

Original Article

Upgrades of Water Distribution Network Pipeline by using Watergem

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Abstract: Water distribution system play a vital role in supplying safe and reliable drinking water to urban populations. However, due to rapid population growth, aging infrastructure, leakage, and uneven pressure distribution, many existing water supply networks face operational inefficiencies. This project focuses on the analysis and up gradation of the water distribution network in Cumbum Municipality using Water GEMS software. The study area, Cumbum, has experienced increasing water demand due to urban development and population growth. The existing system was analyzed by collecting data such as population, water demand, pipe network details, elevation, and storage structures. A hydraulic model of the distribution network was developed using WaterGEMS to evaluate key parameters such as flow, pressure, and velocity.

Keywords: Water distribution network, Pipe line network upgrade, Hydraulic modeling, Water gems, Water supply system, Pressure management, Leakage reduction, Resilient infrastructure.

I. INTRODUCTION

A water distribution system plays a vital role in supplying safe and reliable drinking water to people. Due to rapid population growth, urban development, and increasing water demand, many existing water supply networks are facing problems such as low pressure, leakage, and uneven distribution of water.

Efficient planning and proper management of pipeline networks are necessary to ensure continuous water supply. In many areas, old pipelines and poor design lead to water loss and reduced system performance. Therefore, it is important to analyze the existing system and upgrade it based on current and future requirements.

Hydraulic modeling tools like WaterGEMS are widely used to study and improve water distribution systems. These tools help in analyzing flow, pressure, and velocity in pipelines, and identifying problem areas such as low-pressure zones and high head loss regions.

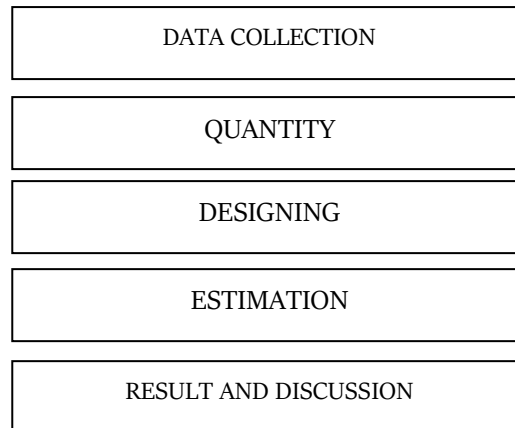
This study focuses on improving the performance of a water distribution network by analyzing the existing system and suggesting suitable upgrades. The aim is to ensure efficient water supply, reduce losses, and provide a reliable and sustainable distribution system for the future.

II. LITERATURE STUDY

A water distribution system is an important infrastructure that supplies safe and clean drinking water to people in urban and rural areas. Due to population growth, aging pipelines, leakage, and low pressure in some areas, many existing water supply networks require improvement and upgrading. Efficient planning and management of the pipeline network are necessary to ensure continuous and reliable water supply.

To analyze and improve the performance of water distribution systems, advanced hydraulic modeling software such as Water GEMS is widely used. This software helps engineers create a model of the water distribution network and analyze parameters such as flow, pressure, and velocity with in the pipelines. Using this analysis, engineers can identify problem areas, select suitable pipe diameters, reduce water losses, and design an efficient distribution network.

Therefore, upgrading the water distribution pipe line network using Water GEMS help in improving the efficiency, reliability, and sustainability of the water supply system.

III. MATERIALS AND METHODS**A. Data Collection**

The required data for the study were collected from municipal records, field surveys, and standard design guidelines.

The following data were used:

- Population Data
Present and projected population for the design years (2024, 2027, 2042, 2057).
- Water Demand Data
Per capita water demand (90 LPCD) and total water requirement were calculated based on population.
- Pipeline Network Details
Layout of the existing pipeline system including pipe length, diameter, and material.
- Elevation Data
Ground elevation of different nodes collected using survey data for hydraulic analysis.
- Storage Structures
Details of overhead tanks, reservoirs, and their capacities.
- Losses in Distribution System
Water losses such as transmission losses (2%) and distribution losses (10%) were considered.
- Field Survey Data
Information on pipe condition, leakage areas, and low-pressure zones.

B. QUANTITY

The quantity of water required for the study area is estimated based on the projected population and per capita demand.

Per capita water demand is taken as 90 LPCD as per standard guidelines.

Population and Water Demand:

- 2024 - 77,290 → 6.96 MLD
- 2027 - 79,311 → 7.14 MLD
- 2042 - 89,418 → 8.05 MLD
- 2057 - 99,525 → 8.96 MLD

Losses Considered:

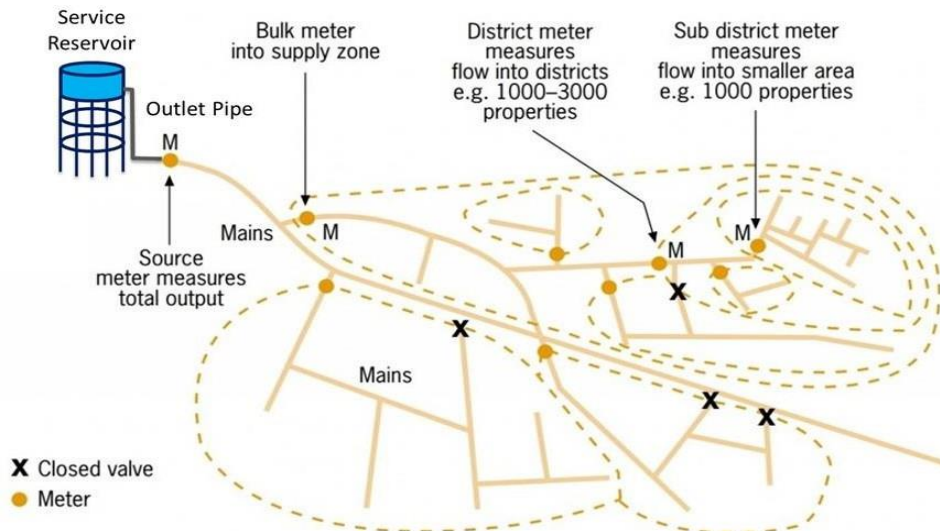
- Distribution losses = 10%
- Transmission losses = 2%

Total Water Requirement:

- 2024 → 7.79 MLD
- 2027 → 7.99 MLD
- 2042 → 8.26 MLD
- 2057 → 9.20 MLD

Thus, the total quantity of water required increases with population growth and system losses, which is considered for designing the upgraded water distribution network.

3. DESIGN



IV. RESULTS AND DISCUSSION

The water distribution network was analyzed using Water GEMS based on population, demand, and pipeline data. The total water requirement increases from due to population growth.

The existing system shows problems such as low pressure, high head loss, and uneven water distribution. Some pipes are undersized and old, causing inefficiency and leakage.

To improve the system, pipe diameters were increased, old pipes replaced, booster pumps added, and loop systems introduced. After modification, the network showed improved pressure, reduced losses, and better water distribution, meeting future demand efficiently.

V. CONCLUSION

The water distribution network was analyzed using WaterGEMS software to evaluate its performance under present and future demand conditions. The study identified key issues such as low pressure zones, leakage, and uneven water distribution due to population growth and aging infrastructure. Hydraulic analysis helped in locating critical areas where the existing system was insufficient. Based on the results, improvements such as increasing pipe diameters, replacing old pipelines, and installing booster pumps and additional storage facilities were proposed. These modifications enhanced the overall efficiency of the system by improving pressure distribution, reducing losses, and ensuring reliable water supply. Thus, the upgraded network is capable of meeting both current and future water demands in an efficient and sustainable manner.

VI. REFERENCES

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