

# DESIGN OF DISTRIBUTION NETWORK- A CASE STUDY FOR AZHIYUR PANCHAYATH, KERALA

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**Abstract** - Water plays a vital role in the life of all the living organisms and the water demand increases day by day. Analysis and design of a pipe network is complex and time consuming. Nowadays lot of pipe softwares are available which can be used for analysis and layout of a network. The Road Network Survey is conducted using GEO TRACKERS and then plotted using QGIS Software. The population is projected to 30 years and its water demand in each year is also computed. The present study includes the design of a distribution network using EPANET 2.0. EPANET is a computer program that performs extended period simulation of hydraulic and water quality behaviour within pressurized pipe networks. The results obtained verified that the pressures at all junctions and the flows with their velocities at all pipes are feasible enough to provide adequate water to the network of the study area.

**Key Words:** QGIS, Epcad, EPANET, GEOTRACKERS, Design, Water Distribution Network.

## 1.INTRODUCTION

Water is present in abundant quantities on and under the earth's surface, but less than 1% of it is liquid fresh water. The components of a water supply scheme include source of water, intakes, treatment and distribution system. Sources of water can be surface or subsurface sources. Intake structures are used for collecting water from the surface sources such as river, Lake Reservoir and conveying it further into the water treatment plant. The available sources is collected from various sources in KWA and additional details are plotted using QGIS software. The Road Network survey is conducted using GEOTRACKERS and then plotted in QGIS. The study involves the proposal of all the components in a water supply scheme and the design is limited to only Azhiyur Panchayath. The current scheme in this area can cater only 30 percent demand and hence a new scheme is inevitable. The design is in line with CPHEEO Manual, KWA Pipe policy and JAL JEEVAN MISSION Guidelines EPANET provides an integrated environment for editing network input data, running hydraulic and water quality simulation. EPANET is a public domain water distribution system modelling software packaged by United States Environmental Protection Agency (EPA). This can also be used in planning of pipe network system to meet forecasted demand in the next 20 years to 30 years.

## 1.1 Population Forecast and Water Demand

Before A Water supply scheme is designed for a design period of 30 years. Hence population forecast is required to determine the expected population for the particular design period. Considering 2011 as base year and population forecast is determined using 4 different methods Arithmetic increase method, Incremental increase method, Geometrical Increase method and Decreasing growth rate method based on previous year population from Census of India. After plotting the graph the final forecast method is Arithmetic Increase method as this seems to be logically correct. The per capita demand adopted is 135lpcd as per CPHEEO Manual. The final demand is calculated by considering the losses 15 % UFW and 5% other losses.

**Table 1-** Population forecast table

Year	Arithmetic	Incremental	Geometric	Decreasing growth rate
2021	33104	32020	33635	27371
2031	36814	34018	37681	26933
2036	37724	35242	40322	25332
2041	39265	36105	42214	25425
2051	42345	38012	47292	22984

