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Integrated Urban Water Cycle Management Plan for Tarnaka Division, Secunderabad

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Abstract—*Global urban population growth, particularly in developing countries, is happening at an unprecedented rate. The world population rose from 750 million in 1950 to 2.9 billion in 2000, and the number of people living in urban areas has equaled the rural population in 2007, and is on the way to reaching 60 per cent by 2030.*

The sustainability of such a vibrant growth is contingent upon the availability of sufficient water for covering domestic, commercial, industrial, environmental as well as other minor demands. If on the one side the urban demand for water is growing, on the other the availability of the resource has shrunk over the last decades due to many reasons i.e., increase in urban population, climatic changes, reduction in catchment areas, encroachments of Water bodies, sealing of surface with roads, digging bores to undesirable depths, etc.,.

Integration means integration of the physical system affecting water availability (catchments, surface water, groundwater, storm water, wastewater outflows) so as to ensure hydrological system integrity; integration of the socio-economic systems affecting various water demands so as to manage inter sectoral water allocation integration of the technical systems that collect, treat and supply water for various uses, and collect and treat storm water and wastewater so as to ensure sustainable water supply; integration of urban water management actions at various scales using the principle of subsidiary in order to improve management capacity; and integration of institutions, policies and laws governing water supply. Besides this, IUWM would also mean cost Effectiveness of the various interventions

1. INTRODUCTION

1.1 Background

Integrated Urban Water Management takes a comprehensive approach to urban water services, viewing water supply, storm water and wastewater as components of an integrated physical system

The integration of urban water management plan is one of the solutions to tackle the scarcity of water by improving ground water levels with various methods and increase in the revenue to the Government also supplying the water as per the need of the urban population.

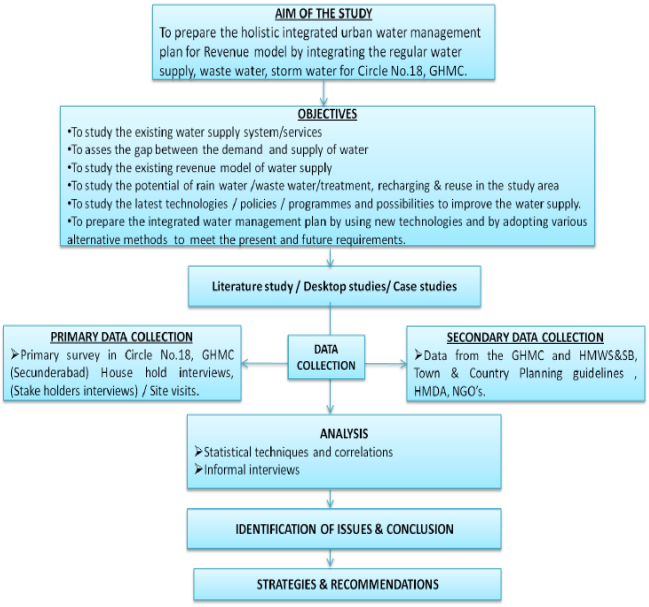
1.2 Aim

- To prepare the holistic integrated urban water management plan for Revenue model by integrating the regular water supply, waste water, storm water for Circle No.18, Tarnaka Division.

1.3 Objective

- To study the existing water supply system/services
- To assess the demand and supply gap of water
- To study the existing revenue model of water supply
- To study the potential of rain water /waste water/treatment, recharging & reuse in the study area
- To study the latest technologies / policies / programmes and possibilities to improve the water supply.
- To prepare the integrated water management plan by using new technologies and by adopting various alternative methods to meet the present and future requirements.

