Analysis of Availability and Water Demand: A Case Study in Sumberejo Village Tanggamus Regency

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Abstract. Clean water is a basic need for humans so that it is normal if clean water gets priority in handling and fulfilling it. The spring in Sumberejo Village, Sumberejo Subdistrict, Tanggamus District is needed to facilitate. The purpose of this study is to identify the potential sources of raw water (clean water) in Sumberejo Village. The EPANET 2.0 program was implemented by calculating the number of people to be served as well as the need for clean water, reservoir capacity, and planning for distribution network. The methods used in water availability include measurement of discharge, topographic data, and water quality and for water requirements are projections of population, total water requirements and pipeline network pressure. The results of the analysis and projections of the number of villagers up to 2030 with a total of 2443 people, total water needs of 2842 liters/second, the availability debit in Sumberejo water eyes was 2,979 liters/second, the discharge was still sufficient for water needs until 2030. Hydraulic analysis using EPANET 2.0 obtained pressure at the highest location is 24.75 meters and the lowest is 2.95 meters. The study indicates that availability and water demand is sufficient until 2030.

1. Introduction

Water is one of the most important needs for human life and other living things. So far, human needs for water are very large. When viewed in terms of its use, water has never been separated from all aspects of humans. Nature has provided quite a lot of water, but with population growth and increased activity so that the use of water needs increases. Clean water has a very important role in improving environmental health or the community, which has a role in reducing the number of people with diseases, especially those related to water and plays a role in improving the level or quality of life of the community [1-2]. In Indonesia until now the provision of clean water for the community is still faced with a number of quite complex problems and still cannot be fully addressed [3-5].

Sumberejo Village has a water source in the form of springs which have sufficient head potential but are not well distributed. At present the distribution of clean water still uses simple technology, namely by using temporary shelters that are distributed by hoses to the homes of residents. In clean water services to the community, the availability of clean water is a very important part. The main function of the distribution pipeline network is to deliver clean water to all villagers while taking into account the quality, quantity and water pressure factors. The condition desired by the whole community is continuous water availability [6-8].

In this case the author tries to plan a large capacity reservoir to store water so that the distribution can be carried out continuously or continuously, and the water distribution system used will use a gravity
system, because the location of Sumberejo Village is at a lower elevation than the raw water source will be used.

With consideration of the above problems, it is necessary to have a study on "Analysis of Availability and Need for Clean Water in Sumberejo Village, Sumberejo District, Tanggamus Regency". The analysis is expected to meet domestic and non-domestic needs that meet the requirements standards.

2. Research Methodology

In carrying out research on the availability of analysis and the need for clean water in Sumberejo Village, Tanggamus Regency, a systematic stage of research planning is needed. This stage of analysis consists of several stages, which include area observation or area identification, evaluation of existing clean water network systems, population size, analysis of water availability, population growth and population needs.

This research was conducted in Sumberejo Village Sumberejo District, Tanggamus Regency. Sumberejo Village is one of 13 villages in the Sumberejo District area. Sumberejo Village is located in a highland area. Geographically the village borders on north side, Pulau Panggung sub-district, east side, Sidomulyo Village, south side, Sumber Mulyo Village and west side, Argopeni Village

Sumberejo Village is located in Sumberejo District, Tanggamus Regency which consists of 4 hamlets. The area of Sumberejo Village is 367.64 km², accessibility to Sumberejo Village from the subdistrict capital is 3 km and from the district capital which is about 36 km. The population is 2162 in 2016. In Figure 1, it is a map of village administration.

![Figure 1. Map of Village Administration.](image)

In this study, the progress of data collection can be grouped into two; primary data, are data obtained from field observations, laboratory tests and interviews. Field observations include potential discharge and potential energy potential (altitude / topography). For laboratory tests carried out is a test of physical and chemical quality of water to be carried out at the Lampung State Polytechnic Laboratory. Secondary data is the data needed to do calculations and analysis. This secondary data is in the form of data including population data and maps of Sumberejo Village, Sumberejo District, Tanggamus Regency.