**Table-2** Water demand

Year	Water Demand (MLD)
2021	4.4
2031	4.8
2036	5
2041	5.3
2051	5.7

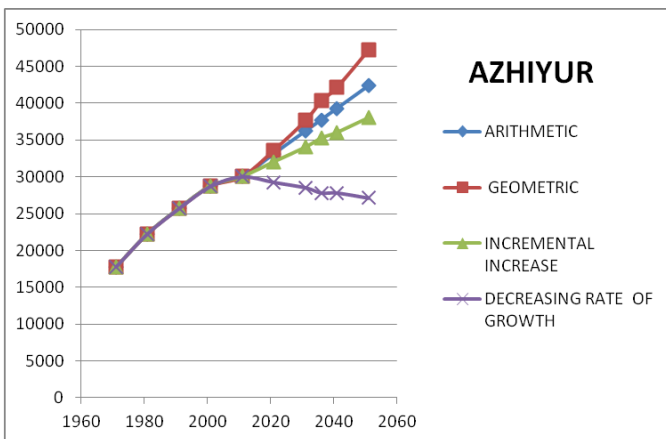


Chart -1: Population forecast in 4 methods

## 2. QGIS Survey

Quantum GIS (QGIS) is a user friendly Open Source GIS Licensed under the GNU Public License. Digital Elevation Model(DEM)s are files that contain either vector or raster, with each point having elevation .In this study DEM files are added to extract elevation. A real world inside a computer is represented in the form of spatial or geographical objects. QGIS Supports both raster and vector data. Vector data is stored as either point, line or polygon. There are mainly two types of Raster data presently used. SRTM by ISRO is used as raster in this study. QGIS provides tools for computing elevation, contour, building location, length of road etc. These datas are then converted into input file in EPANET Also the input datas can be plotted using mobile phone through GEOTRACKERS, Which in turn reduces the difficulty in a resurvey.

### 2.1 Advantages of QGIS Survey

- Moderate accuracy.
- Sufficient for WSD design where variations in nodal pressure can be adjusted to overcome variation in elevation.
- Layer complex data to drive improve decision making.
- Can obtain datas like Contour.
- It can provide Building footprints.
- Less time required.
- Elevations of places without roads can also be obtained.

## 2.2 Steps For Computation of Elevation

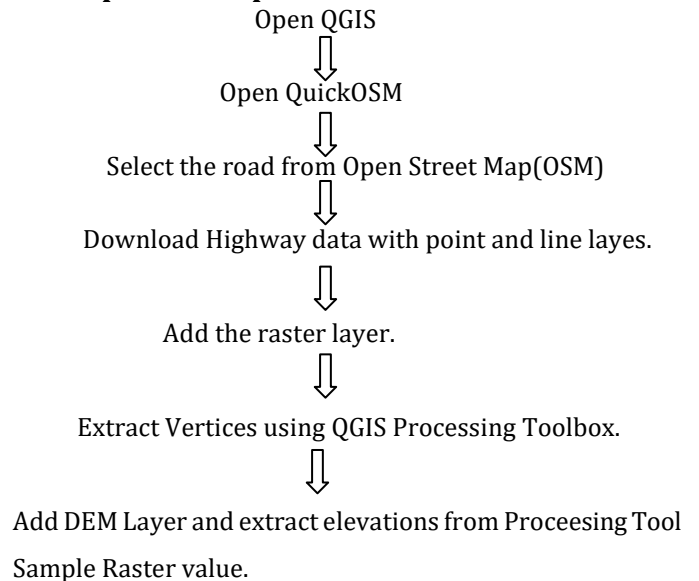


Fig -1 Steps to compute elvation in QGIS.

## 3. DESIGN

### 3.1 Study Area

The study area is plotted in QGIS. The area is taken from the Kozhikode District map Layer and then the corresponding Kml layers using GEOTRACKERS of Azhiyur Panchayath's Road Network is plotted with two storage tanks, the existing one Karappakunnu and the proposed tank at Kakkachikunnu.

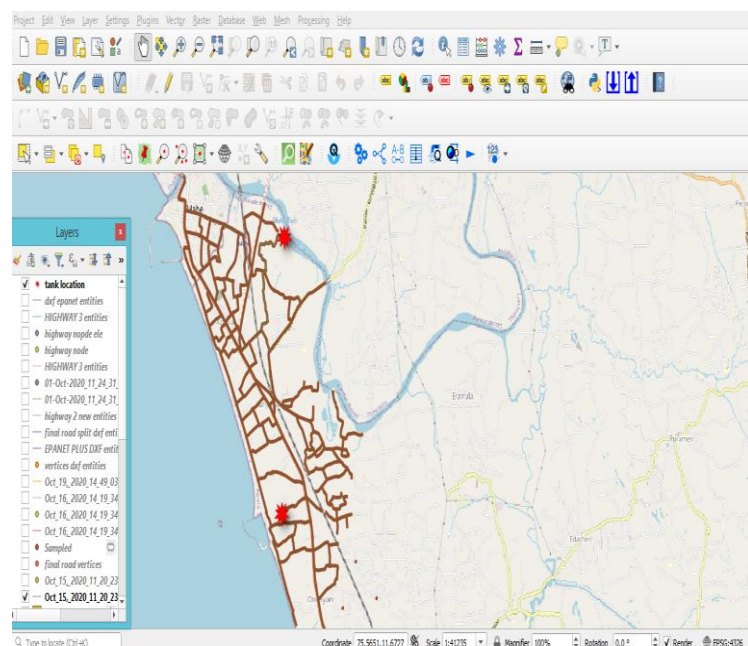


Fig -2 Study Area plotted in QGIS.