1.4. Methodology



1.5 About Integrated Urban Water Management

1.5.1 Traditional Approach of Water Supply

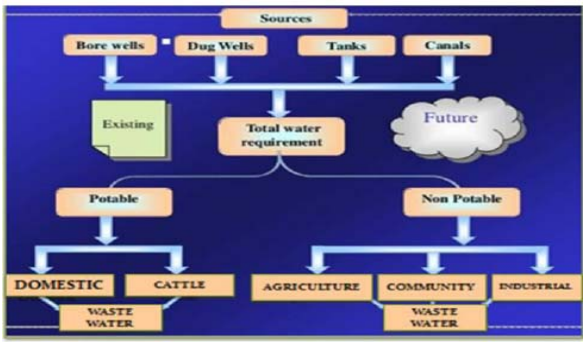


Fig. 1 Traditional approach of water supply

1.5.2 Integrated Approach of Water Supply

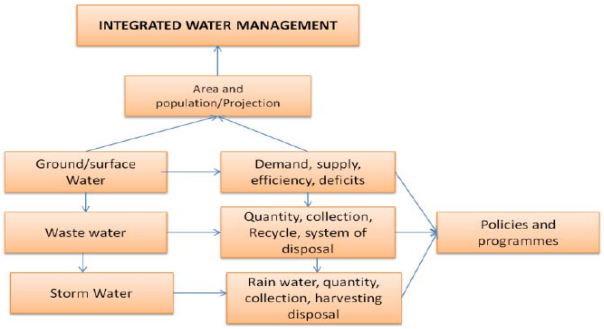


Fig. 2: Integrated Approach

1.5.3 Integrated urban water management

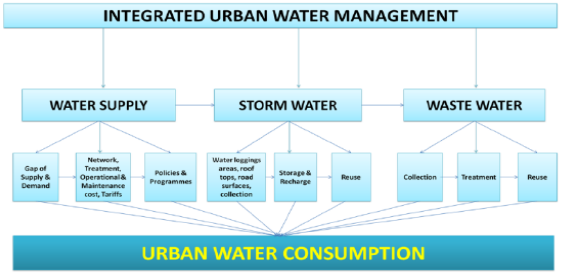


Fig. 3: Integrated Urban Water Management

2. LITERATURE REVIEW

2.1 Factors Causes for the Scarcity of Water

Fig. 4: Showing the Causes of water scarcity

2.2 Need of Water Supply in India

- Domestic needs such as drinking, cooking, bathing, washing, flushing of toilets, gardening an individual air cooling.
- Institutional needs
- Public purposes such as street washing or street watering, flushing of sewers, watering of public parks.
- Minor industrial and commercial uses
- Fire fighting ,Requirements of live stock and
- Minimum permissible Unaccounted for Water (UFW)

The National Commission for integrated Water Resources Development Plan, as a final goal, has suggested the norms for water supply as 220 LPCD for urban areas and 150 LPCD for rural areas.

2.3 Service Level Benchmarks for Water Supply

Table 1 Service level Benchmarks for water supply

Water Supply		
Sl. No.	**Indicator**	**Benchmarks**
1.	Coverage of WS connections(Population)	100 %
2.	Per capita availability of WS at consumer end	135 LPCD
3.	Extent of metering of WS connections	100%
4.	Extent of Non-Revenue water	20%
5.	Continuity of Water Supply	24x7
6.	Efficiency of redressal of customer complaints	80%
7.	Quality of water supplied	100%
8.	Cost recovery in water supply services	100%
9.	Efficiency in collection of water supply charges	90%

2.4 Storm Water / Rain Water

Rainwater is harvested as it runs off roofs, or over natural ground, roads, yards, or specially prepared catchment areas

By diverting storm water into the said purposes, the urban floods and overloading on sewerage lanes can be reduced.

- Also reduced power consumption in pumping water
- Reduced water logging and flooding in low lying areas and also Reduced erosion
- Improved Groundwater quality through dilution.

Benefits of Rainwater Harvesting

1. Rainwater is a relatively clean and free source of water & it provides a source of water at the point where it is needed
2. It is owner operated and managed & It is socially acceptable and environmentally responsible
3. It promotes self sufficiency and conserves water resources
4. Rainwater is friendly to landscape plants and gardens ,It reduces storm water runoff and non-point source pollution
5. Offers potential cost savings especially with rising water costs

6. Provides safe water for human consumption after proper treatment and Low running costs
7. Construction, operation and maintenance are not labour intensive.

