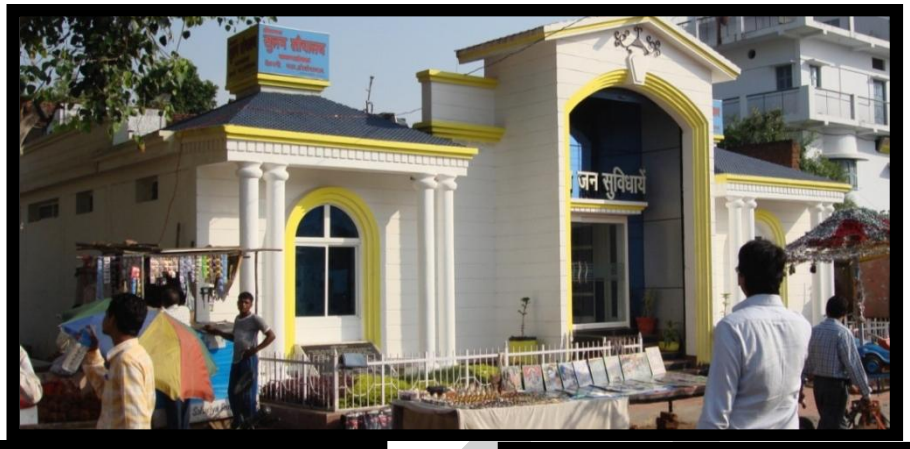
HOSHANGABAD:
TOWARDS CITY-WIDE SANITATION



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CONTENT

Revision Information

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IMPORTANT INFORMATION

Definitions

Slum Area in Madhya Pradesh: where the competent authority is satisfied in respect of buildings in an area 'the buildings in that area are in any respect unfit for human habitation; or are by any reason of dilapidation, overcrowding, faulty arrangement of streets, lack of ventilation, light or sanitation facilities or any combination of these factors, are detrimental to safety, health or morals may, by notification, declare such area to be a slum area (MP Slum Area Improvement and Relocation Act, 1976)

Septage: Septage is the liquid and solid material pumped from a septic tank or on-site sanitation facility**.**

Domestic Sewage: Wastewater generated as a result of household human activities – bathing, cloth washing, excreta flushing, etc.

Sewer: A pipe or conduit that carries wastewater or drainage water.

Sewerage: A complete system of piping, pumps, basins, tanks, unit processes and infrastructure for the collection and transport of wastewater.

Sewage Return Factor: A constant denoting the proportion of household water supply returning as wastewater after use. *For example sewage return factor of 0.80 indicates that 80 percent of water supplied returns as sewage.*

Definitions of Household Sanitation Arrangements according to Census 2001

Water closet latrine (WC): The sanitary water flush latrines are those latrines that have water closets fitted with flushing cistern. Such latrines that may be connected to a septic tank or an underground sewerage system will also be recorded as water closet latrines. The faecal matter from these types of latrines is removed without the need for scavenging or manual handling of excreta.

Pit latrine: The latrines attached to the pit that is dug into the ground for the reception of night soil are reckoned as pit latrines.

Other latrine: This category includes service latrines (i.e. those that are cleaned manually); latrines serviced by animals such as pigs, etc. and all latrines other than the pit and the water closet types of latrine

Note: the definitions adopted for baseline sanitation survey follow the above definitions.

Interceptor Tank: Interceptor tank is similar to septic tank but has a single chamber and lesser hydraulic retention time (hence smaller size). These are built on-plot as part of small bore/ settled sewerage system. These serve two purposes- 1) retain most of the solids; and 2) dampen peak flows, thus the design of downstream sewerage network can be relaxed.

