

## Leveraging Water-GEMS for Hydraulic Modeling in Large-Scale Event Areas: A Simhastha Mela Case

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### ABSTRACT

Water is prime requirement for everyone. In Simhastha (Kumbha) mela area water demand is very essential. The Water distribution network plays important role in supplying water to all user in mela area as well as the existing population of the city. Demand for drinking water is increasing on basis with increase in population. This increasing demand can be fulfilled by availability of water sources and designing efficient water distribution networks. The efficient WDN can be achieved based on advance computing systems include modern hydraulic modeling and designing softwares. The review has been carried out for softwares and data used in hydraulic modeling (i.e. EPS, Pressure driven system, zoning etc) of designing water distribution networks.

**Keywords:** Simhastha Mela, WDN (water distribution networks) EPS (Extended period simulation), Pressure driven system, Zoning.

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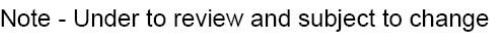
### I. INTRODUCTION

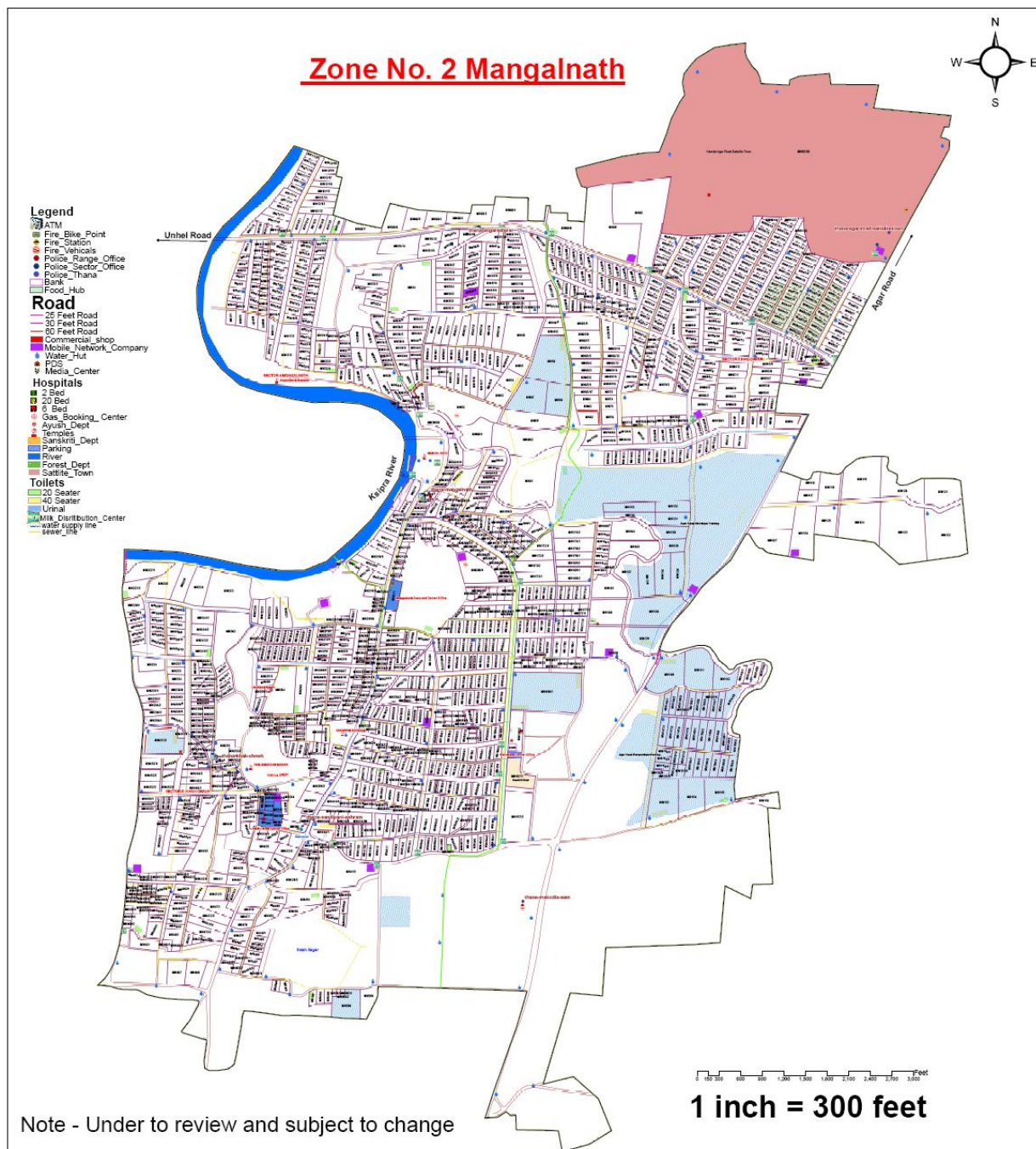
Ujjain is a religious city of Madhya Pradesh, situated on the bank of holy river Kshipra. Ujjain is also called as the seat of Lord Mahadev, known as Mahakal. Simhastha is held at Ujjain in the month of "Kartik" (April- May) .when planet Jupiter happens to be in Simha rashi and the Sun in Mesha rashi. The Simhastha also known as Kumbh is organized every 12 years when Jupiter completes one revolution around zodiac. The Kumbha Mela is a massive religious festival celebrated at three year intervals in four different cities Haridwar , Allahabad(Prayagraj), Ujjain and Nasik . The festival thus comes to each city every twelve years. The Simhastha or Kumbh is the largest congregation of people on the earth creating a challenging task of providing adequate drinking water facility in the mela area as well as in the existing city area during this period.

