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STUDY AND DESIGN OF 24/7 WATER SUPPLY DISTRIBUTION SYSTEM BY WATERGEMS

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ABSTRACT- *24-7 supply is achieved when water is delivered continuously to every customer of the service 24 hours a day, every day of the year, through a transmission and distribution system that is continuously full and under positive pressure throughout all of its pipelines and networks. Of course, very occasionally, in times of exceptional circumstances, there may be short interruptions to this continuity of supply. However, any service which routinely fails to provide continuity "24 hours a day, every day of the year" must be considered intermittent – and the problems experienced are precisely the same for all periodicities of intermittent supply, whether there is an intermittency of 20 hours a day or of two hours a day. One thing is common to all water distribution systems –intermittent water supplies are a considerable danger to health and preclude any possibility of practicing service efficiency and cost-effectiveness. The negative aspects of this can be avoided by conversion to continuous supply.*

I.INTRODUCTION

A **Background**

Government of Maharashtra (GoM) has undertaken "Sujal-Nirmal Abhiyaan" project for up gradation of water systems of small & medium towns under which government insisted various urban local bodies in the state to participate. This ULB improvement program includes funding various municipal councils in the State to increase serviceability of the system. The program comprises of works such as carrying out Consumer survey, water audit, energy audit, providing and installing flow meters, Geographic Information System (GIS) development & mapping and hydraulic modeling for towns in the State. The funds disbursement is planned on a first-come-first-serve basis.

B **Aim of Sujal-Nirmal Abhiyaan**

In Maharashtra state, population of the urban areas is rising rapidly. The State Government has embarked upon "Sujal-Nirmal Abhiyaan". Under this program, it has been decided to give sufficient financial help to the Urban Local Bodies (ULB) which are ready to improve the Urban Water Supply Schemes, Sewerage & Sanitation, including public toilets and dry waste disposal.

For Water Supply Component, Sujal-Nirmal Abhiyaan aims at achieving 24x7 water supplies as per the central government guidelines with emphasizing the focus on water conservation. It is a program to improve and sustain the performance of urban water supply by active participation of the ULBs with government support. It includes improvement of accountability mechanisms like theft, leakages and to promote the judicious and equitable distribution of available water to all consumers while extending the access to water to all the residents in the ULB.

"Sujal-Nirmal Abhiyaan" encourages Urban Local Bodies (ULB) for project development and implementation wherein

up to 90% of the project cost would be borne through funds to be made available by State Government while remaining 10% would be contributed by individual ULBs. With this, serviceability and access of water could be increased to the urban poor communities. Parameters for improvement includes the intra-city equitable distribution of water, water to the desirable level quality, non-revenue water within acceptable limits, optimal cost of service provision, improved service level and functionality of metering etc.

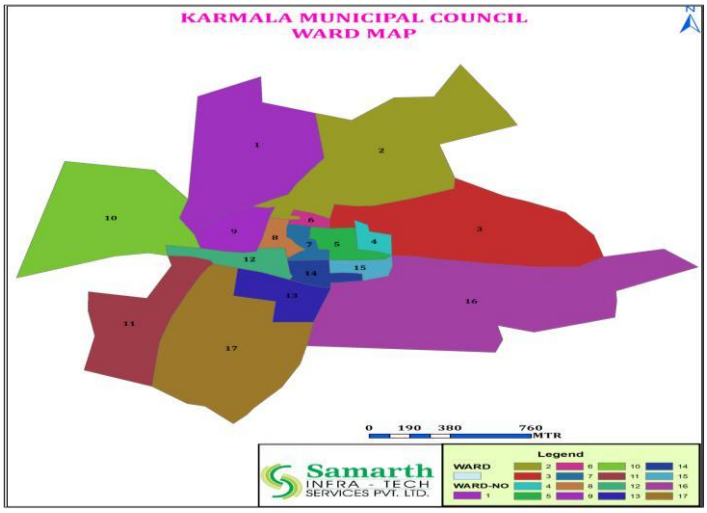
II.OBJECTIVES

- 24 X 7 water supply projects in pilot area and improved water supply services
- Sustainable water source development
- Metering of 80% household connections
- At least 80% recovery of O&M cost of water supply and sanitation
- Achieve at least 80% collection efficiency
- Providing safe collection and disposal of drainage and sewerage system
- Creating MIS at various levels
- Establish system of water tariff framing
- City wide 24 X 7 water supply system
- 100% consumer metering
- 100% O & M cost recovery & 100%Billing & collection efficiency.