The analysis was carried out using data that had been obtained, both in the field and in the laboratory, then adjusted to the literature and the results of previous related studies. This water quality analysis was carried out at the Lampung State Polytechnic Laboratory. The method and parameters of the water being analyzed refer to the provisions / requirements for the quality of clean water and drinking water based on RI Minister of Health Regulation No. 416 / MENKES / Per / IX / 1990. Furthermore, water feasibility
is carried out by comparing the parameters of water samples with the quality standards of clean water and drinking water based on Minister of Health Decree No. 416 of 1990.

Population analysis is carried out to determine the number, density, and population growth of Sumberejo Village, which is geographically possible to be served by springs. The amount of water needs of the rural population refers to the 2001 drinking water SK-SNI, which is 60 liters per person per day. For water needs for public facilities refer to Lampung Province P3P of 20% of domestic water needs. Water losses caused by leakage of piping systems and such are estimated at 20% of total production and referring to Lampung Province P3P data. Fluctuations in water demand for maximum day factor values are 1.5 and the water service system is carried out through public faucets (KU) or public hydrants (HU), so that the population's water needs can be known per year.

In the drainage in the pipe there is friction along the pipe and due to the bend of the pipe so that head loss occurs in the pipe. Energy losses (head losses) due to friction along the pipe (hf) in water distribution are calculated using the formula. Calculation of the amount of energy loss in pipe narrowing (hf1) in water distribution. Jetting energy analysis is carried out to simulate an adequate pipe size / diameter by using EPANET software, so that it is known to what extent the source of the spring can flow its service area.

3. Results and Discussion

3.1. Total population

In 2016 the population of Sumberejo Village Sumberejo Subdistrict was 2,612 people with a ratio of 1,101 men and women of 1,061 people, as shown in Table 1, and Table 2 shown the population and growth rate of Sumbererjo Village.

| Table 1 Total Population Based on Gender Ratio in Sumberejo Village [1] |
|-----------------|-----|-----|-----|
| Age             | Male | Female | Total |
| 0-4             | 55   | 55    | 112  |
| 5-9             | 69   | 67    | 136  |
| 10-14           | 70   | 68    | 138  |
| 15-19           | 114  | 110   | 224  |
| 20-24           | 163  | 158   | 321  |
| 25-29           | 69   | 67    | 136  |
| 30-34           | 78   | 75    | 153  |
| 35-39           | 130  | 126   | 256  |
| 40-44           | 136  | 132   | 268  |
| 45-49           | 147  | 142   | 289  |
| 50-54           | 78   | 75    | 153  |
| 55-59           | 74   | 71    | 145  |
| 60-64           | 76   | 73    | 149  |
| 65+             | 67   | 65    | 132  |
| Total           | 1328 | 1284  | 2612 |

| Table 2. Population and Growth Rate of Sumberejo Village [1] |
|----------------|-----|-----|-----|
| No             | Year | Total Population | Population Growth Rate (%) |
| 1              | 2010 | 2043 | 0.95 |
| 2              | 2011 | 2078 | 0.95 |
| 3              | 2012 | 2095 | 0.95 |
| 4              | 2013 | 2112 | 0.95 |
3.2. Projected Population Amount

Population increase due to birth, loss due to death, increase and decrease due to migration and increased merging. Each of these elements is influenced by economic and social factors in the community. Other factors such as war, natural disasters, and industrial and commercial activities also influence. These elements, especially industry and commerce can produce sharp, slow growth, stable conditions or population decline.

Calculation of population projections can be done using 3 methods, namely arithmetic methods, geometric methods and least square methods. After knowing the results of the calculation of each method and also determined the value of the standard deviation of each method, determine which method will be used to calculate the projections of water requirements.

3.2.1. Arithmetic Method

Formula of the arithmetic method are:

\[ P_n = P_o + n(Pr) \]  
\[ Pr = \frac{P_{n1} - P_o}{n_1} \]

Where:

- \( P_n \): Total population in the nth year projection
- \( Pr \): Ratio of population
- \( P_o \): Total population at the beginning of the data
- \( P_{n1} \): Total population at the end of the data
- \( n \): Number of years to come
- \( n_1 \): Data collection year / final year minus the initial year

\[ Pr = \frac{2163 - 2043}{2016 - 2010} = 20 \]

\[ P_{2030} = P_o + n(Pr) \]

\[ P_{2030} = 2163 + (14 \times 20) \]

\[ P_{2030} = 2443 \]

| No | Year | Total Population |
|----|------|------------------|
| 1  | 2016 | 2163             |
| 2  | 2017 | 2183             |
| 3  | 2018 | 2203             |
| 4  | 2019 | 2223             |
| 5  | 2020 | 2243             |
| 6  | 2021 | 2263             |
| 7  | 2022 | 2283             |
| 8  | 2023 | 2303             |
| 9  | 2024 | 2323             |

