

# Ujjain City Water Supply, Sanitation and Hygiene (WASH) Situational Analysis Report

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## Contents

1. General Situation .....	1
2. Hydrogeological Situation .....	3
3. Water Supply Situation .....	3
4. Sanitation Situation.....	4
5. Finances of Ujjain Municipal Corporation .....	5
6. Situation in Slums.....	6
7. WASH Situation Improvement Plans of Government Agencies and their Implementation .....	7
8. Critique of existing WASH Planning.....	9
9. An Alternative WASH Scenario for Ujjain .....	10
9.1 Water Sensitive Urban Design .....	10
9.2 Recharging of Groundwater Aquifers in Ujjain .....	11
9.3 Treatment and Reuse of Waste Water .....	11
9.4 Equitable and Sustainable WASH Management for Ujjain.....	12
10. WASH Situation in a Representative Sample of Slums in Ujjain and Recommended Interventions ..	12
10.1 Hira Mill Ki Chawl .....	13
10.2 Distillery and Barah Kholi .....	14
10.3 Shantinagar .....	15
10.4 Loharpatti.....	15
10.5 Kala Patthar.....	16
11. Conclusions .....	16
References .....	17

## Ujjain City Water Supply, Sanitation and Hygiene (WASH) Situational Analysis Report

A development intervention, jointly by the Bharatiya Grameen Mahila Sangh and Water Aid India, is currently underway to improve the Water Supply, Sanitation and Hygiene (WASH) situation prevailing in the slums in Ujjain city. The present report is based on a brief study of the city carried out to assess the prevailing status of WASH and the possible interventions that can be carried out by this project given the existing policy provisions. In what follows the status of services as gleaned from a review of relevant documents and a field visit of the city of Ujjain is detailed, followed by a set of recommendations for improving the WASH situation in the city and the slums based on best practices implemented elsewhere.

### 1. General Situation

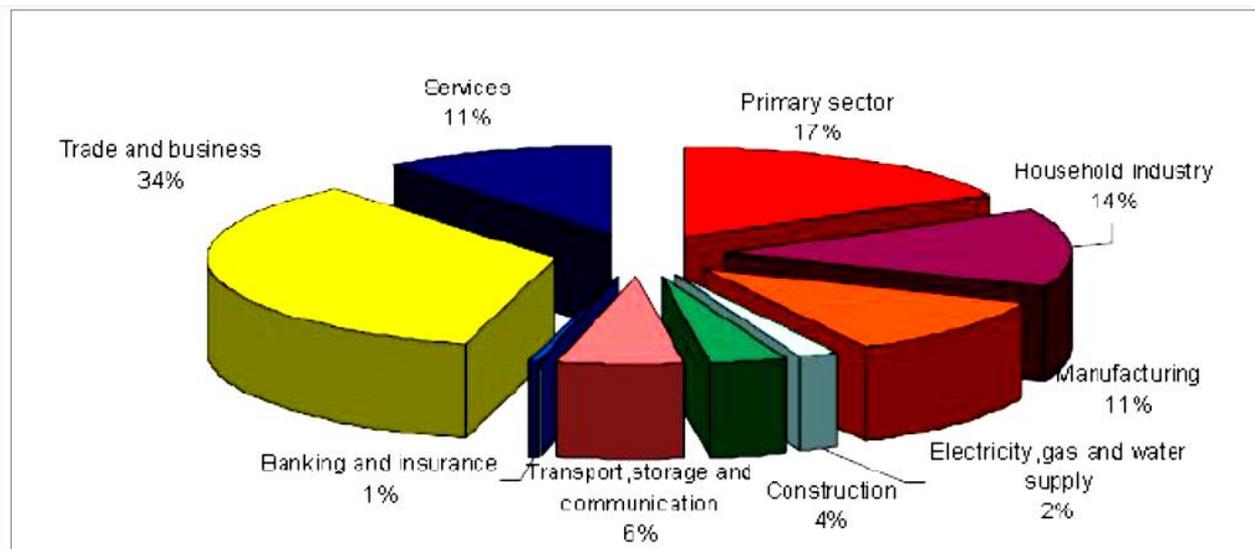
The city of Ujjain is located in the western part of Madhya Pradesh on the Malwa Plateau and is primarily a religious tourism centre due to the Mahakal Temple which is not only one of the 12 Jyotirlingas in India but also has prominence as the location for the Simhastha Kumbh Mela every 12 years. Its location in the regional setting is shown in the map below.

#### Regional Setting Map



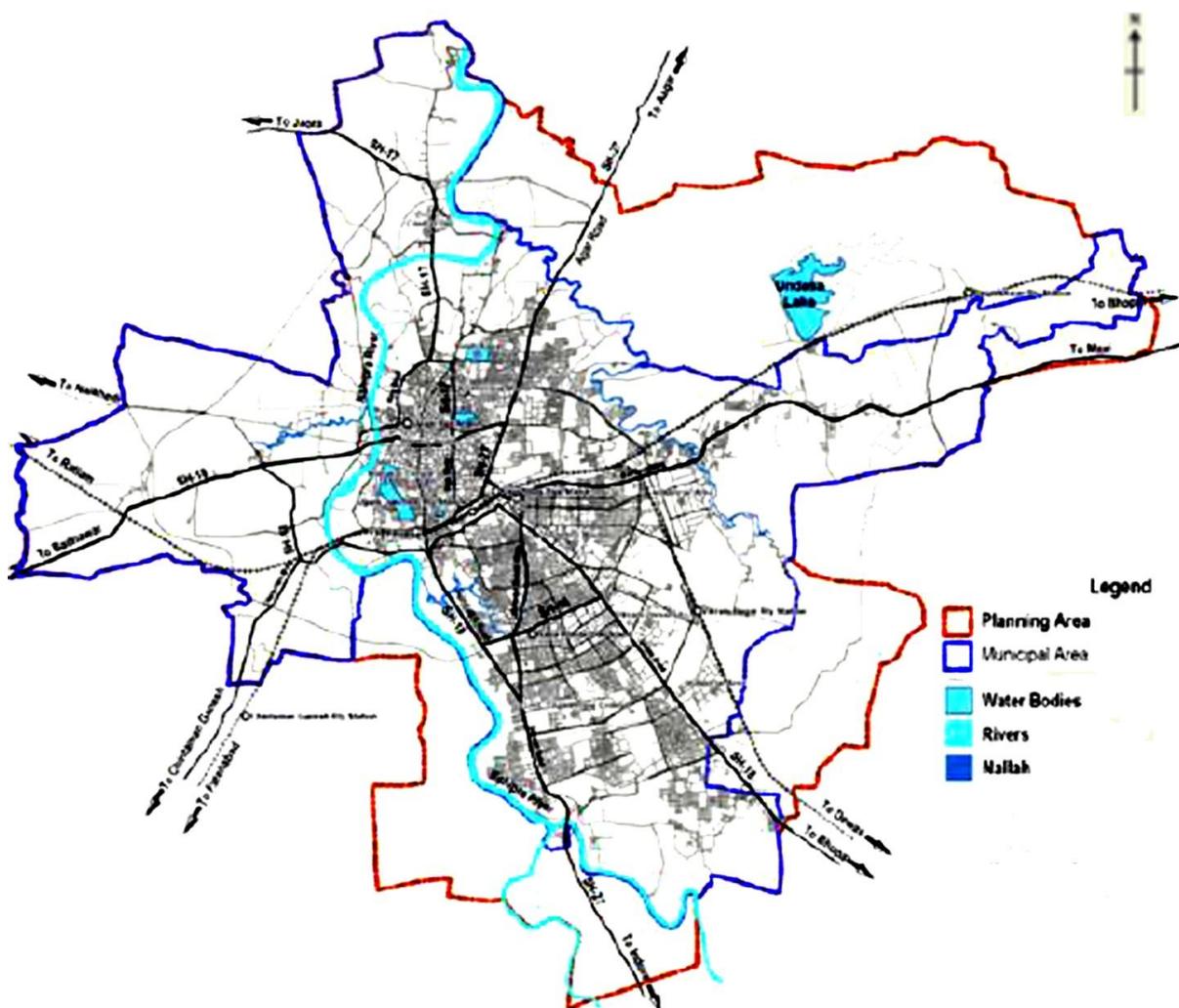
**Fig. 1 : Location of Ujjain in Western Madhya Pradesh (Source: UMC, 2016a)**