III.NEED OF THE PROJECT

Presently water is being supplied to Karmala town from the Ujjani Dam Back water . The water supply system is managed by Council. Karmala Municipal Council needs to develop new water supply scheme since the water demand is increasing due to rise in the population per decade and there is necessity to design proper zoning and distribution network as town is facing problem of uneven water distribution.

Presently KMC provides water to consumer at flat rate. There are certain disadvantages of flat rate like maximum use of fresh water, non-respect of water, unequal distribution of water, loss of revenue etc. To overcome these problems KMC had planned to meter each and every connection.



IV. SCOPE OF WORK

1. Preparation of water pipe network in Bentley Water GEMS from GIS files

2. Preparation of hydraulic model and extended period simulation of the same.

3. Load elevations to the hydraulic model from the 3D contour data.

4. Check the design of all the zones of the town for its adequacy

5. Creation of the District Metering Areas (DMA)s for transformation to the 24/7 water supply system.

4. Creation of scenarios as required.

5. Preparation of final output of hydraulic design with AutoCAD drawing and report, etc. complete.

V. LITERATURE REVIEW

Dr. Sanjay and V. Dahasahasra Member Secretary Maharashtra Jeevan Pradhikaran Mumbai, India-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.

Rutva N. Gohil1 1 PG Student ME-IV, Department of Civil Engineering 1S.S.E.C, Bhavnagar, Gujarat, India - The declining availability of water supplies is one of the most important environmental issues facing various countries at the present time. Climate change, affluence and population growth have resulted in vast requirements of water for use in domestic, industrial and agricultural settings. Using data from the local government body, the paper presents the status of existing water supply network condition, and comparing it with continuous water supply system of selected DMA of Bhavnagar town in Gujarat (India). Key Terms- Urban Local Bodies (ULB), District Metering Area (DMA), negative pressure.

Evaluation of Intermittent Water Supply System and Design of 24x7 for a residential area in Mysore, Karnataka, India-Water is a basic need for life, without water life would not exist. Today in Indian scenario about one in every nine people lack access to good quality water. Although water is renewable it is finite and precious. Now-a-days due to increase in water demand resulted in depleting ground water resources that in turn increased in the capital cost for water supply thus, alternative methods for conservation are to be developed one such is 24x7 which helps to prevent deliberate wasting of water in comparison to intermittent water supply system. In this paper along with the design of the 24x7water supply system for existing intermittent water supply system water quality analysis is being done. Designing of Water supply system is made using LOOP and EPANET and compared for their efficiency.

VI.METHODOLOGY

A. System Layout

By using GIS and survying the field with the help of Council Engineers and water supply staff, we track the entire water network starting from source to line before consumer end with the help of total station and also collects relevant data.

B. Data Entry

Once collected all the data from the field, transfer the tracked network into the ArcGIS software, where we create shape files for various elements of water supply system. Then we add all the relevant information to the respective element layer.

For example: i) In pipe attribute table, we input diameter, material, length, etc.

ii) In pump attribute table, we input head, flow, power, etc.

iii) In ESR attribute table, we input GL, LSL, FSL, etc.

After creating the shape files, authenticates the network with the Municipal Council and then hydraulic modelling is done.

C. Data checking

After receiving the authenticated shape files from hydraulic modelling, checking all the data with relevant information is done like For example:

i) From Energy Audit report we check all the pumping details.

ii) From scheme file, we check the transmission line and ESR details, etc.

iii) From census population, we check the consumer survey data.

iv) From contour plan, we check elevations.