Table 3. Projected Population Growth Using Arithmetic Method
From the calculation of the standard deviation or standard deviation above in the projected number of populations using the arithmetic method, the standard deviation value is 121.37, as shown in Table 4.

\[
s^2 = \frac{(21) \times (106148594) - (2222933904)}{21 \times (20)}
\]

\[
s^2 = 14729.928
\]

\[
s = \sqrt{14729.928}
\]

\[
s = 121.37
\]

**Table 4. Standard Deviation in Arithmetic Method**

| No | Year | Projected Population (xi) | \(x_i^2\) |
|----|------|---------------------------|-----------|
| 1  | 2010 | 2043                      | 4173849   |
| 2  | 2011 | 2078                      | 4318084   |
| 3  | 2012 | 2095                      | 4389025   |
| 4  | 2013 | 2112                      | 4460544   |
| 5  | 2014 | 2129                      | 4532641   |
| 6  | 2015 | 2146                      | 4605316   |
| 7  | 2016 | 2163                      | 4678569   |
| 8  | 2017 | 2183                      | 4765489   |
| 9  | 2018 | 2203                      | 4853209   |
| 10 | 2019 | 2223                      | 4941729   |
| 11 | 2020 | 2243                      | 5031049   |
| 12 | 2021 | 2263                      | 5121169   |
| 13 | 2022 | 2283                      | 5212089   |
| 14 | 2023 | 2303                      | 5303809   |
| 15 | 2024 | 2323                      | 5396329   |
| 16 | 2025 | 2343                      | 5489649   |
| 17 | 2026 | 2363                      | 5583769   |
| 18 | 2027 | 2383                      | 5678689   |
| 19 | 2028 | 2403                      | 5774409   |
| 20 | 2029 | 2423                      | 5870929   |
| 21 | 2030 | 2443                      | 5968249   |
| \(\sum\) | \((\sum x_i)^2\) | 47148 | 106148594 |

\[
\sum x_i^2 = 2222933904
\]

### 3.2.2. Geometric Method

Formula of the geometric method are:

\[
P_n = P_0(1 + r)^n
\]

\[
r = \left(\frac{P_{n1}}{P_0}\right)^{\frac{1}{(n_1-o_1)-1}}
\]
Where:
\( P_n \): Amount in the coming year
\( P_0 \): Total population at the beginning of the estimate
\( P_{n1} \): Total population at the end of the data
\( P_{01} \): Total population at the beginning of the data
\( r \): Average percentage of population increase
\( n \): Duration of production year from the initial year of calculation
\( n_1 \): Data end year
\( o_1 \): Data start year

\[
r = \left( \frac{2163}{2043} \right)^{\frac{1}{(7-1)}} - 1
\]
\[
r = 0.0095
\]
\[
P_{2030} = 2163(1 + 0.0095)^{14}
\]
\[
P_{2030} = 2471
\]

Table 5. Projected Population Growth Using Geometric Methods

| No | Year | Total Population |
|----|------|------------------|
| 1  | 2016 | 2163             |
| 2  | 2017 | 2184             |
| 3  | 2018 | 2205             |
| 4  | 2019 | 2226             |
| 5  | 2020 | 2247             |
| 6  | 2021 | 2268             |
| 7  | 2022 | 2290             |
| 8  | 2023 | 2312             |
| 9  | 2024 | 2334             |
| 10 | 2025 | 2356             |
| 11 | 2026 | 2379             |
| 12 | 2027 | 2402             |
| 13 | 2028 | 2425             |
| 14 | 2029 | 2448             |
| 15 | 2030 | 2471             |