Water is essential for everyone. WDN is necessary infrastructure for supply of water. for the present study to forecast the population of Ujjain city as well as simhastha mela area in 2028. and design the WDN for Mangalnath Zone of Simhastha mela area of Ujjain city. which is approximate 35% of whole mela area or approximate 1600 hectare area come under this zone. As per collected view from government organization in some part of mangalnath zone find low pressure zone. To consider this problem in present study, design the WDN using Water gems software for upcoming simhastha (i.e. in 2028) for mangalnath zone of Simhastha mela area in Ujjain city.

### II. NECESSITY OF PROJECT

The present water supply arrangement will not be sufficient for Ujjain city as well as Simhastha mela in 2028. hence a safe, potable and an adequate water supply arrangement is necessary. Under these project population forecasting will done for Ujjain city and Simhastha mela for year 2028. and for simhastha area forecasted population will divide in the zones according to area of zone and size of plots. And design a suitable water distribution network for the same. I will consider Mangalnath simhastha mela area which covered 43% area from whole simhastha mela area and is completed with including of two zone i.e. Kaalbhairav Zone and Mangalnath Zone. The planning of roads and plots of proposed zone are shown in fig.





**Proposed Plan of Kaal bhairav Zone and Mangalnath Zone of Simhastha Mela Area**

### III. PRESENT WATER SUPPLY ARRANGEMENT

The population of Ujjain city as per 2011 census is 5,30,000. Water supply to town is presently made from the following sources:

- River Gambhir
- Undasa and Sahib Khedi reservoirs
- Narmada kshripa link yojna
- Hand pumps and tube wells with power pumps.
- The total capacity of the plants constructed with above sources is as under

**Table 1. Present Water Supply Source**

| Available sources                               |           |
|-------------------------------------------------|-----------|
| River Gambhir (at Ambodiya near River Gambhir ) | 56.75 MLD |
| River Gambhir (at Gaughat, Ujjain )             | 81. 72MLD |
| Sahib khedi reservoir ( at Sahib khedi)         | 08.00 MLD |
| Undasa/Sahib khedi reservoir ( at Undasa)       | 04.54 MLD |
| Hand pumps & Tube –Well with power pumps        | 05.68LD   |

## IV. LITERATURE STUDY

**Design of Continuous Water Supply System by using Watergems: Dhumal, et. al., (2018)** has studied continuous water distribution network i.e. 24 x7 water supply to every consumer throughout the year using with watergems software. Now a days, the concept of continues water supply has generated significant interest in India due to its advantages over intermittent system of water supply. Author suggested that watergems is very effectively design tool for design a continuous water supply system than the manual process and it required minimum time and gives accurate results within short period. Also it optimizes the distribution network on the basis of performance and cost.

**Analyzing the existing water distribution system of Surat using Bentleys Watergems: DilipBabubhai Paneria et al (2017)** In this study, the existing water distribution system is simulated through construct of a model using Bentley Water GEMS. It helped in analyzing the entire network system, visualized the effects of constituent components and parameters as well as the pressure at end node is detected low, that shows the consumer near the reservoir having more advantages of water than the one that resides away from the reservoir.

**A model for transforming an intermittent into a 24x7 water supply system: Dr. Sanjay and V. Dahasahasra (2015)**-In this case-study, the author presents the award winning project undertaken in Maharashtra's Badlapur city for supplying pure drinking water round the clock. It is unique not only because it is the first such attempt in India but also because of the methods adopted. Water is indispensable for life but is finite and therefore precious. Serving pure and potable water to the dense populations in developing countries, especially in India, is a daunting task. According to the World Water Development Report, 1.1 billion people worldwide do not have access to safe drinking water. This figure is expected to touch 2 billion by 2050. 1.6 million die every year due to diseases related to poor sanitation and polluted water supply and 160 million are infected with Schistosomiasis while 133 million suffer from high intensity intestinal helminthes infections.