The planning area according to the Ujjain Development Plan 2021 is 151.83 sq. kms while the area under the Ujjain Municipal Corporation (UMC) is 92.68 sq. kms or 62 per cent of the planning area divided into 5 zones covering 54 wards with about 29 sq kms that is developed. The population of the municipal area was 5.15 lakhs in 2011 with an overall density of 5539 but this increases to 17000 persons per sq. km in the developed area and it is projected to rise to 7.02 lakhs in 2021 (UMC, 2016a). The floating population varies from 10000 to 10 lakh per day depending on the festival season. There are 169 slums packed into only 5.7 sq kms with a population of 1.65 lakhs at a density of 29000 per sq km with inadequate provision of basic services. The city had several textile mills at one time but these have all become defunct and there has not been much subsequent industrial development and so occupationally most people are engaged informally in the tertiary sector which accounts for 90 per cent of the workforce as shown in the chart below. The literacy rate is very high at 74.76 per cent and the sex ratio too is fairly high at 945.



**Fig. 2: Occupational Distribution of Workforce in Ujjain City (Source: AILSSNPUR, n. d.)**

Situated as it is on the east bank of the south to north flowing Kshipra river, its spatial growth too has taken place in the northern and southern directions as shown in the map below.



**Fig. 3 : Ujjain City Map (Source: UMC, 2016a)**

## 2. Hydrogeological Situation

The normal annual rainfall in Ujjain is 914 mm with 90 per cent of the precipitation taking place during the monsoon months from June to September. There is very little forest area and combined with preponderance of built up area, the runoff is high and most of the rain flows out through the river. The city drains into the Kshipra river which in turn is part of the Ganga basin. The underlying geological layer is primarily of Deccan Trap basalts. The major water bearing formations are fairly deep weathered alluvium near the river and vesicular and fractured basalts elsewhere. There is overexploitation of the underground aquifers with very little artificial recharge.

## 3. Water Supply Situation

The water supply and storm water drainage for Ujjain is the responsibility of the Madhya Pradesh Public Health Department. The sources of water supply are a dam on the Gambhir river, a barrage on the Kshipra river, a few tanks and groundwater. The water from the rivers and tanks is treated in a plant before being supplied through a system of overhead tanks and pipelines as shown in the table below.

**Table 1: Water Supply Details of Ujjain City**

<b>Water Capacity</b>	<b>Million m<sup>3</sup></b>
Gambhir Dam	63.68
Undasa Tank	6.17
Sahabkheri Tank	12.62
Gaughat Barrage	2.72
Total Capacity	85.19
Total Annual Water Demand	40
<b>Water Supply</b>	
Total Water Supply (Million Litres per day - MLD)	109.2
Average Per Capita Water Supply (litres per capita per day - lpcd)	193
Capacity of Tanks (MLD)	47
Cost of Supply (Rs Crore)	22
Unit cost /1000 litres (Rs)	5.5
Monthly cost of 100 lpcd supply for 5 member household (Rs)	83

Source: Author's calculation from MPPHED and UMC data.

The total water capacity is more than double the demand and so that is not a problem. The capacity of the tanks is 47 MLD. There is thus a loss of 62 MLD which is non-revenue water arising from leakages, thefts and free supply to some institutions and the poor (UMC, 2016b). The average per capita supply theoretically is also almost double the norm for a city like Ujjain which does not have sewerage but does have flush toilets - 100 lpcd. However, given the huge losses in the system the actual supply is much less especially so in the slum areas where there is only intermittent pipe water supply or none at all. The unit cost of this supply in 2015 was Rs 5.50 per litre resulting in a monthly cost of 100 lpcd supply for a 5 member household of Rs 83. As opposed to this not only is the average monthly water user charge levied by the UMC lower at Rs 75 without any metering but there is also under collection of this low charge as only 62.5 per cent of the projected revenue from charges were recovered in 2015 (UMC, 2016c). The water pipelines are leaking and there is infiltration of dirty water into the pipelines leading to turbidity and contamination of the water supplied. The laboratory of the MPPHED is ill equipped and under staffed and microbiological tests to determine whether the water is free of bacteriological and virological contamination are not being carried out. As a precautionary measure the water is being heavily chlorinated before release into the distribution system.

#### 4. Sanitation Situation

There is no sewerage system or stormwater drainage currently in Ujjain city. There are open drains along the sides of the roads. The waste water from the kitchen and bathrooms and also from the outflow of septic tanks, cumulatively amounting to about 80 MLD is released into these drains untreated with high levels of pollution. These drains empty into the natural nullahs which in turn empty into the River Kshipra or the many tanks that are there in the city including the seven main tanks which are known as the Sapsagar and which are perennial because they are situated in alluvial aquifers with high groundwater level. This is in gross violation of the provisions of the Water (Prevention and Control of Pollution) Act 1973 and both government institutions and private organisations are culpable in this regard. Shown below are pictures of the release of highly polluted untreated waste water into the open drains and nullahs by the Ujjain Development Authority (UDA) at its office, a private hospital and a housing colony.



**Fig. 4: Untreated Wastewater Release - 1. UDA, 2. Private Hospital, 3. Private Housing Colony**

As a consequence the water of the River Kshipra is highly polluted and the level of this pollution as determined by an independent study at four locations on the river starting from its confluence at Triveni Ghat with the highly polluted waters of the Khan river coming from Indore through to the other end of the city at Mangalnath with the intervening points at Gaughat and Ramghat which are major bathing points for the religious pilgrims are as given in the table below (Kumawat and Sharma, 2015). Matters are compounded during the monsoons when the stormwater also has to be carried by the open drains which cannot accommodate this extra flow and so there is frequent waterlogging of the streets with a mixture of waste and storm water. Moreover, leaching of sewage also results in contamination of groundwater.