Table 6. Standard Deviation in Geometric Methods

| No | Year | Projected Population (xi) | \( xi^2 \) |
|----|------|---------------------------|----------|
| 1  | 2010 | 2043                      | 4173849  |
| 2  | 2011 | 2078                      | 4318084  |
| 3  | 2012 | 2095                      | 4389025  |
| 4  | 2013 | 2112                      | 4460544  |
| 5  | 2014 | 2129                      | 4532641  |
| 6  | 2015 | 2146                      | 4605316  |
| 7  | 2016 | 2163                      | 4678569  |
| 8  | 2017 | 2184                      | 4768434  |
| 9  | 2018 | 2205                      | 4860025  |
| 10 | 2019 | 2226                      | 4953375  |
| 11 | 2020 | 2247                      | 5048518  |
| 12 | 2021 | 2268                      | 5145489  |
| 13 | 2022 | 2290                      | 5244322  |
From the calculation of the standard deviation or standard deviation above in the projected number of populations using the geometric method, the standard deviation value is 121.37, as shown in Table 4.

\[
\sigma^2 = \frac{(21)x(87650829) - (1840667409)}{(21)x(20)} \\
\sigma^2 = 1688124 \\
\sigma = \sqrt{1688124} \\
\sigma = 1299.28
\]

### 3.2.3. Least Square Method

Formula of the arithmetic method are:

\[
y = a + bX
\]

\[
a = \frac{N \sum xy - \sum y \sum x}{N \sum x^2 - (\sum x)^2}
\]

\[
b = \frac{\sum x^2 y - \sum x \sum xy}{N \sum x^2 - (\sum x)^2}
\]

Where:

- \(y\): Total population for the year expected
- \(x\): Number of years or years calculated from the base year
- \(a\): constant
- \(b\): linear regression coefficient

### Table 7. Calculations Determine Value A and B Method of Least Square

| No | Year | Total Population \((y)\) | \(x\) | \(y^2\) | \(x^2\) | \(xy\) |
|----|------|-------------------------|------|--------|--------|-------|
| 1  | 2010 | 2043                    | -3   | 4173849| 9      | -6129 |
| 2  | 2011 | 2078                    | -2   | 4318084| 4      | -4156 |
| 3  | 2012 | 2095                    | -1   | 4389025| 1      | -2095 |
| 4  | 2013 | 2112                    | 0    | 4460544| 0      | 0     |
| 5  | 2014 | 2129                    | 1    | 4532641| 1      | 2129  |
| 6  | 2015 | 2146                    | 2    | 4605316| 4      | 4292  |
| 7  | 2016 | 2163                    | 3    | 4678569| 9      | 6489  |
| \(\sum\) | | 14766                  | 0    | 31158028| 28    | 530   |
\[
a = \frac{(7 \times 530) - (0 \times 14766)}{(7 \times 28) - 0}
\]
\[
a = 18.928
\]
\[
b = \frac{(28 \times 14766) - (0 \times 530)}{(7 \times 28) - (0 \times 0)}
\]
\[
b = 2109.429
\]
\[
s^2 = \frac{(21) \times (110800771) - (2317507740)}{(21) \times (20)}
\]
\[
s^2 = 22162.98
\]
\[
s = \sqrt{22162.98}
\]
\[
s = 148.872
\]

**Table 8. Projected Population Growth Using Least Method**

| No | Year | Total Population |
|----|------|------------------|
| 1  | 2016 | 2163             |
| 2  | 2017 | 2261             |
| 3  | 208  | 2280             |
| 4  | 2019 | 2299             |
| 5  | 2020 | 2318             |
| 6  | 2021 | 2337             |
| 7  | 2022 | 2356             |
| 8  | 2023 | 2374             |
| 9  | 2024 | 2393             |
| 10 | 2025 | 2412             |
| 11 | 2026 | 2431             |
| 12 | 2027 | 2450             |
| 13 | 2028 | 2469             |
| 14 | 2029 | 2488             |
| 15 | 2030 | 2507             |

**Table 9. Standard Deviation in Least Method**

| No | Year | Projected Population (xi) | xi^2  |
|----|------|----------------------------|-------|
| 1  | 2010 | 2043                       | 4173849|
| 2  | 2011 | 2078                       | 4318084|
| 3  | 2012 | 2095                       | 4389025|
| 4  | 2013 | 2112                       | 4460544|
| 5  | 2014 | 2129                       | 4532641|
| 6  | 2015 | 2146                       | 4605316|
| 7  | 2016 | 2163                       | 4678569|
| 8  | 2017 | 2261                       | 5111475|
| 9  | 2018 | 2280                       | 5197423|
| 10 | 2019 | 2299                       | 5284087|
| 11 | 2020 | 2318                       | 5371468|
| 12 | 2021 | 2337                       | 5459566|
| 13 | 2022 | 2356                       | 5548380|
| 14 | 2023 | 2374                       | 5637911|
| 15 | 2024 | 2393                       | 5728158|
The results of the 3 (three) population projection methods above and by considering the standard deviation value, it can be concluded that the Arithmetic Method is approaching reality. The reason for choosing this method is because the value of the standard deviation is smaller than the other methods.