2.5 Waste Water

Why Reuse of Wastewater Is Required

- ✓ To reduce the ever increasing gap of Potable Water and Supply and Demand in Urban Cities
- ✓ To bring down billing charges of fresh water resulted due to long distance transportation, gradient and high energy costs.
- ✓ To mitigate conflicts of water resource allocation between the Domestic and Agricultural / Industry
- ✓ To reduce groundwater extraction and Increase conservation of water resources
- ✓ Make water and sanitation sector sustainable

3. STUDY AREA: TARNAKA DIVISION, SECUNDERABAD

3.1 Existing Scenario

The area which is identified as circle No. 18 under GHMC has an area of 20.26 Sq.kms. with a Coordinates 17.45oN78.5oE with a population of 4, 11,597lakhs (as per 2011 census).

1. Present water supply demand 14.81 MGD (or) 66.67 MLD
2. Water supply by HMWSSB 5.94 MGD (or) 26.73 MLD.
3. 75% of slum people are facing drinking water shortage as 65 LPCD is present supply
4. The area is having water bodies which are in dried condition, the recharging can be done if the surface water is diverted and by removing encroachment
5. There 250 public open spaces, and parks which can be utilized for the harvesting
6. There is no waste water treatment plants

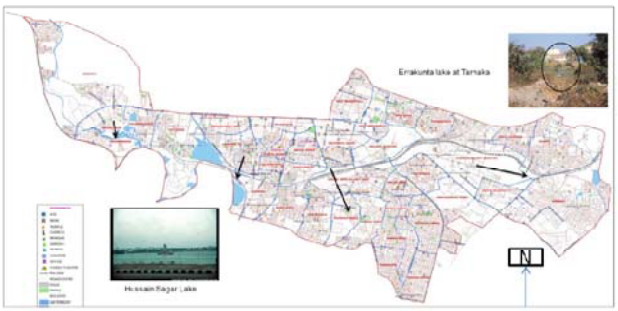
3.2 Issues

The existing supply by the HMWS&SB is not sufficient, supplies alternate days for 1 to 2 hours only

- The circle is having 134 slums, people are facing drinking water problem in slums
- Encroachments of water bodies, Errakunta lake Tarnaka, Water Bodies at Minister road and Begumpet,
- Nala Encroachments, obstructing flow of rain water
- Water logging areas (Mettuguda, Mahmoodguda, Bholakpur, Lalapet
- Lack of harvesting facilities and programmes
- Lack of waste water treatment and reuse facilities
- Lack of enforcement and lack of public interest

3.3 Details of Circle No.18, GHMC

- Secunderabad has an average elevation of 543 mts (1781 ft) and It has natural slope towards southern side.Natural slope towards eastern side area covers Lalapet, Tarnaka



Map 1: Showing Base map of Study area

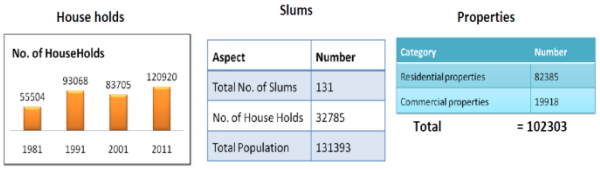
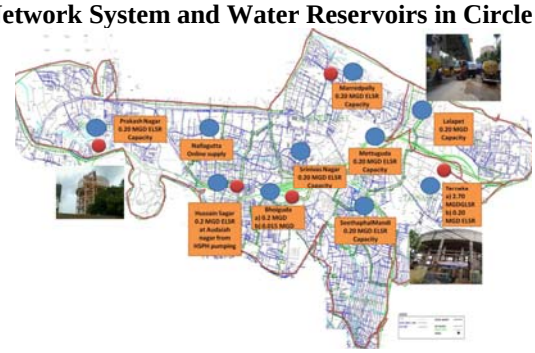