**Table 2: Pollution Parameters of Kshipra River 2015**

Parameters (Permissible levels)	Triveni Ghat	Gaughat	Ramghat	Mangalnath
Biochemical Oxygen Demand in mg/litre (< 3)	52	40	63	47
Dissolved Oxygen in mg/litre (> 5)	0.8	1.2	0.9	1.5
Total Coliforms in most probable number (0)	$25 \times 10^6$	$10 \times 10^6$	$80 \times 10^6$	$45 \times 10^6$
Faecal Coliforms in most probable number (0)	$64.5 \times 10^4$	$35 \times 10^3$	$21.8 \times 10^3$	$74 \times 10^3$
Faecal Streptococci in most probable number (0)	$110 \times 10^2$	$71 \times 10^2$	$43 \times 10^2$	$20 \times 10^2$

Source: Kumawat and Sharma, 2015

Total solid waste generation is about 160 tonnes per day and about 40 per cent of this is collected through door to door collection and then transported to the dumping ground which has been outsourced to a private company which collects the waste, transports it to the dumping ground, segregates it and then recycles the inorganic waste and composts the organic waste. The slums and some far flung areas are under served and so there is considerable accumulation of solid waste in these areas leading to unhygienic conditions.

## 5. Finances of Ujjain Municipal Corporation

The analysis of the UMC budget for 2014-15 which is the latest year for which both the estimates and the actuals are available (UMC, 2016c) is given in the table below.

**Table 3: Finances of the Ujjain Municipal Corporation 2014-15 (Rs Crores)**

	Item	Estimates	Actuals	Shortfall (%)
<b>Revenue Receipts</b>				
General	Property Tax	23	5.5	-76.1
	Property Tax Arrears	8	1.49	-81.4
	Service charges from Govt. Agencies	0.03	0	-100.0
	Integrated Tax (health, lighting, fire etc)	3.52	1.15	-67.3
	Integrated Tax Arrears	1.25	0.63	-49.6
	City Development Tax	4.11	1.12	-72.7
	City Development Tax Arrears	0.4	0.32	-20.0
	Education Tax	0.69	0.22	-68.1
	Education Tax Arrears	0.25	0.06	-76.0
	<b>Total Property Tax</b>	<b>41.25</b>	<b>10.49</b>	<b>-74.6</b>
	Other Taxes	0.32	0.08	-75.0
	Grants	2.4	0	-100.0
	Duty Compensation (Stamp, Octroi, Pass Tax)	84	68.11	-18.9
	Non-tax Revenue	23.38	7.12	-69.5
	Interest Earned	4.5	5.26	16.9
<b>Total General Revenue Receipts</b>	<b>155.85</b>	<b>91.06</b>	<b>-41.6</b>	
PHED	PHED Water User Charges	17.42	6.53	-62.5
	PHED Grant	4.2	3.05	-27.4
	<b>Total PHED Receipts</b>	<b>21.62</b>	<b>9.58</b>	<b>-55.7</b>
<b>Total UMC Revenue Receipts</b>		<b>177.47</b>	<b>100.64</b>	<b>-43.3</b>
<b>Revenue Expenditure</b>				
General	Salaries and Pensions	59.77	47.09	-21.2
	Administration and Transportation	12.42	7.52	-39.5
	Electricity	7.15	9.29	29.9
	Maintenance and Repairs	29.8	15.28	-48.7
	Interest Payment	14.37	0.73	-94.9
	Others	4.42	1.04	-76.5
	<b>Total General Revenue Expenditure</b>	<b>127.93</b>	<b>80.95</b>	<b>-36.7</b>
<b>Total General Revenue Surplus</b>		<b>27.92</b>	<b>10.11</b>	<b>-63.8</b>
PHED	PHED Administration	0.41	0.28	-31.7
	PHED Electricity and Fuel	12.83	9.77	-23.9
	PHED Maintenance	7.86	4.41	-43.9
	<b>Total PHED Revenue Expenditure</b>	<b>21.1</b>	<b>14.46</b>	<b>-31.5</b>
	<b>Total PHED Revenue Surplus</b>	<b>0.52</b>	<b>-4.88</b>	<b>-1038.5</b>
<b>Total UMC Revenue Expenditure</b>		<b>149.03</b>	<b>95.41</b>	<b>-36.0</b>
<b>Total UMC Revenue Surplus</b>		<b>28.44</b>	<b>5.23</b>	<b>-81.6</b>
<b>Capital Receipts</b>				
General	Grants	463.86	70.02	-84.9
	Loans	67.57	6.99	-89.7
	<b>Total General Capital Receipts</b>	<b>531.43</b>	<b>77.01</b>	<b>-85.5</b>
PHED	Grants	2.05	0.69	-66.3
	<b>Total PHED Capital Receipts</b>	<b>2.05</b>	<b>0.69</b>	<b>-66.3</b>
<b>Total UMC Capital Receipts</b>		<b>533.48</b>	<b>77.7</b>	<b>-85.4</b>
<b>Capital Expenditure</b>				
General	Land	0.01	0	-100.0
	Building	15.12	2.73	-81.9
	Roads and Bridges	7.85	1.69	-78.5
	Drains	4.55	0.79	-82.6
	Motor Vehicles	3.72	0.31	-91.7
	Tools and Appliances	0.33	0.1	-69.7
	Projects	508.43	70.82	-86.1
	Loan Principle and Interest Repayment	19	18.54	-2.4
	<b>Total General Capital Expenditure</b>	<b>559.01</b>	<b>94.98</b>	<b>-83.0</b>
PHED	PHED Building	0.6	0.07	-88.3
	PHED Tools and Appliances	0.90	0.31	-63.5
	PHED Projects	1.0	0.66	-34.0
	<b>Total PHED Capital Expenditure</b>	<b>2.5</b>	<b>1.04</b>	<b>-58.4</b>
<b>Total UMC Capital Expenditure</b>		<b>561.51</b>	<b>96.02</b>	<b>-82.9</b>
<b>Total UMC Capital Surplus</b>		<b>-28.03</b>	<b>-18.32</b>	<b>-34.6</b>
<b>Total UMC Surplus</b>		<b>0.41</b>	<b>-13.09</b>	<b>-3292.7</b>
<b>Property Tax to Revenue Receipt Ratio (%)</b>		<b>26.5</b>	<b>11.5</b>	<b>-56.5</b>
<b>Salary &amp; Pens. to Tot. General Rev. Exp Ratio (%)</b>		<b>46.7</b>	<b>58.2</b>	<b>24.5</b>

The salient points that emerge from this financial analysis are as follows -

1. The actual financial performance both in receipts and expenditures falls far short of the budget estimates. In the case of revenue receipts this shortfall is a little over 40% while in the case of capital receipts this is as high as 85%. In the case of revenue expenditure the shortfall is above 35% whereas in the case of capital expenditure it is over 80%. This puts a question mark on the validity of the budgeting procedure and the UMC's proficiency in mobilising resources which seriously affect its capacity to bring about improvement in the prevailing situation and provide better services, especially to the poor who cannot provide for themselves on their own.
2. Particularly of concern is the poor performance with regard to the mobilisation from property tax which is 75% less than the budget estimates. It is budgeted to be 26.5% of revenue receipts which is as it should be but actually it is only 11.5% of the actual receipts. The per capita property tax collection, assuming a 10% increase in population of Ujjain from the 2011 number, works out to Rs 185 which is way below the average for tier 2 cities in India of Rs 500 (Banerjee, 2013). The JNNURM norm is that at least 85% of all properties should be registered for property tax and collection level should be 90% of these. Clearly the UMC is not being able to fulfill these norms.
3. It is intriguing to note that even in the case of expenditure on salaries and pensions there is a shortfall of 21%. This seems to indicate that the estimates provide for an increase in the number of staff but in reality there is a decrease in the number of staff as new recruitment is not made in sufficient number to replace those who are retiring. Along with the huge shortfall in expenditure this only contributes to the inefficiency of service provision as the staff are already inadequate in number especially in the health department which is responsible for sanitation. As it is 58% of the actual revenue expenditure is on salaries and pensions which too is a drag on the finances and unless revenue mobilisation is increased drastically the UMC will be unable to improve the quality of services it is providing.
4. Capital receipts and expenditures are woefully low and combined with a very low revenue surplus severely restrict the possibilities of investment for urban renewal from UMC's own resources.
5. The shortfall in actual PHED water user charges collection from budget estimates is as much as 62.5%. The PHED Operation and Maintenance costs are met by the UMC and these were actually around Rs 15 crores. The staff salary cost is met by the Government of Madhya Pradesh and so is not part of the UMC budget. However, going by the norms elsewhere this will be another Rs 7 crores or so and thus the total water supply cost is about Rs 22 crores. Against this only Rs 6.5 crores is being collected from user charges which is a huge shortfall. As mentioned earlier there is inadequate collection of user charges and a huge proportion of non-revenue water due to leakage and theft.