Now, with the help of Model Builder, we add all the shape files into the Bentley Water GEMS v8i software.

D. Population forecasting and Demand calculation

We collect the census population from 1961 to 2011 and based on that with the help of “CPHEEO Manual on Water Supply and Treatment” guidelines and as per service level benchmark, we forecast the population for the next 30 years from the base design period.

Now, with the help of consumer survey data, we segregate the ward wise population for respective council and based on council’s development plan, we forecast the ward wise population for next 30 years.

i) Based on scheme files LPCD we calculate the demand for that particular municipal Council.

ii) Now, we create the Thiessen Polygon for all the nodes of the distribution.

iii) And with the help of Load Builder, we assign the demand to the respective junction/node.

E. Analysis

i) Validation

ii) Zoning

iii) Pattern

iv) Controls

v) Alternatives and Scenarios

vi) Computation of scenarios

VII.DESIGN CRITERIA

A. Design Year

Water supply project is normally designed for the period of 30 years. Therefore, the project is designed for implementation in two phases. Phase-I will be from year 2015 to year 2030 and Phase-II from year 2030 to year 2045.

Table 1: Stage wise years of the project

Sr. No.	Stage	-	Year
1	Immediate Stage	-	2015
2	Intermediate Stage	-	2030
3	Ultimate Stage	-	2045

B. Population

The population analysis is based on 2011 census and the trend value during 1961-2011.

Among the various mathematical models usually adopted for population projections, the adopted methods are as described below and the mean of arithmetic and incremental increase method is adopted for calculating the water demand.

1. Arithmetic Increase Method
2. Geometric Increase Method
3. Incremental Increase Method

Table 4.5: Density and ward wise details

Density	Multiplier	Ward Nos.	No of Ward
LD	1.100	4,5,6,7,8,9,12,13,14,15	10
MD	1.14	17	1
HD	1.24	2,3,11,10	4
VHD	1.31	1,16	2
		Total	17

C. Water Demand

Domestic demand for resident population - 135 LPCD

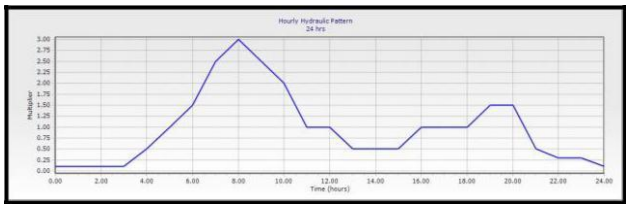
D. Losses in the System

The losses in the transmission and distribution are taken as 15%.

E. Demand Pattern

The supply of water is targeted for continuous 24x7 module, with peak factor of 3.0.

Figure: Hourly hydraulic pattern



F. Pumping Main

Design Hours - 20 hours

Pipe size – DI-K9 pipes up to and including 600 mm diameter.

Velocity - The design velocity in the transmission mains and feeder mains should preferably be not less than 0.8 m/s and in no case greater than 1.8 m/s.

Terminal pressure - The terminal pressure in the transmission mains at the point of discharge into various OHT reservoirs will be 2 m.

G. Sluice Valves

Sr. No.	Criteria	Diameter of valve
1	For pipe size upto 300 mm	Same size as pipe
2	For pipe size greater 300 mm	Above 2/3rd of pipe size but minimum of 300 mm diameter

H. Air Valves

Air valves shall be provided at the high points in the pipeline. Size of air valve shall be D/4th to D/6th of pipe diameter, where D is diameter of pipe.