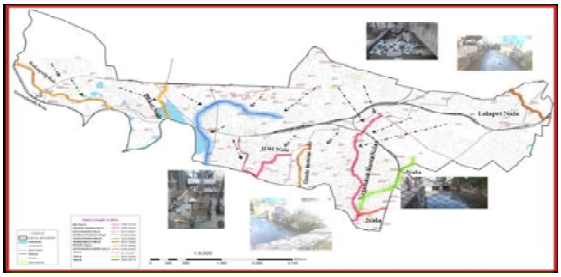
Fig. 5: Details at Study area

3.2.1 Network System and Water Reservoirs in Circle No.18



Map 2: Network and water reservoirs Secunderabad

3.2.2 Storm Water - Nalas in Circle No.18



Map 3. Nalas

The entire storm water is collected with Minor storm water drains and connected to the Major Nalas in the localities, and the total length of the Major Nalas are 26.36 Kms. with average width 7 M to 9 M.

Map 4: Low Laying Areas and Major Stagnation Points on Main Roads

3.2.3 Waste water Sewage Network in Circle no 18

Map 5: Sewage network

- The total waste water generating is 53.33 MLD (80% of the total water supply of 66.67MLD)
- Moderate sewage network is noticed, , the sewage passing through the sewer mains to the Musi River via Amberpet Sewerage treatment plant.
- No treatment and reusing facilities in the circle.

4. DATA ANALYSIS

4.1 Water supply

- 76% of individual Drinking water facility & 26% are dependent on community taps in slum areas
- 69 % having bore well facilities in addition to the existing water supply & 31% doesn't have bores in Slums & EWS localities

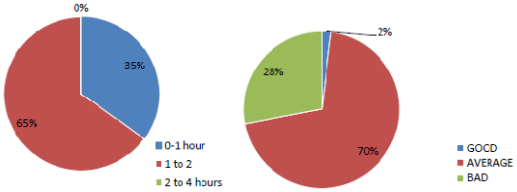


Fig. 6: Details of Water duration and Quality

4.2 Sewage

- 62% of the people are willing to use recycled waste water, if provided proper treatment. 38% of the people are not willing, who are living in slums, due to lack of awareness of system

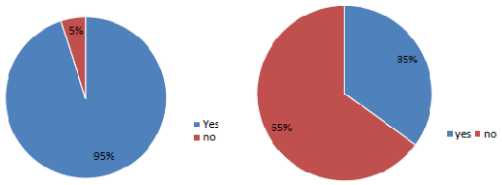


Fig. 7 Details of Sewage

4.3 Rain Water Harvesting Facility

- 83% are not having Rain Water Harvesting facilities, only 17% are in colonies and group housing having the RWH facilities,
- 71% of storm water Nalas mixed with sewerage lines due to which the overflows and pollution is occurring and people are facing health problems.

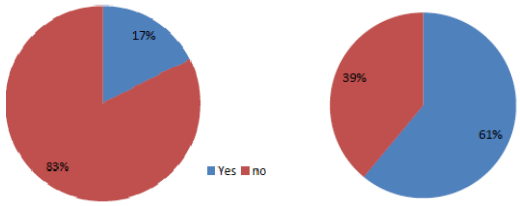
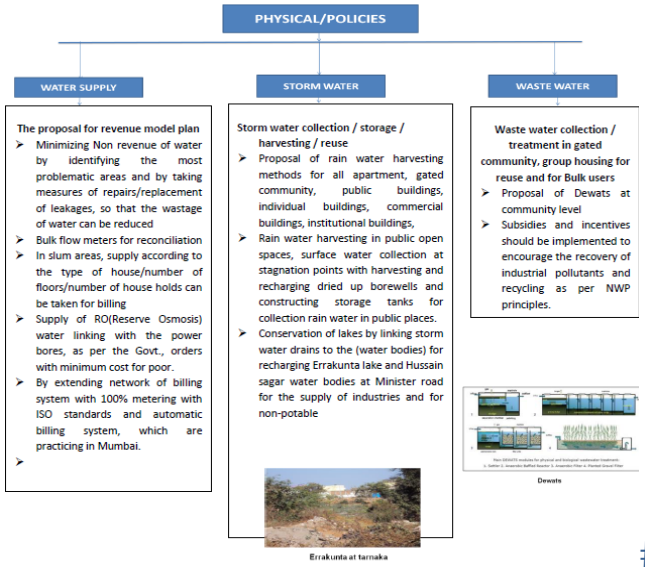


Fig. 8 Details of Rain water harvesting facility & Stagnation

5. PROPOSALS

5.1 Physical Policies



5.2 Proposals

5.2.1 Water Supply

The circle is having 35-40% of Non Revenue of water supply through leakages in transmission pipes and negligence of end user for switch off of tap.