## 6. Situation in Slums

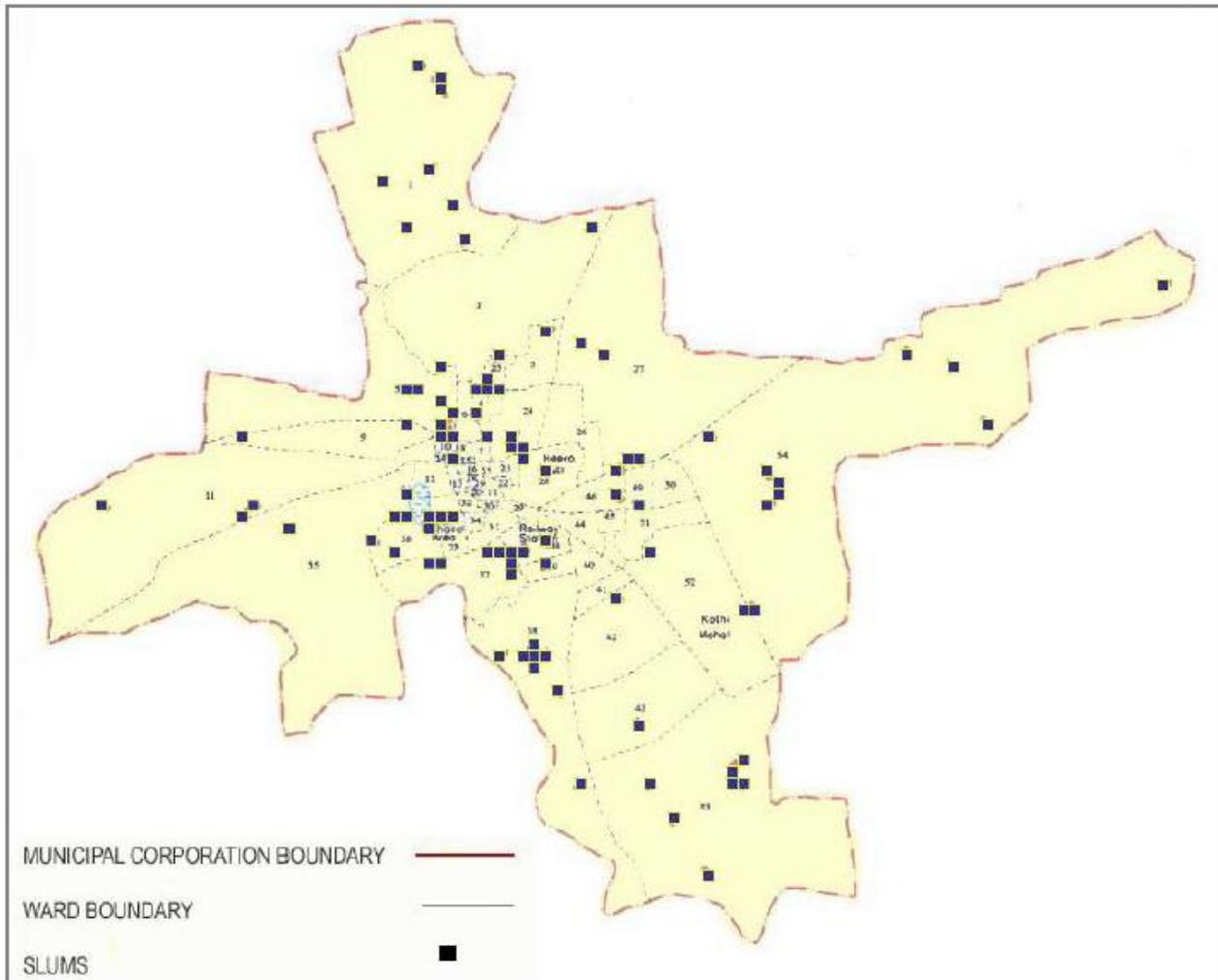
The latest slum count in Ujjain is given in the table below.

**Table 4: Number of Slums of different category in Ujjain 2016**

	No. of Slums	Under RAY	Developed
Notified	113	99	14
Non-Notified	16	10	6
Newly Identified	60	60	0
<b>TOTAL</b>		<b>169</b>	

Source: AILSSNPUPR, n. d.

These slums are situated across the city as shown in the map below.



**Fig. 5: Location of Slums in Ujjain (AILSSNPUPR, n. d.)**

Both water supply and sanitation are deficient in most of these slums with only about 10 per cent of the slum population getting free access to quality water and sanitation.

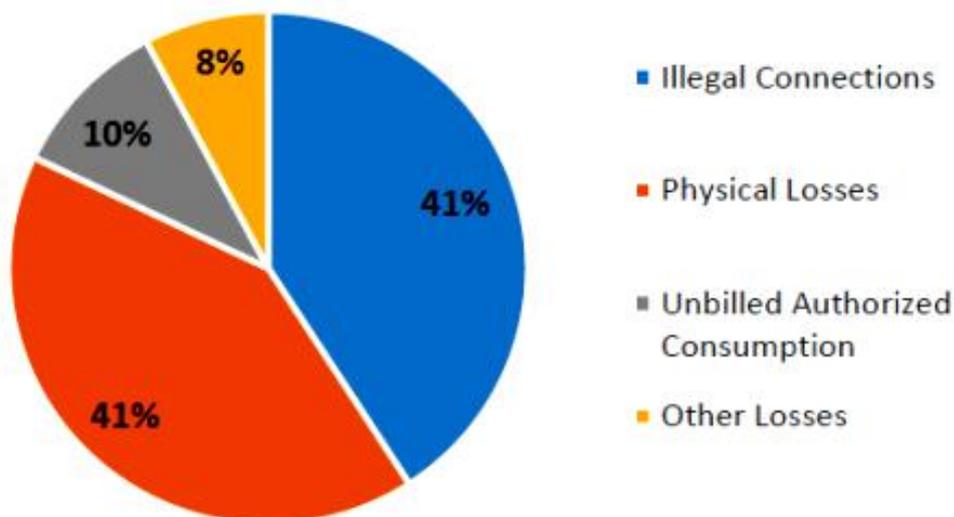
### **7. WASH Situation Improvement Plans of Government Agencies and their Implementation**

The Ujjain Development Plan 2021 adopted in 2006 provides a fairly detailed framework for improving the WASH situation in Ujjain. It recommends the revival of the traditional open wells and the many lakes in Ujjain which can provide considerable water supply because of the high water table in the alluvial formations (MP Govt., 2006). The plan proposes the laying of sewerage lines and stormwater drains to prevent the pollution of these wells, reservoirs and the river and the treatment of the sewage through the establishment of a sewage treatment plant and the reuse of the treated water for maintenance of parks and lakes. However, no action was taken on this plan by the Government as investments were not made to implement it. This was followed by the City Development Plan under the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) in 2007 which made a provision of an investment of Rs 42 crores for augmenting the water supply, Rs 152 crores for sewerage and sanitation, Rs 40 crores for solid waste management and Rs 79 crores for stormwater drains over a five year period (CEPT, 2007). The water supply component was implemented and the water supply from the Gambhir dam was augmented as was the capacity of the water treatment plant in Ujjain. Some investment has been made in solid waste management but very little has been done to improve waste and storm water management.