I. Hazen-William's C-Value

Pipe Material	Recommended C Values	
	New Pipes	Design Purpose
CI ,DI and MS lined with cement mortar or epoxy	--	
Upto 1200 mm dia	140	140
Above 1200 mm dia	145	145
Asbestos Cement	150	140

VII. POPULATION PROJECTION

1. Arithmetic Increase Method:-

i. Population of 2015 = $P_{2015} = P_{2011} + 0.4 \times 2271$

$= 22699 + 0.4 \times 2271 = 23578$

ii. Population of 2030 = $P_{2030} = P_{2011} + 1.9 \times 2271$

$= 22699 + 1.9 \times 2271 = 26876$

iii. Population of 2045 = $P_{2045} = P_{2011} + 3.4 \times 2271$

$= 22699 + 3.4 \times 2171 = 30174$

2. Geometric Increase Method:-

i. Population of 2015 = $P_{2015} = P_{2011} \times (1 + r)^{0.4}$

$= 22699 \times (1 + 0.1193)^{0.4} = 23652$

ii. Population of 2030 = $P_{2030} = P_{2011} \times (1 + r)^{1.9}$

$= 22699 \times (1 + 0.1193)^{1.9} = 27594$

iii. Population of 2045 = $P_{2045} = P_{2011} \times (1 + r)^{3.4}$

$= 22699 \times (1 + 0.1193)^{3.4} = 32194$

3. Incremental Increase Method:-

i. Population of 2015 = $P_{2015} = P_{2011} + 0.4 \times 2271 + (0.4 \times 1.4 \times 178)/2$

$= 22699 + 0.4 \times 2271 + (0.4 \times 1.4 \times 178)/2 = 23576$

ii. Population of 2030 = $P_{2030} = P_{2011} + 1.9 \times 2271 + (1.9 \times 2.9 \times 178)/2$

$= 22373 + 1.9 \times 2271 + (1.9 \times 2.9 \times 178)/2 = 26819$

iii. Population of 2045 = $P_{2045} = P_{2011} + 3.4 \times 2271 + (3.4 \times 4.4 \times 178)/2$

$= 22373 + 3.4 \times 2271 + (3.4 \times 4.4 \times 178))/2 = 30018$

IX. RESULTS

A. Source

The Existing source of kamala water supply scheme is Ujani Dam & this source is adequate for 30 year design period .So There is no need of other source.

B. Zone wise and ESR wise Population and Water Demand Estimation

The zone wise and ESR wise population distribution as per hydraulic modeling for immediate, intermediate and ultimate stages including the institutional demand with losses (15%) is calculated.

Table 2: Details of zone wise population and water demand estimation

Sr. No.	ESR Name	E/P	Feeding Zone	Capacity (Litres)	Population Served			Domestic Demand (MLD)			Required Capacity of ESR (Litres)			Surplus/Deficit (Litres)		
					2015	2030	2045	2015	2030	2045	2015	2030	2045	2015	2030	2045
1	GSR at WTP	E	Zone-1	11,00,000	13486	15272	17049	2.0229	2.2908	2.5573	674300	763600	852433	425700	336400	247567
2	MBR cum ESR	E	Zone-2	4,00,000	6126	7019	7908	0.9189	1.0529	1.1862	306300	350967	395400	93700	49033	4600
3	Karjat Road ESR	E	Zone-3	2,77,000	4617	5511	6400	0.6926	0.8266	0.9600	230867	275533	320000	46133	1467	-43000
4	Hirde Plot ESR	E	Zone-4	74,000	1224	1453	1681	0.1836	0.2179	0.2521	61200	72633	84033	12800	1367	-10033
5	Old GSR at Devichamal	E	Zone-5	4,50,000	1853	2259	2661	0.2780	0.3388	0.3992	92667	112933	133067	357333	337067	316933
6	New GSR at Devichamal	E	Zone-6	5,00,000	2565	3047	3527	0.3848	0.4571	0.5291	128267	152367	176367	371733	347633	323633
	Total			**2801000**	**29872**	**34561**	**39226**	**4.4808**	**5.1841**	**5.8839**	**1493600**	**1728033**	**1961300**	**1307400**	**1072967**	**839700**

X.CONCLUSION

The current system is on intermittent mode. By controlling the valve operations of the existing wat er supply system, it is possible to convert the existing system into 24x7, which is the ultimate aim of the project.

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