### 3.2 Preparing For Input Data

Save modified pipe layer in QGIS and export into DXF Format.

Format.

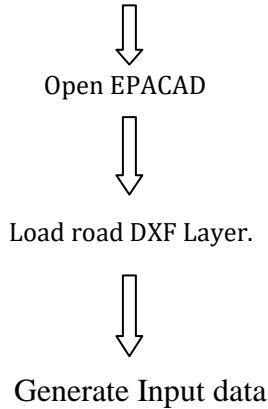


Fig -3 Steps to prepare input data.

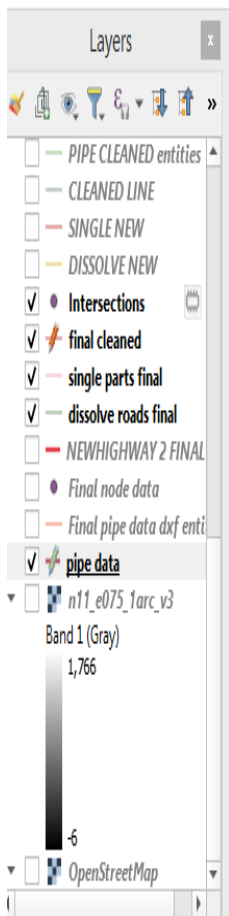
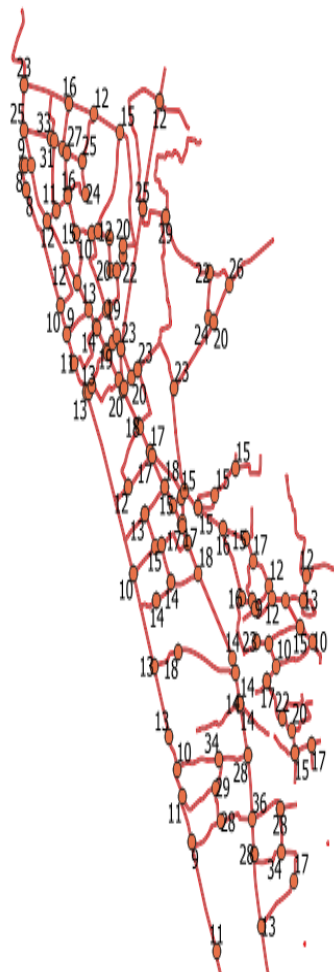


Fig -4 Elevations in QGIS.



### 4. EPANET

Finally import these datas into EPANET. While assigning water demand, we assume the population is uniformly distributed. Every demand assigned will be taken by the nodes and half of the pipe length is chosen. The basic steps include;

- I. Draw the zone and set the hydraulics.
- II. Load the water demand.
- III. Import the pipe catalogue.
- IV. Do Pipe Sizing for Maximum Velocity and Minimum Pressure.
- V. Finally Run the Analysis.