Then there is the Swacch Bharat Mission (SBM) under which open defecation is to be eliminated through the construction of toilets. Several households have constructed pit latrines under this scheme. However, there are several problems with this scheme like the delayed release of the funds to the beneficiaries, under funding of the scheme so that the beneficiaries have to spend their own money to construct decent usable toilets, some of the toilets are to be built by contractors instead of the beneficiaries themselves and this is adversely impacting the quality of construction and finally the construction of a large number of pit latrines in the alluvial subsoil is increasing the pollution of the groundwater and adversely affecting the quality of open well and handpump water in the slums. In cases where the people have contributed their own money to construct rudimentary septic tanks, the outflow from these is being released directly into the open drains and nullahs creating further health hazards. Disease is rampant in the slums.

The smart city plan which was first mooted in 2015 is the latest initiative. In the public polling that took place as part of the preparation of the smart city plan the citizens put the highest priority on the improvement of sanitation, almost double of the other services like street lighting, traffic and security. In the latest smart city plan there is an proposed outlay of Rs 12.24 crores for installation of bulk metres and leakage detection instruments in the water supply system so as to eliminate theft and leakage loss. Laying of sewerage lines and construction of STPs has been given a provision of Rs 195.78 crores and the provision for stormwater drainage and flood prediction is Rs 95.37 crores. There is also mention of water recharging but no financial provision has been made for this important activity (UMC, 2016a).

Finally the UMC has drawn up two action plans for reducing non-revenue water (NRW) (UMC, 2016b) and for increasing the green cover of the city (UMC, 2016d). The action plan for reduction of NRW reveals that there are as many as 30,000 illegal connections as opposed to around 55,000 legal connections. Apart from this there are losses due to leakages in the supply system. The contribution of the different sources to the huge overall loss of 62.5 per cent of the total water supplied is shown in the graphic below.



**Fig. 6: Distribution of Various Sources in the Overall Loss in Water Supply (UMC, 2016b)**

Clearly, these huge losses not only affect adversely the operation and maintenance of the system but also prevent its augmentation due to lack of funds for further investment. The UMC proposes to install a Supervisory Control and Data Acquisition (SCADA) system which will install meters and radio frequency devices to measure water flow and detect leaks in the supply system accompanied by an awareness drive followed by implementation of water metering on individual connections after the identification of all illegal connections. The funding for this is proposed to be done from Atal Mission for Rejuvenation and Urban Transformation (AMRUT), Smart City Mission, State Government grants, UMC own resources and private public partnership (PPP) endeavours.

The action plan for increasing the green cover of the city surprisingly does not include the many tanks in the city and neither does it detail where the water for the greening of the parks and public spaces is to come from. Ideally the treatment and reuse of waste water and the management of storm water through recharging and harvesting should be integrally tied up with the maintenance of tanks and parks in a city and this should be done in a decentralised manner. That is, the parks and tanks should be the means of reusing, recharging or harvesting the waste and storm water in their vicinity, thus, ensuring a comprehensive cost effective and environmentally sound solution to the problems of water supply, waste and storm water management and global warming.

### **8. Critique of existing WASH Planning**

There are several problems with this kind of centralised planning which only pays lip service to people's participation without carrying out extensive awareness programmes on the problems of water and sanitation and eventually only forces the adoption of economically and environmentally unviable projects and this needs to be addressed as follows -

1. Grandiose projects which do not take into account the political will and technical capacity of the UMC to undertake them, eventually result in poor implementation. For instance under the JNNURM, the UMC had submitted a comprehensive City Development Plan of Rs 1580.79 crores of which eventually Rs 114.25 crores was sanctioned for the augmentation of the water supply and the redevelopment of the Mahakal area but of this only Rs 55.43 crores was spent. Of this Rs 49.93 crores was the contribution by the Central Government (JNNURM, 2014). Thus, not only is the UMC unable to spend the little grant money it gets but this also discredits it with the central government and private parties which do not want to trust it with investment to execute grand plans like the one that has been drawn up for the Smart City Mission. Moreover, it is salient to note that neither the UMC nor the State Government have contributed their shares to the implementation of the JNNURM projects and neither have they been able to mobilise resources from private investors and this is likely to be the case in future also given the poor status of the finances of both entities, thus, severely compromising the prospects of their implementation.
2. There is a huge vested interest in the theft of water supplied by the UMC as this is being done with the collusion of the PHED staff both at the individual connection level and also at a bulk commercial level. There is going to be tremendous opposition to the installation of SCADA which will expose this theft and so a proper strategy needs to be worked out to counter this.
3. The most serious problem is with the approach to waste and storm water management which is a pan India disaster. The standard solutions offered are the laying of underground sewerage and storm water drains at a huge cost and then their treatment in Sewage Treatment Plants again at a huge capital and operation cost. Due to the high cost of setting up and running the STPs these are not set up in adequate numbers and after that they are rarely run 24x7 and in most cases they are dysfunctional. The Central and State Pollution Control Boards, which are tasked with the responsibility of monitoring the functioning of these STPs, do not have real time data on their

installation and performance and the latest data available is a report of a study conducted by the CPCB in 2011. This study revealed that all over India the total urban waste water from 498 cities in 29 states was 35558 MLD whereas the installed STP capacity was only 11553 MLD. The situation was even more dismal in Madhya Pradesh with a discharge of 1249 MLD from 25 cities and towns and an STP capacity of only 186 MLD (CPCB, 2013). This study monitored the functioning of the better functioning 15 per cent or so of the STPs across India and found a capacity utilisation of 66 per cent. Most other STPs are performing much more poorly. Moreover, due to the extensive use of plastic packaging which finds its way into the sewers and stormwater drains there is extensive clogging of these and this leads to severe water logging during the monsoons.