3.3. Water Quality

The source of raw water used as a source of raw water in Sumberejo Village is a spring. The Sumberejo Springs are in the coordinates of 5° 21’ 08.74” S - 104° 42’ 06.52” E while for the Springs of the Workspace are at coordinates 5° 21’ 06.78” S - 104° 42’ 44.18” E. The results of the discharge measurement are obtained debit of 3.00 liters / second for Sumberejo Springs and 0.35 liters / second for Sumber Spring works. The results of testing the quality of clean water that has been sampled are as follows.

Table 10.1 Water Quality of Sumberejo Village.

| No | Parameter         | Maximum Limit Allowed   | Test Result        | Unit |
|----|-------------------|-------------------------|--------------------|------|
| 1  | Smell and Taste   | No smell/ tasteless     | No smell/ tasteless| -    |
| 2  | Color             | Colorless               | Colourless         | -    |
| 3  | Temperature       | ±3°C                    | 27                 | °C   |
| 4  | TDS               | 1                       | 75                 | mg/litre |
| 5  | Turbidity         | 5                       | 3,6                | FAU  |
| 6  | Salinity          | 0                       | 0                  | -    |
| 7  | pH                | 6.5-9.0                 | 7.3                | -    |

Table 11. Water Quality of Sumberkarya

| No | Parameter         | Maximum Limit Allowed   | Test Result        | Unit |
|----|-------------------|-------------------------|--------------------|------|
| 1  | Smell and Taste   | No smell/ tasteless     | No smell/ tasteless| -    |
| 2  | Color             | Colorless               | Colourless         | -    |
| 3  | Temperature       | ±3°C                    | 26                 | °C   |
| 4  | TDS               | 1                       | 75                 | mg/litre |
| 5  | Turbidity         | 5                       | 3,6                | FAU  |
| 6  | Salinity          | 0                       | 0                  | -    |
| 7  | pH                | 6.5-9.0                 | 7.0                | -    |

Based on the results of measurements and laboratory tests of samples from springs it can be seen that all parameters can be said to meet the requirements to be used as raw water. Clear water flowing with turbidity levels that only ranges from 3.6 FAU because there is no rain, but according to information if the day before the rain occurs it appears that the spring is cloudy, it must be anticipated by using a slow sand filter.

3.4. Topographic Data

Based on the topographical data of Sumberejo Village, the location of the elevation of the spring is located at an elevation of ± 490 m asl and the water service area ranges from ± 488 m asl to ± 380 m asl. So that clean water services do not use pumps and can be done by means of gravitational flow because
service areas are in lower elevations than raw water sources. Existing topographic images can be seen in Figure 2, and Figure 3.

Figure 2. Topographic Sumberejo.  

Figure 3. Springs Potential Map.

3.5. Projection of Water Needs

Sumberejo Village already has a clean water supply system, but the supply of clean water still uses simple technology and the clean water obtained now comes from springs.