Sl. No.	Category	No. of Cans	Consumption in Kls.	Amount can collect @Rs.200/- per month per CAN
1	Individual domestic houses	17443	56689	0.34 Crores
2	Domestic slums	8780	28535	0.17 Crores
3	Meters repaired	38674	12569	0.77 Crores
4	Savings from Non-revenue of water	30 % of 20 MGD i.e., Rs.30/- per KL	270000	0.81 Crores
5	Reverse Osmosis (RO) water	10 Plants (12000 Cans per day x Rs.4/- per Can)	-	0.148 Crores Rs.4/- per Can consisting of 20 litres)
TOTAL			-	2.238 Crores

5.2.2 Storm Water

Rain Water Harvesting For Apartment and Gated Community, Different Categories of Buildings

5.2.2.1 for Apartment

The group housing at Tarnaka Division, which is consisting of Stilt+(5) Upper floors with (4) Blocks having total 160 flats with the population of 800.

The demand of water requirement is 0.108 MLD.

During the Rainy season, if the rain water captured, stored, treated, we can get 5997 litres per head which can be utilized 44 days by each person

- If the construction cost can be distributed among all the flat owners @ Rs. 8450/ per each flat owner

5.2.2.2. For Gated Community

The proposed row of houses at Shiridi Sai Nagar, Tarnaka, Hyderabad in Sy.Nos. 148, in 3.5 Acres of land with 62 independent houses.

- If the construction cost can be distributed among all the individual owners @ Rs. 19048/ per each individual owner

5.2.2.3. For Commercial Buildings

- In commercial buildings, the Rain water can be use for multi purpose i.e., for fire fighting and secondary use.
- The Commercial complex consisting of Cellar, Ground floor + (4) Upper floors

No. of visitors & staff - 800/day

The Rain water storage capacity (4.5 x 5 x 4 M) - 90 Cum (or) 90000 litres

Rain Harvesting pits (3 x 5 x 2.5 M) – 37.5 Cum (or) 37500 litres

Plot area – 929 Sq. Mtrs.

Roof area - 428.17 Sq.Mtrs.

Surface area – 891.50 Sq.mtrs.

Table 2: Rain Water Calculations for Commercial buildings

BLOCK ESTIMATE	
DESCRIPTION	COST IN RS.
Construction of Rain water storage tank / collecting & pumping & over head tank	3 Lakhs
Construction of Rain water harvesting pits	1.5 Lakhs
= Total	4.50 Lakhs

5.2.2.4 For Institutional Buildings

Table 3 Rain Water Calculations for Institutional buildings

BLOCK ESTIMATE	
DESCRIPTION	COST IN RS.
Construction of Rain water storage tank / collecting & pumping & over head tank – Rs. 3.5 Lakhs	1.5 Lakhs
Construction of Rain water harvesting pits – Rs. 1.5 Lakhs	1.5 Lakhs
= Total	3 Lakhs

5.2.2.5 For Individual Residential Buildings

Table 4 Rain Water Calculations for Residential buildings

BLOCK ESTIMATE	
DESCRIPTION	COST IN RS.
Construction of Rain water harvesting pit	25000/-
= Total	25000/-

Proposal for RWH at Stagnation Points & Recharging of Dried up Bore wells

The recharging of Govt. bores can activate the aquifers and overhead tank, the bore can be used. Hence, the recharging of 25 Nos. dried up bores in the circle should be taken up on priority basis.