4. There is no attempt whatsoever to explore decentralised methods of waste and storm water management which are both economically cheap, environmentally sound and easy to implement and only need investments in awareness building among the citizens and some strict implementation of the laws relating to pollution control as the financial investments can be made by the individuals and institutions themselves, thus, unburdening the government and the municipalities from this onerous responsibility.
5. Studies have shown that pit latrines have a deleterious effect on groundwater quality and so eventually there is no significant improvement in health outcomes (Clasen et al, 2014). The stress on constructing these pit latrines in large numbers under the SBM is misplaced and is causing more harm than good. Thus, there is a need to use better technologies for stand alone latrines like the Gram Kranti Ecobiotoilet (Khandekar, 2016).
6. Despite the improvement of revenue mobilisation from property taxes and water and sanitation charges having been made a mandatory condition of JNNURM funding, most urban local bodies (ULB) have not done enough on these fronts and the UMC is no exception. Low revenue mobilisation adversely affects the ability of ULBs to provide proper services and to invest in urban renewal. One time grants from the Central Government through schemes like JNNURM, AMRUT and Smart City Mission can result in some development but it will not be sustainable. Even the huge funds received for the Simhasth in Ujjain were misspent as far as the WASH interventions are concerned. Rs 100 crores were spent on diverting the polluted water of the Khan River before its confluence with the Kshipra through an underground pipeline but this was not completed leading to the polluted backwater flowing into the Kshipra and now it is not being used at all (FPJ, 2016). Temporary and expensive solutions such as ozonisation of the Kshipra River at the bathing ghats was done to ensure water of permissible quality but these have now been discontinued.

## **9. An Alternative WASH Scenario for Ujjain**

The foregoing discussion has made it clear that there is an urgent need to explore other WASH systems for Ujjain than the one that has been adopted so far since the UMC has neither the financial resources nor the technical capacity to implement the grandiose plans it has drawn up.

### **9.1 Water Sensitive Urban Design**

The concept of Water Sensitive Urban Design (WSUD) is defined as "an approach to urban planning and design that integrates the management of the total water cycle into the urban development process" (SASTORM, 2011). It includes:

1. Integrated management of groundwater, surface runoff (including stormwater), drinking water and wastewater to protect water related environmental, recreational and cultural values,
2. Storage, treatment and beneficial use of runoff,
3. Treatment and reuse of wastewater,

4. Using vegetation for treatment purposes, water efficient landscaping and enhancing biodiversity, and
5. Utilising water saving measures within and outside domestic, commercial, industrial and institutional premises to minimise requirements for drinking and non drinking water supplies.

Thus, by reusing stormwater through appropriate water harvesting techniques involving both surface and aquifer storage and the treatment and reuse of waste water, the need for expensive drainage and water supply systems is reduced considerably. The design of buildings is done in such a way as to save on water use and increase water storage and reuse. In the process the environment is also conserved as extensive soil conservation and plantation activity is undertaken in the unbuilt environment. This approach can bring about substantial benefits at less cost compared to further investments in solutions that rely only on technological fixes for water supply and waste water management problems. In the urban water management context this involves an optimal use of both groundwater and surface water sources and where feasible recharging, harvesting and reuse of storm and waste water.

### **9.2 Recharging of Groundwater Aquifers in Ujjain**

Extensive water recharging and wastewater treatment and reuse have to be explored for a sustainable hybrid ground cum surface water combination. There are already rules that all buildings of area more than 140 sq mtrs must have water recharging systems in place so that all the stormwater is filtered and recharged within these building premises in a decentralised manner (MP Govt., 2010). However, these rules are not being followed. The cost of installing a water recharge system is about 3 per cent of the total building cost and it goes down proportionately as the size of the building increases, yet this is not being done. The benefits in terms of obviating the need for extensive centralised storm water drainage systems and increasing the groundwater availability far outweigh these costs. Moreover, since these costs will be borne by the building owners themselves it is a progressive measure wherein those with better economic capacity are made to bear the costs of WASH directly without burdening the UMC.

The Central Groundwater Board has prepared a detailed artificial recharge master plan for the whole of the country so as to replenish the available groundwater storage capacity. The details of the measures to be adopted in the Gambhir and Shipra River basins which form the catchment of Ujjain city, have been given in this document (CGWB 2016). If this plan were to be implemented then the availability of groundwater in the whole of the catchment of Ujjain city would be improved considerably. Moreover, the many surface water bodies in Ujjain city would be suitably replenished. The potential for harvesting and recharge in the Ujjain Planning Area of 160 sq km itself is 320 MLD which can easily take care of the water supply requirements of the city.

### **9.3 Treatment and Reuse of Waste Water**

Then, there is the issue of treatment and reuse of wastewater. As with storm water so with wastewater it is much cheaper to treat and reuse or recharge it in a decentralised manner. The Dhas Gramin Vikas Kendra in Indore has installed such a decentralised system in its office premises in which the bathroom and kitchen wastewater is filtered through a soakpit and recharged into the ground with a BOD of less than 30 mg/litre which is the permissible limit (Pillai, 2012). The toilet waste water is first directed into a septic tank. This septic tank has an aerator installed in it that causes aerobic digestion of the waste to take place. Thus, the inlet water which has a BOD of about 500mg/litre is treated by the aeration process resulting in a BOD of about 55 mg/litre of the water flowing out of the septic tank. This water is then filtered through a soakpit and the final water that seeps into the ground has a BOD within the permissible limit of 30 mg/litre. The installation cost of this system is less than 1 per cent of the total building cost

while the running cost of the aerator is only Rs 2/1000litres/day of toilet sewage. Moreover, due to the oxidation of sewage through aeration there is no generation of sludge and foul smelling gases. Most importantly, the need for a centralised underground sewer system and sewage treatment plants, which are expensive to construct and maintain, can be done away with. Over and above this all the waste water which constitutes about 90% of the potable water supplied, is recharged into the ground enhancing the groundwater availability. The greater availability of groundwater will mean lesser use of electrical energy which in turn means the lesser production of greenhouse gases. Thus, this alternative system will also have a positive climate change mitigation impact. There is also the option of treating the wastewater a little more and re-using it for flushing of toilets and gardening which together constitute close to 47 per cent of the water use (CPHEEO, 1999).

#### 9.4 Equitable and Sustainable WASH Management for Ujjain

Thus, by using the WSUD principles described earlier, it is possible to design a hybrid ground cum surface water system of water supply. This will be augmented by storm water recharge and waste water treatment and recharge and reuse done in a decentralised manner, that is much more sustainable in financial, social and environmental terms. This kind of hybrid alternative system has also been recommended by a committee formed to recommend National Sustainable Habitat Standards for the Urban Water Supply and Sewerage sector under the National Mission for Sustainable Habitat (NMSH, 2011). Instead of relying on taxes, user charges and grants to fund hugely expensive centralised systems, this alternative system would put the onus on the more affluent citizens, corporations, private institutions and government institutions, who are all in possession of a considerable portion of urban land, to tackle their water supply and waste water disposal needs in a decentralised manner and so leave the UMC to take care of the WASH needs of the slum residents who are not in a position to bear the costs.

#### 10. WASH Situation in a Representative Sample of Slums in Ujjain and Recommended Interventions

A representative sample of six slums in Ujjain were studied in depth for the WASH problems being faced by the residents. The location of these slums and the BGMS-WAI office is shown in the map below.