### EPANET input/output

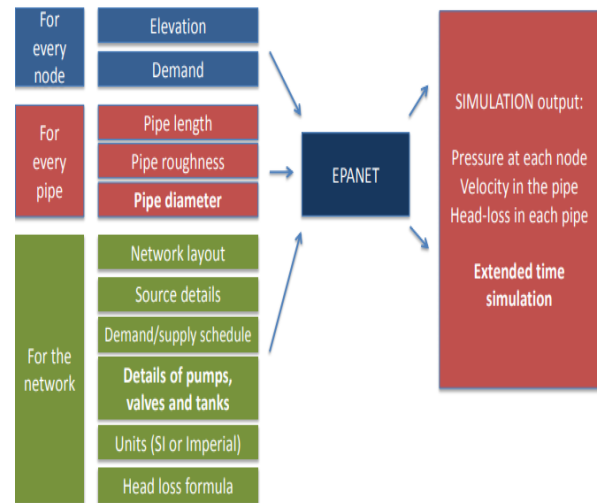


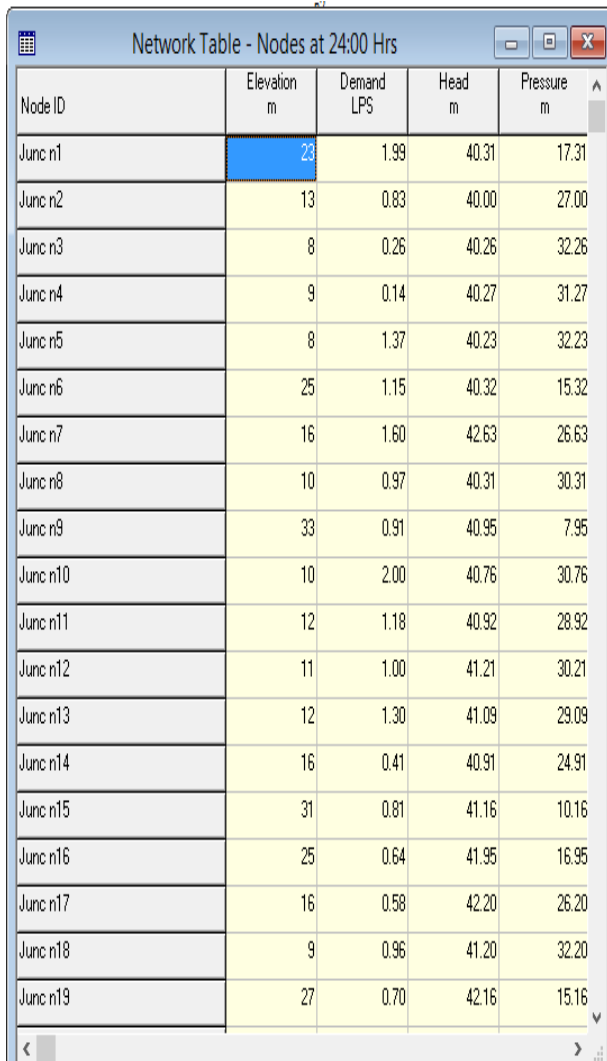
Fig -5 EPANET Parameters.

#### 4.1 Design Check

1. Velocity Check for maximum velocity 1m/s.
2. Pressure check for pressure morethan 7m.
3. Diameter check by some manual interventions.

### 5. CONCLUSIONS

Since all the design checks are satisfied, the design is safe to implement. The results obtained verified that the pressures at all junctions and the flows with their velocities at all pipes are feasible enough to provide adequate water to the network of the study area.



Node ID	Elevation m	Demand LPS	Head m	Pressure m
Junc n1	23	1.99	40.31	17.31
Junc n2	13	0.83	40.00	27.00
Junc n3	8	0.26	40.26	32.26
Junc n4	9	0.14	40.27	31.27
Junc n5	8	1.37	40.23	32.23
Junc n6	25	1.15	40.32	15.32
Junc n7	16	1.60	42.63	26.63
Junc n8	10	0.97	40.31	30.31
Junc n9	33	0.91	40.95	7.95
Junc n10	10	2.00	40.76	30.76
Junc n11	12	1.18	40.92	28.92
Junc n12	11	1.00	41.21	30.21
Junc n13	12	1.30	41.09	29.09
Junc n14	16	0.41	40.91	24.91
Junc n15	31	0.81	41.16	10.16
Junc n16	25	0.64	41.95	16.95
Junc n17	16	0.58	42.20	26.20
Junc n18	9	0.96	41.20	32.20
Junc n19	27	0.70	42.16	15.16

Fig -6 Example network table ( nodes) in EPANET.

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