CONSTRUCTION OF RWH PIT (BLOCK ESTIMATE)

Stagnation points along the roads – 30 Nos. @ Rs. 50000/- for each

i.e., 30 x 50000/- = 15 Lakhs

Revenue from Rain Water Collection from Open Spaces and Roof Areas

Table 5: Revenue from rain water collection

Sl. No.	Type of collection	Total area in Sq. Kms.	Total area in Sq. meters (A)	Rain fall (R) In mm.	Run off co-efficient (C)	Quantity (AxRxC)	Revenue can be obtained by diverting the water @ Rs. 10/- per Kl per annum
1	Open area	0.94	941801.96	0.780	0.85	624.41 Kls (or) 0.62 MLD	0.22 Crores
2	Roof area (70% of Total area i.e., 20.26 Sq.Kms)	14.18	14182000	0.780	0.85	9402.66 Kls (or) 9.4 MLD	3.38 Crores

Cost of RWH Pit in Open Areas (Block Estimate)

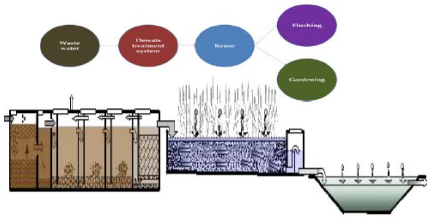
- RWH Pits in Public open spaces/parks - 139Nos.
- Average size of pit - 5 x 4 M
- Each pit cost – Rs.1.5 Lakhs
- 139 x 1.5 Lakhs = 2.08 Crores

5.2.4 Waste Water

Proposal for Waste Water Treatment & Recycling For Apartment & Gated Community

Proposed Dewats system in group housing at Tarnaka division, the building is consisting of Stilt+(5) Upper floors having 160 flats with a population 800 (Approximately),

For Apartment



Dewats system

- If the construction cost can be distributed among all the flats owners @ Rs. 8535/ per each flat owner

For Gated Community: The proposals of Dewats in gated community at Tarnaka Division

- The construction cost can be distributed among all the individual owners @ Rs. 28322/ per each individual owner

5.2.4.1 Waste Water Treatment Plants

Option 1- Decentralized waste water treatment

Option 2 – Centralized waste water treatment

Decentralized waste water treatment plants in Circle No.18, GHMC, for treating of waste water of 66.67 MLD in different localities with treated water 28.75 MLD can be used for the secondary purposes, by selling @ Rs.10/- per Kl, which is amount Rs. 0.86 Crores per Month

Option - 2 Centralized Waste Water Treatment

The treatment plant is proposed in Govt. land admeasuring 1.2 Ha. With an install capacity of 66.6 MLD and the treated water of 28.75 MLD will be utilized for the secondary purpose for supply of industries, washing, maintenance of public gardens, gardening, in the Division to reduce the load on HMWS&SB with a cost of Rs.0.

5.2.5 Revenue Model for Integrated Urban Water Management Plan

- **Revenue from the Various Categories**

The Revenue can be enhanced in the Circle with the savings made from the different categories i.e., Water supply Storm water, Waste water

Table 6 Revenue from the Various Categories

Sl. No.	Description	Units	Reverue Rs. In Crores. Per month	Revenue Rs. In Crores. Per Annum	Remarks
1	Unauthorized Individual domestic houses	17443 (Cans)	0.34	4.18	Unauthorized connections @ Rs. 200/- per can
2	Unauthorized Domestic slums	8780 (Cans)	0.17	2.1	Unauthorized connections @ Rs. 200/- per can
3	Meters repaired	38674 (Cans)	0.38	4.56	Repair meters (50% over the slab rates can be enhanced, if the volumetric tariff imposed by installing new meters)
4	Savings from Non-revenue of water	30 % of 20 MGD i.e., 270000 KLs i.e., Rs.30/- per KL	0.81	9.72	Unaccounted water can be saved by Detecting leakages and maintenance
5	Reverse Osmosis (RO) water	10 Plants (12000 Cans per day x Rs.4/- per Can)	0.0124	0.148	Rs.4 /- per can of 20 litres
TOTAL			1.71 Crores per month	20.70Crores per Annum	