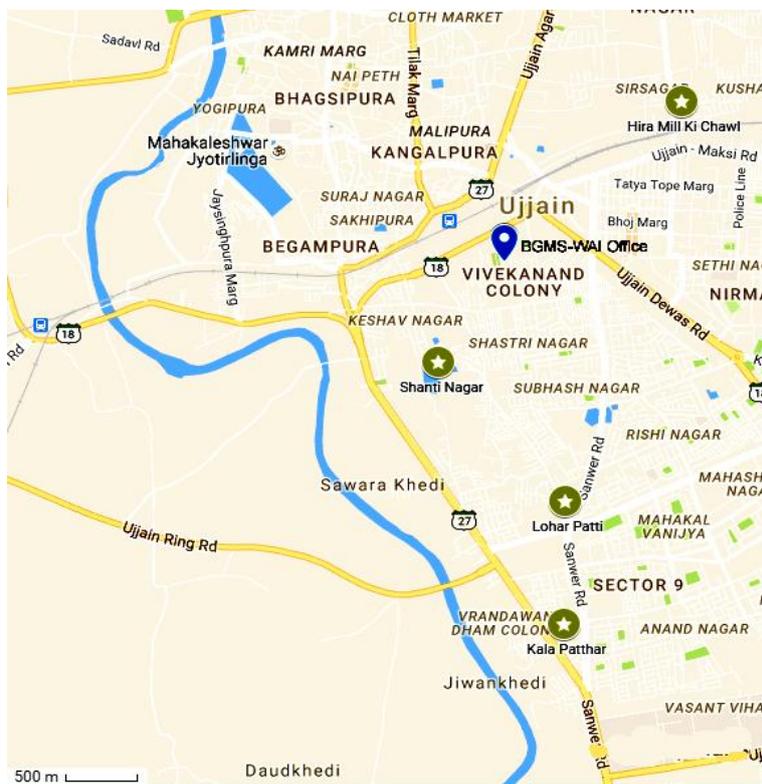


Fig. 7: Map of Ujjain Showing Location of BGMS-WAI Office and Surveyed Slums

Three slums Hira Mill Ki Chawl, Distillery and Barah Kholi are situated very close to each other and have been shown through one marker on the map named after the first of these slums. The other three slums visited were Shantinagar, Lohar Patti and Kala Patthar. Group discussions were held with the residents in all these slums to determine the water supply, sanitation and hygiene situation.

### 10.1 Hira Mill Ki Chawl

This is a dilapidated cluster of quarters that initially housed the workers of the Hira Textile Mills which has now become defunct. The 300 resident families have fallen into poverty over the past two decades since the mill stopped production and are mostly engaged in casual labour. They are also threatened with displacement due to the Government's plans of redeveloping the area against which they are waging a struggle. The water supply and sanitation situation is very bad here. Both the grey water from the kitchen and bathroom and the outflow from the few toilets that have been built flow into open drains which in turn empty into unlined drains. The stormwater also flows in these drains and so when it rains heavily then the whole area becomes flooded with dirty water which enters the houses. There are a few open wells and handpumps here but as the water table is high due to the subsoil being alluvial, the water is contaminated with the seepage from the waste water as shown in the pictures below.



**Fig. 8: Open Drain contaminating the water of the open wells and handpumps in Hira Mill Ki Chawl**

There is also a community toilet constructed and maintained by the Sulabh Shouchalay Organisation which is in bad shape with its toilets choked with faeces. The septic tank that was built to receive the sewage from the toilet has filled up and is overflowing, further contaminating the groundwater of the area as shown below.



**Fig. 9: Overflowing septic tank and choked toilet of Sulabh Shouchalaya in Hira Mill Ki Chawl**

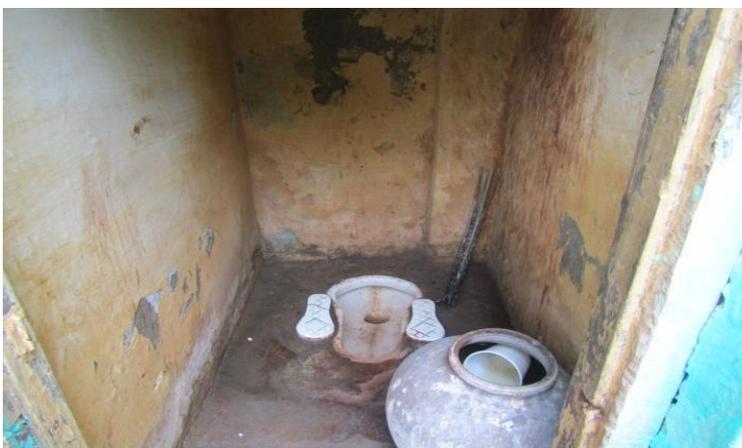
Presently the residents are bringing water from a distance of 1.5 kms from the standpipe under the nearest MPPHED overhead water supply tank on cycles or motorised two wheelers but this is not always possible and then they have to rely on the contaminated water of the handpump. Not surprisingly diseases are wide spread in this slum and every household has someone or other falling ill all the time. The samples of water from the well and handpump were given to the MPPHED for testing. However, as mentioned earlier the MPPHED laboratory is not equipped and staffed to do proper testing and so they did only chemical testing and found only dissolved solids to be higher than permissible limits. Samples of water have to be tested again for bacteriological and virological contamination and oxygen demand at a properly equipped and staffed and preferably independent laboratory. Given the serious WASH situation in this slum, there is need to implement decentralised community run waste water treatment and reuse, water harvesting and recharge and reverse osmosis (RO) based water treatment systems on a pilot basis with say twenty household groups at a time. The discussions with the people revealed that they are desperately looking for solutions to the serious WASH problems that they are beset with.



**Fig. 10: The Gram Kranti Eco-bio Toilet which requires little space and the outflow is safe**

As mentioned earlier, pit latrines or septic tanks without proper treatment of their outflow are a public health disaster and so it would be better to install Gramkranti eco-bio toilets as shown in the pictures above. These toilets use a patented bacterial culture to digest the faeces and urine and produce only gases and a nutrient rich liquid that can be used as a pesticide or disposed of in the ground or the open drains to disinfect them. This will of course require community mobilisation of a high order given the fact that awareness and technical knowledge of such alternative WASH systems is low. The residents may be prepared to undertake such community WASH projects if a viable alternative is presented to them.

## 10.2 Distillery and Barah Kholi



**Fig. 11. Dry Toilet in Distillery Slum**

There are a dozen quarters of a defunct distillery in which there are some unauthorised residents and some others who are employees of the Madhya Pradesh Excise Department. These quarters have dry latrines with pits below them as shown in the picture along side. There is tremendous water shortage here as the handpump water is contaminated and not fit for drinking. So like in Hira Mill Ki Chawl, the residents have to bring water from a distance.

Often this water carriage has to be done by children as shown in the picture along side. The Barah Kholi slum nearby has about two dozen more residents and it faces the same problems as the Distillery quarters. Discussions revealed that the possibilities of community mobilisation for WASH alternatives in these two slums is less than that in Hira Mill Ki Chaal. Especially as there are open fields around, the residents do not feel the need to construct toilets. However, like in Hira Mill Ki Chawl, the residents here too suffer from various diseases frequently. The water needs to be tested.



**Fig. 12 : Children Carrying Drinking Water**

### 10.3 Shantinagar

This is a congested slum of 150 households which has piped water supply from the UMC. However, this water is turbid and heavily laced with chlorine. This is not surprising as the water supply line is next to the open drain and there will be pollution from the latter in it. To ward against infiltration of polluted water the PHED laces the treated water with more chlorine. The open drain carries the effluents from the septic tanks, especially the heavy sewage of the



Sulabh Shouchalay community toilet as shown below.

**Fig. 13 Water Line near open drain into which the sewage from the Sulabh Toilet drains in Shantinagar**

There are handpumps and open wells in this slum but their water is contaminated from seepage of the waste water from the open drains which eventually drain into a nullah nearby. The water needs to be tested properly as here too there is a preponderance of disease. People here want to build individual toilets as they are not satisfied with the functioning of the Sulabh and other community toilets. Therefore, they may be prepared to install the Gram Kranti toilets.