| No | Year | Total Population | Debit Domestic Water Needs (Qd) | Debit Non-Domestic Water Needs (Qn) | Water Losses (Qa) | Total Water Needs (Qt) in ℓ/s |
|----|------|------------------|-------------------------------|------------------------------------|------------------|-------------------------------|
| 1  | 2016 | 2163             | 1.590                         | 0.318                              | 0.286            | 2.194                         |
| 2  | 2017 | 2183             | 1.592                         | 0.318                              | 0.287            | 2.197                         |
| 3  | 2018 | 2203             | 1.653                         | 0.331                              | 0.298            | 2.282                         |
| 4  | 2019 | 2223             | 1.692                         | 0.338                              | 0.306            | 2.336                         |
| 5  | 2020 | 2243             | 1.732                         | 0.346                              | 0.312            | 2.390                         |
| 6  | 2021 | 2263             | 1.749                         | 0.350                              | 0.315            | 2.413                         |
| 7  | 2022 | 2283             | 1.789                         | 0.358                              | 0.322            | 2.469                         |
| 8  | 2023 | 2303             | 1.806                         | 0.361                              | 0.325            | 2.493                         |
| 9  | 2024 | 2323             | 1.848                         | 0.370                              | 0.33             | 2.550                         |
| 10 | 2025 | 2343             | 1.866                         | 0.373                              | 0.336            | 2.574                         |
| 11 | 2026 | 2363             | 1.908                         | 0.382                              | 0.343            | 2.633                         |
| 12 | 2027 | 2383             | 1.926                         | 0.385                              | 0.347            | 2.658                         |
| 13 | 2028 | 2403             | 1.970                         | 0.394                              | 0.355            | 2.719                         |
| 14 | 2029 | 2423             | 2.040                         | 0.408                              | 0.367            | 2.815                         |
| 15 | 2030 | 2443             | 2.059                         | 0.412                              | 0.371            | 2.842                         |

3.6. **EPANET 2.0 Piping Network**

The clean water distribution pipeline network that will be planned uses pipes with a diameter of 12.5 - 100 mm with the type of planned pipe, namely using PVC pipes. The formula used in calculating Head Loss on a distribution pipeline is to use the Hazen Williams formula.
To analyze the clean water distribution network system using the EPANET 2.0 program, it can be done in 2 ways, namely by Single Period and Extended Period Simulation. In the single period the process of analyzing the distribution of clean water needs is considered the same every hour and the flow is steady, while in the extended period simulation analysis of the distribution of clean water needs varies at each time. In this planning analysis an extended period simulation system is used.

The work steps taken to begin the analysis with the EPANET 2.0 program are as follows:

a. Making a new project.
b. Program settings.
c. Depiction of the scheme of clean water distribution network.
d. Input data on clean water distribution network components.
e. Input water pattern data.
f. Program simulation.
g. Interpretation of simulation results

After the program is run, then see the simulation results. The simulation results can be accessed in the form of tables, graphs, and hourly parameter maps. The flow pressure of each pipe can be seen in the table below.

**Table 13. Pressure at Every Point in the EPANET 2.0 Program**

| Node ID (Junc) | Elevation (m) | Base Demand LPS | Demand LPS | Head (m) | Pressure (m) |
|---------------|--------------|-----------------|------------|----------|--------------|
| 2             | 488          | 0.229           | 0.23       | 499.41   | 11.41        |
| 3             | 483          | 0.222           | 0.22       | 498.09   | 15.09        |
| 4             | 480          | 0.014           | 0.01       | 498.05   | 180.05       |
| 5             | 479          | 0.007           | 0.07       | 498.04   | 19.04        |
| 6             | 475          | 0.208           | 0.21       | 497.55   | 22.55        |
| 7             | 472          | 0.201           | 0.2        | 496.14   | 24.14        |
| 8             | 471          | 0.007           | 0.01       | 496.12   | 25.12        |
| 9             | 465          | 0.188           | 0.19       | 476.68   | 11.68        |
| 10            | 463          | 0.007           | 0.01       | 476.66   | 13.66        |
| 11            | 450          | 0.174           | 0.17       | 472.8    | 22.8         |
| 12            | 447          | 0.021           | 0.02       | 466.53   | 19.53        |
| 13            | 445          | 0.014           | 0.01       | 466.43   | 21.43        |
| 14            | 443          | 0.007           | 0.01       | 466.41   | 23.41        |
| 15            | 448          | 0.153           | 0.15       | 469.86   | 21.86        |
| 16            | 437          | 0.146           | 0.15       | 460.04   | 23.04        |
| 17            | 430          | 0.139           | 0.14       | 452.14   | 22.14        |
The results of EPANET 2.0 data above the highest elevation point are at 488 m with a pressure of 11.41 m and the lowest elevation is at an altitude of 395 m with a pressure of 24.75 m.

From the results of the below data it can be concluded that the highest head loss is in pipe 18 at 29.13 m / km and pipe 36 at 27.16 m / km and for the lowest head loss in pipe 15 and pipe 53 because it has the same value i.e. 0.04 m / km.