5.2.6 Revenue from Storm Water

Table 7 Revenue from Storm water

Sl. No.	Description	Units	Revenue Rs. In Crores. Per month	Revenue Rs. In Crores. Per Annum	Remarks
1	Open areas	624414 Kls (or) 0.62 MLD	0.018	0.22	Rain Water Harvesting @ Rs.10/- per KL
2	Roof area	9402666 Kls (or) 9.4 MLD	0.28	3.38	Rain Water Harvesting @ Rs.10/- per KL
	TOTAL		0.298	3.6	

5.2.7 Revenue from Waste Water

Total income (per annum) of revenue Model

Existing Revenue (HMWS&SB) Rs. 48.84 Crores

Proposed Integrated Revenue Model Rs. 35.1 Crores

Total Income = Rs.83.94 Crores

Expenditure per Annum:

Water supply O&M, Salaries for 66.67 MLD (including existing) Rs. 73.80 Crores

Waste water O&M, salaries Rs. 2.4 Crores

Maintenance of Rain Water Harvesting Rs. 1 Crore

RO water maintenance Rs. 0.024

Total Expenditure Rs.77.224 Crores

Savings:

Total income – Total expenditure

i.e., (Rs.83.94 – Rs.77.224 = 6.72 crores /annum) savings: Rs.6.72 crores per annum

5.2.8 Block Estimate of the Project

The integrated urban water management plan for Circle No.18,

Table 8 Block Estimate of Improvement of Integrated Water Supply Management in Circle No.18

BLOCK ESTIMATE OF IMPROVEMENT OF INTEGRANTED WATER SUPPLY MANAGEMENT IN CIRCLE NO.18, GHMC				
Sl. No.	Description	Quantity	Rate per each in Rs.	Amount in Crores
1	Improvement of distribution system (major)	-	-	15
2	Installation of meters	64897	4000	25.95
3	Installation of consumer service pipe lines (connections) @Rs.1500 per connection	64897	1500	9.73
4	Repairs of leakages	Lump sum	-	11
5	installation RO water treatment plants	10 units	735000 per each unit	0.735
6	Waste water treatment plant including pumping, storage & electrical charges and O&M	66.67 MLD	-	48
7	Recharging of dried up Bore wells	89	20000	0.178
8	RWH pits at Stagnation points	30	50000	0.15
9	TOTAL=			122.743
10	Physical contingencies @3%of sub total			3.68
11	GRAND TOTAL=			126.423

6. CONCLUSION

In this connection, the integration of urban water management plan for the urban core areas i.e., Circle No.18, GHMC is proposed, wherein the best utilization of storm water methods by collecting, recharging, reusing and effective management in regular water supply to minimize the leakages and identifying the Non-Revenue of water & Unaccounted of water and installation of new meters and indentifying the unauthorized connections, etc.

Waste water recycling facilities with low cost systems like Dewats for bulk consumers and group housing (apartment) & institutional / commercial / individual buildings, which will not only minimize the dependency of water supply on HMWS&SB and the equllant quantity can be supplied in demand areas at cost. So that the Revenue can be enhanced in the Circle

7. ABBREVIATIONS

HMDA- Hyderabad Metropolitan Development Authority
GHMC- Grater Hyderabad Municipal Corporation
HMWSSB-Hyderabad Metropolitan Water Supply & Sewerage Board
LPC- Lake protection Committee
GHEP-Green Hyderabad Environment Programme
NLCP-National Lake Conservation Policy
MOEF- Ministry of Environment and Forests
CSIR-Council of Scientific & Industrial Research
NGRI-National Geographical Research Institute
NSRI-National Remote Sensing Centre
SOI-Survey of India
EPTRI- Environment protection Training & Research Institute
PPP-Public Private Partnership
BOD-Biological Oxygen Demand
FTL-Full Tank Level
STP-Sewerage Treatment Plant
MLD-Million Liters per Day
EIA-Environmental Impact Assessment
PCB-Pollution Control Board
ILEC-International Lake Environment Committee
GWP -Global Water Partnership

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