**Design of Optimal Water Supply Network and Its Water Quality Analysis by using WaterGEMS Sajedkhan S. Pathan and Dr. U. J. Kahalekar (2013):** In this paper design of water supply network duly considering optimization in addition to the cost minimization, minimum head requirement and minimum chlorine requirement is presented. A design is obtained duly considering minimum and maximum head and velocity criteria in order to determine the actual supply form each node to all consumers. In this paper a part of Aurangabad city is designed and its water quality analysis is done by WATERGEMS software. In this paper WATERGEMS software is used for obtaining optimal design of water supply network of a part of Aurangabad city. With the help of WATERGEMS software design of optimal water supply network and its water quality analysis is done with achieving objective of minimizing the overall cost while meeting the water demand requirements at sufficient pressures for specified maximum discharge over a long period of time. The software is also used for solving problems in existing network and also in expansion of existing water supply network.

**Sumithra R.P., et. al., (2013)-** has carried out the feasibility analysis of water distribution system of Tirunelveli Municipal Corporation, Tamilnadu, India with the help of LOOP and WaterGEMS softwares packages for design period of 30 years. The variety of analysis has been carried out yielding wide range of results for diameter of pipes, pressure at different nodes, cost analysis, etc. The network analysis has been done pertaining to the criteria of 135 lpcd water supply with the minimum head of 7.0 m. It has also been discussed as a result that LOOP and WaterGEMS softwares are highly efficient to do various hydraulic and costing analysis. WaterGEMS found extremely user friendly

with variety of hydraulic and graphical analysis options. It is also less time consuming for the renovating and reanalyzing the network.

**Vaghela and Bhagat (2013) :-** In this paper hydraulic analysis of Water distribution network of laxminagar territory of west zone of Rajkot City is carried out. the whole analysis is based on Steady State condition. The result obtained verified that the pressure at all junction and the flows with their velocities at all pipes are feasible enough to provide adequate water to the network of study area. At the end of the analysis it was found that the resulting pressure at all nodes and the flows with their velocities are sufficient to provide to the study area.

## V. OBJECTIVES OF STUDY

- To forecast the Population of Ujjain city for the year 2028 with different method and population for mela area consider with respect to previous Simhasth data and as per declared by the Simhasth mela pradhikarn Ujjain.
- To calculate the demand of water requirement for all Simhasth mela area and City area as per standards.
- To collect the data of detailed survey (i.e., contour survey for Simhasth mela area, treatment plant, over head tanks, city map and city distribution system etc.) from Simhasth mela office and MPPHE Department Ujjain.
- To design of Hydraulic model of water distribution network with appurtenances for Mangalnath zone of Simhasth mela area.
- To develop detailed computerized drawings of water distribution network for Simhasth mela area with using of following software i.e ArchGis, Autocad and Watergems etc.
- Preparation of detailed report of distribution network.

## VI. PROPOSED METHODOLOGY

- To collect & compile survey data, details of zones & plots in the mela area, available with the PHED, Municipal Corporation, Mela authority.
- To take help of officers and other concerned persons of the Public Health Engineering Department, who have experience of Simhasth mela problems related to water supply system.
- To collect the data of total station survey as per requirement and prepare a digital map of water supply network.
- To prepare hydraulic design and estimates of proposed project on the basis of latest SOR( Schedule of Rates) of MPPHED, MPPWD, MPWRD, including detailed rate analysis of items.
- The mela area is divided in to 6 zones- Mahakal area, Dutta ka akhara, Ujar kheda, Mangalnath, Bherugarh & New area. This area will further be divided on the basis of proposed water supply network.
- Fixing location of over head tank, location of existing water supply network etc.
- Assessment of the existing capacity of water treatment plants. Upgrading will be carried out the same and proposed new water treatment plant if required.
- Designing new water distribution network for mela area using watergems software.
- Assessment of water quantity likely to collect from existing water supply system including consumption of water in city area and for utilization of available capacity for the Simhasth area.

## VII. EQUATIONS USED IN WATERGEMS SOFTWARE

Following equations are used in Watergems software, with the help of which flow of water is calculated.

1) Hazen-Williams Equation:-  $Q = k.C.A.R^{0.63}.S^{0.54}$

Manning's equation is used for analysis of the roughness coefficient.

1) Manning's Equation:-  $Q = k/n.A.R^{2/3}.S^{1/2}$

2) Darcy-Weisbach Equation:-  $h_L = f L V^2 / 2gd$

## VIII. CONCLUSION

The purpose of present study is to design water distribution network for Mangalnath zone of Simhastha mela area in Ujjain city for upcoming Simhastha in 2028 because as per concerned department for water supply arrangement in mela area Mangalnath Zone is one of the problematic zone in distribution of water. In this study it is observed that watergems software is most suitable, easy to use and accurate for design and analysis of large water supply network. the review of softwares for modeling ,analysis and designing water distribution networks concludes that the choice of design softwares are depends upon the availability of the data, time, financial aspects, applicability and compatibility of the project. Designing of Water Distribution Networks (WDNs) requiring modest accuracy can opt for free-wares but for the speedy and accurate designing of water distribution networks commercial softwares are needs to be adopted.

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