### Table 14.2 Speed and Head Loss in Pipes

| Link ID (Pipe) | Length (m) | Diameter (mm) | Roughness | Flow LPS | Velocity (m/s) | Unit Head loss (m/km) | Friction Factor |
|----------------|------------|---------------|-----------|----------|----------------|------------------------|----------------|
| 2              | 299.04     | 25            | 100       | 0.2      | 0.41           | 19.3                   | 0.056          |
| 3              | 385.16     | 25            | 100       | 0.1      | 0.21           | 5.73                   | 0.062          |
| 4              | 644.96     | 25            | 100       | 0.07     | 0.14           | 2.67                   | 0.065          |
| 5              | 893.77     | 25            | 100       | 0.04     | 0.08           | 1.04                   | 0.071          |
| 6              | 1121.49    | 12.5          | 100       | 0.02     | 0.17           | 8.4                    | 0.072          |
| 7              | 357.32     | 12.5          | 100       | 0.01     | 0.06           | 1.1                    | 0.084          |
| 8              | 312.55     | 25            | 100       | 0.04     | 0.08           | 1.04                   | 0.071          |
| 9              | 404.94     | 12.5          | 100       | 0.02     | 0.17           | 8.4                    | 0.072          |
| 10             | 495.02     | 12.5          | 100       | 0.01     | 0.06           | 1.1                    | 0.084          |
| 11             | 1113.51    | 12.5          | 100       | 0                | 0.01           | 0.02                   | 0.118          |
| 13             | 690.43     | 100           | 100       | 2.22     | 0.28           | 1.91                   | 0.047          |
| 14             | 131.73     | 25            | 100       | 0.02     | 0.04           | 0.29                   | 0.078          |
| 15             | 199.62     | 25            | 100       | 0.01     | 0.01           | 0.04                   | 0.092          |
| 16             | 350.76     | 100           | 100       | 1.98     | 0.25           | 1.54                   | 0.048          |
| 17             | 277.15     | 75            | 100       | 1.77     | 0.4            | 5.1                    | 0.047          |
| 18             | 667.98     | 50            | 100       | 1.56     | 0.8            | 29.13                  | 0.045          |
| 19             | 483.46     | 25            | 100       | 0.0     | 0.01           | 0.04                   | 0.092          |
| 20             | 1229       | 75            | 100       | 1.37     | 0.31           | 3.16                   | 0.049          |
| 21             | 176.96     | 50            | 100       | 1.15     | 0.59           | 16.58                  | 0.047          |
| 22             | 770.56     | 50            | 100       | 1       | 0.51           | 12.74                  | 0.048          |
| 23             | 830.28     | 50            | 100       | 0.85     | 0.44           | 9.52                   | 0.049          |
| 24             | 834.55     | 50            | 100       | 0.72     | 0.36           | 6.85                   | 0.051          |
4. Conclusion

Based on the results of the analysis carried out in the previous chapter, conclusions can be taken as follows:

I. Based on the results of the survey at the site there are 2 springs in Sumberejo Village, namely the Sumberejo Springs and Sumber Karya Water Spring. The potential discharge from the two springs is 3.00 liters / second and 0.35 liters / second.

II. From the data and results of the calculation of the projection of the residents of Sumberejo Village by using the arithmetic method for 2030, there are 2443 people.

III. Based on the survey results in the study locations, the population’s basic needs were 60 liters / day / capita, so the population was 2443 people for domestic clean water needs of 2.059 liters / second. As well as non-domestic needs, because there are public facilities around 0.412 liters / day. So that the total water needs of Sumberejo Village are 2.482 liters / second and the available spring discharge is 3.35 liters / second, so that the need for clean water is sufficient until 2030.

IV. Based on the calculation of fluctuations in the need for clean water, the reservoir volume for the Sumberejo Spring is found to be 50 m3 and for the Source Spring 6 m3.

V. From the results of the EPANET 2.0 program simulation, the distribution network design criteria have met until 2030. The planned water distribution network uses PVC pipes with a diameter of 12.5 mm - 100 mm, the total length of pipes needed is 4,916 meters. The results of hydraulic analysis using EPANET obtained the highest pressure (pressure) at 24.75 meters and the lowest 2.95 meters.

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