### 10.4 Loharpatti

This is a slum of about 100 households situated next to a nullah in a low lying area and was flooded by the overflowing nullah in the last monsoons. There is piped water supply here and some houses have toilets which empty into the nullah directly or into the open drain which flows into the nullah. Here too the

residents frequently suffer from diseases indicating that the water supply is contaminated and so the water needs to be properly tested. There is not much scope for community run alternative WASH systems here as the residents are not cohesively organised.

### **10.5 Kala Patthar**

This is a slum of about 170 families situated on the outskirts of the city that is in very serious problems regarding both water supply and sanitation. Earlier the residents used to go for open defecation in the nearby fields. However, these have now been closed in by the owners who are developing them into residential colonies. Therefore, it is only possible to go to these fields at night and so families are being forced to construct toilets. These are mostly poorly constructed pit latrines which are stinking badly. The large number of pit latrines has contaminated the ground water and now the handpump water too stinks. So the drinking water has to be brought from afar. There is UMC supply but it is erratic and insufficient. The water here needs to be properly tested. Since the households here are facing serious problems with regard to sanitation and health there is a possibility that they may agree to the installation of the Gram Kranti toilet and may also agree to a community run RO purifier system if enough awareness building work is done with them.

### **11. Conclusions**

This brief survey of the WASH situation in Ujjain reveals the serious anomalies with regard to planning and implementation in the city with regard to proper management of water supply, sanitation and hygiene. The main points that emerge are as follows -

1. There is a huge loss of 62.5 per cent of the total water supply mainly due to theft and technical losses and consequently the slum population which constitutes 35 per cent of the total is woefully under served mostly having to rely on their own resources.
2. There are no sewage carriage and treatment facilities at present and so the waste water is being released untreated into the ground and surface water severely polluting them. Matters have been compounded by the subsoil being alluvial resulting in a high water table which easily gets polluted and the absence of storm water drainage which results in frequent flooding during monsoons with polluted water.
3. The finances of the UMC are in a shambles both with respect to the overall mobilisation of resources and especially with the recovery of user charges for water supply and sanitation with shortfalls in revenue collection exceeding 50 per cent.
4. The plans drawn up for remedying the situation are economically unviable and environmentally unsound and unlikely to be implemented successfully given the lack of political will, financial resources and technical capacity of the UMC.
5. The situation in the slums that were surveyed is very poor with lack of good WASH services resulting in diseases being rampant in them.
6. Water Sensitive Urban Design principles need to be implemented involving storm water harvesting and recharge and waste water treatment and reuse in a decentralised manner with the onus being on organisations and individuals funding their own water and waste water systems with the UMC being left with the responsibility of taking care of public spaces and the slums.
7. Awareness building must be done among the citizens to apprise them of the alternative methods available for WASH management and the pollution control laws should be strictly implemented so that there is greater adoption of these alternatives especially among those from the affluent sections who can easily do so.

## References

- AIILSSNPUPR (n.d.): *City Profile: Ujjain Municipal Corporation*, All India Institute of Local Self Government for Support to National Policies for Urban Poverty Reduction, Bhopal.
- Banerjee, R (2013): *Sustainability and Financial Viability of Urban Water Supply and Sanitation in Dryland Areas in India - Case Study of Indore City*, Dhas Gramin Vikas Kendra, accessed on 12.08.2016 at url [http://www.indiawaterportal.org/sites/indiawaterportal.org/files/sustainabilityfinancial-viability-of-urban-water-supplysanitation-indore-rahul\\_banerjee-2012\\_0.pdf](http://www.indiawaterportal.org/sites/indiawaterportal.org/files/sustainabilityfinancial-viability-of-urban-water-supplysanitation-indore-rahul_banerjee-2012_0.pdf)
- CEPT (2007): *Ujjain City Development Plan: Appraisal Report*, Centre for Environmental Planning and Technology, Ahmedabad.
- CGWB (2016a): *District Profile Ujjain*, Central Groundwater Board, accessed on 13.08.2016 at url [http://cgwb.gov.in/District\\_Profile/MP/ujjain.pdf](http://cgwb.gov.in/District_Profile/MP/ujjain.pdf)
- CGWB (2016b): *Master Plan for Artificial Recharge to Groundwater in India*, Central Ground Water Board, accessed on 11.08.2016 at url [cgwb.gov.in/documents/MASTER%20PLAN%20Final-2002.pdf](http://cgwb.gov.in/documents/MASTER%20PLAN%20Final-2002.pdf)
- Clasen, T., Boisson, S., Routray, P., Torondel, B., Bell, M., Cumming, O., Ensink, J., Freeman, M., Jenkins, M., Odagiri, M., Ray, S., Sinha, A., Suar, M. and W.P. Schmidt (2014): *Effectiveness of a rural sanitation programme on diarrhoea, soil-transmitted helminth infection, and child malnutrition in Odisha, India: a cluster-randomised trial*, Lancet Vol. 2 November.
- CPCB (2013): *Performance Evaluation of Sewage Treatment Plants under NRCD*, Central Pollution Control Board, New Delhi.
- CPHEEO (1999): *Manual on Water Supply & Treatment*, Central Public Health and Environmental Engineering Organisation, Ministry of Urban Development, Delhi.
- FPJ (2016): *Polluted Water of Bhandariya Khaal Nullah and Backwater of Kahn polluting Kshipra*, accessed on 11.08.2016 at url <http://www.freepressjournal.in/ujjain/simhastha-kumbh-2016/polluted-water-of-bhandariya-khaal-nullah-and-backwater-of-kahn-polluting-kshipra/850497> May 17th.
- JNNURM (2016): *Project Implementation Status under UIG: Madhya Pradesh*, accessed on 12.08.2016 at url <http://jnnurm.nic.in/wp-content/uploads/2014/08/MP.pdf>
- Khandekar, N (2016): *More People Should Use this Zero Discharge Toilet*, accessed on 12.08.2016 at url <http://www.indiawaterportal.org/articles/more-people-should-use-zero-sewage-discharge-toilet>
- Kumawat, D.M. and M.K. Sharma (2015): *Quality Status Study of River Kshipra at Ujjain Before its Linkage with Narmada Water*, Journal of Global Biosciences, Vol 4 No 2
- MP Govt (2006). *Ujjain Development Plan 2021*, Directorate of Town and Country Planning, Government of Madhya Pradesh.
- MP Govt (2010). *Madhya Pradesh Bhoomi Vikas Rules 1984*, India Law House, Indore.
- NMSH (2011) *Sustainable Habitat for Urban Areas*, National Mission for Sustainable Habitat, New Delhi.
- Pillai, V (2012): *They are Reusing Waste Water to the Last Drop*, Times of India, Indore, December 23<sup>rd</sup>.
- SASTORM (2011): *South Australia Stormwater Management Programme*. Government of South Australia, Adelaide.
- UMC (2016a): *Ujjain Smart City Plan Round II*, Ujjain Municipal Corporation,Ujjain.
- UMC (2016b): *Action Plan for Reduction of NRW*, Ujjain Municipal Corporation,Ujjain.
- UMC (2016c) *Annual Budget 2016-17*, Ujjain Municipal Corporation, Ujjain.
- UMC (2016d): *Action Plan to Progressively Increase Green Cover in Ujjain to 15% in Five Years*, Ujjain Municipal Corporation,Ujjain.