by 2032

- Number of Subscribers in 2022 = 113,348
- Number of subscribers in 2032 = 413,731
- Customer additions 2022-2032 = 113,348

Addition of water needs =
Number of people per SL = 4 people
Total number of people = 113,348 x 4
= 453,392 people
Consumption Unit = 100 liters/person/day
Average Usage
= 453,392 people x 100 liters/person/day
= 45,339,200 l/day or 45,339.2 m3/day

After knowing the amount of water usage by additional customers in 2032, the development of a distribution network that will be needed by RDWC Lematang Enim is a distribution network that can meet water needs of 45,339,200 liters / day or 45,339.2 m3 / day.

Recommendations and suggestions suitable for Network development

Based on the results of the analysis of this study, as material for consideration and recommendations for infrastructure buildings that are suitable for network development in Gelumbang District are:

1. Intake Building

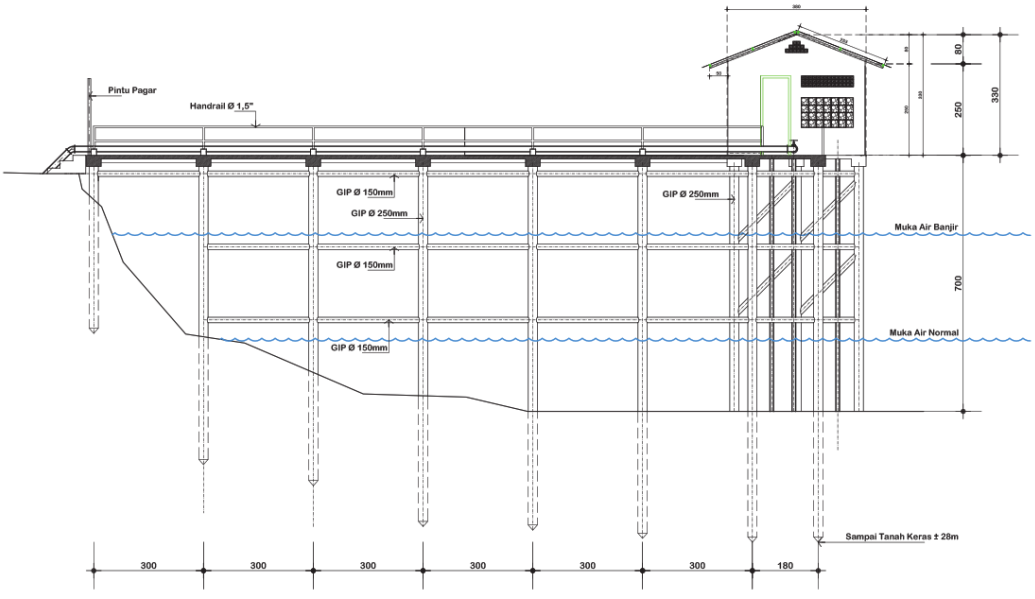


Figure 7. Intake Plan

2. Water Management Plant Building (IPA)

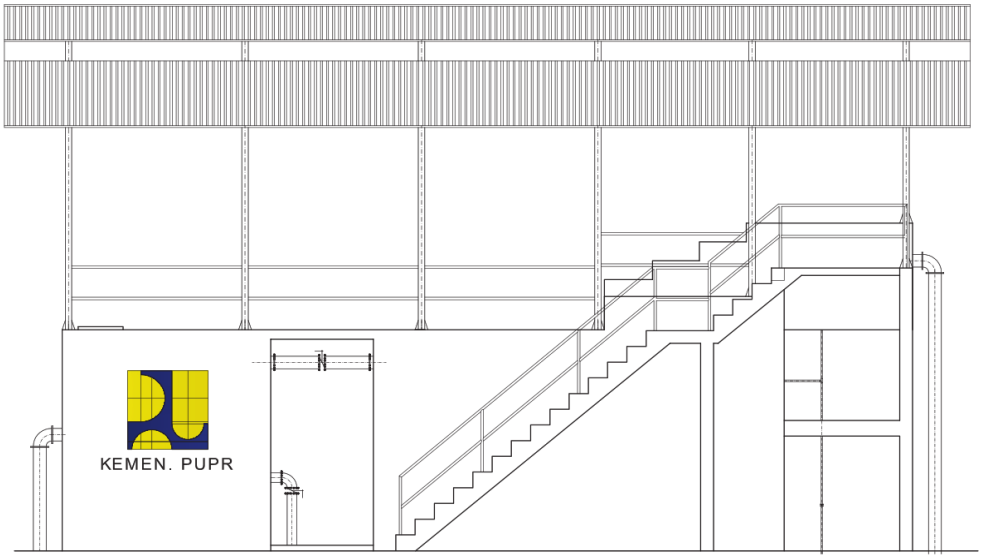


Figure 8. IPA Building Plan

3. Pump House Building

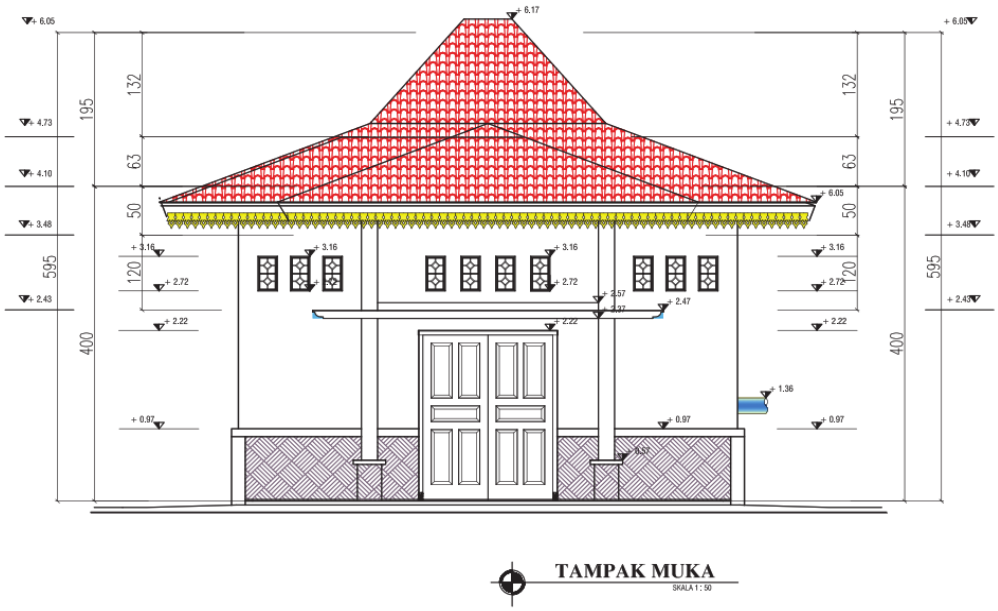


Figure 9. Pump House Plan

CONCLUSION

Based on the calculations and analysis, the following conclusions can be drawn: Firstly, the water demand in the service area of RDWC Lematang Enim in Gelumbang District, Muaraenim Regency, increases every year along with the increase in population, reaching 22,464 m^3/day in 2041, with the availability of water from the Lematang River still sufficient, even having a surplus of 519,264 m^3/day. Secondly, the water demand in Gelumbang District in 2032 includes domestic, non-domestic, and water loss needs of 165,403.6 m^3/day, 419.68 m^3/day, and 33,164.656 m^3/day respectively. Thirdly, to meet the demand for discharge in the next 10 years, an additional number of customers is needed, totaling 113,348, so that the distribution network expansion conducted by RDWC Lematang Enim must meet a discharge of 45,339.2 m^3/day from 2023 to 2032.

The proposed suggestion is to delve into information regarding the availability and sources of raw water that supply RDWC Lematang Enim, and to conduct a more in-depth analysis of consumptive and non-consumptive water needs to improve the accuracy of the analysis results.

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