Effluent Discharge Standards (Key parameters)

Sl #	Parameter	Unit	Standard	
			Inland Surface Water	Land for Irrigation
1	Biochemical Oxygen Demand	mg/l	30	100
2	Chemical Oxygen Demand	mg/l	250	
3	Suspended Solids	mg/l	100	600
Source: Gazette Notification of MoEF, May 1993 (General Standards for Discharge of Environment Pollutants: Effluent) available at www.mangalorecity.gov.in/forms/sez/.../Annexure-VI.DOC accessed on February 16, 2010				

Abbreviations

CDS	Community Development Society
CES	Consulting Engineering Services
CMO	Chief Municipal Officer
CO	Community Organiser
CPHEEO	Central Public Health and Environmental Engineering Organisation, Min. of Urban Development, Govt. of India
CSP	City Sanitation Plan
DfID	Department for International Development, Govt. of United Kingdom
DUDA	District Urban Development Agency
EPCO	Planning & Coordination Organisation
GoI	Government of India
GoMP	Government of Madhya Pradesh
HH	Household
HNPP	Hoshangabad Nagar Palika Parishad
ILCS	Integrated Low Cost Sanitation Scheme
IUSP	Integrated Urban Sanitation Programme
LPCD	Litres per Capita per Day
MLD	Million Litres per Day
MoUD	Ministry of Urban Development
MPPCB	Madhya Pradesh Pollution Control Board
M&E	Monitoring and Evaluation
NGO	Non-Governmental Organisation
NRCP	National River Conservation Programme
NUSP	National Urban Sanitation Policy
ODF	Open Defecation Free
O&M	Operation and Maintenance
SD	Sludge Drying
SPM	Security Press Mill
STP	Sewage Treatment Plant
ULB	Urban Local Body
WC	Water Closet
WHO	World Health Organisation
WSP-SA	Water and Sanitation Programme, South Asia

CHAPTER 1: OVERVIEW

1.1 Introduction

Hoshangabad, a Class II town in Madhya Pradesh, embarked on the path of becoming totally *SANITISED i*n 2008, under the leadership of the Hoshangabad *Nagar Palika Parishad* (municipality, HNPP hereinafter)**.** Following a number of steps including Baseline Survey, Situational Analysis of Sanitation, consultations and discussions with stakeholders, and detailed analysis of technical options, this report presents:

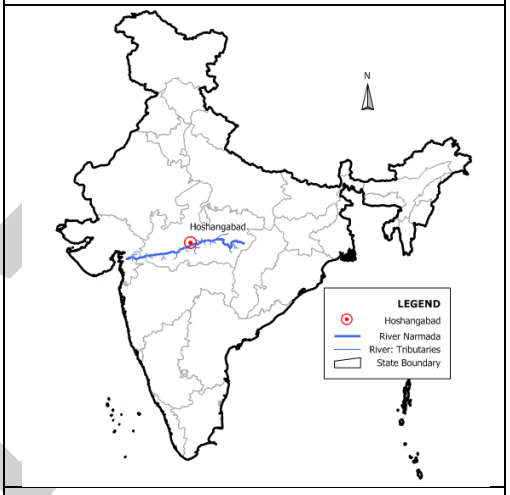
i) Techno-economic analysis of Strategic City level Sanitation Technical Options; and

ii) A brief analysis of institutional and legal issues.

A Draft Communication Strategy is also presented in the Annex for consideration of the HNPP.

Next steps include formation of City and District Sanitation Committees, setting up of the City Sanitation Cell, training, and other consultative and mobilization actions for the development and implementation of the *Hoshangabad City Sanitation Plan*.

Figure (1.1): India Map showing location of Hoshangabad



Source: DevInfo

1.2 Brief City Profile

Hoshangabad, located at 22° 46' N and 77° 44' E, is picturesquely placed along the southern bank of Narmada River, while north of the river stretch the Vindhyan hills. The city's name is derived from *Hoshangshah Ghori*, *Sultan* of *Malwa*, who is said to have founded Hoshangabad in 15th century [[1]]. Hoshangabad had a population of about 97,000 people (Census, 2001), and recent estimates indicate about 28,000 families living in the municipal area extending about 24 sq km. Hoshangabad is a district and *Tehsil* headquarter and an important agriculture trade centre for the region – it is also close to two important tourist attractions of Panchmarhi and Bhimbetika. Situated on the south bank of the Holy River Narmada, the town has religious importance- pilgrims use the several bathing *ghats* built along the riverbank. About 0.10 to 0.15 million pilgrims visit on festive occasions usually once a month. Even on ordinary days about 10,000 to 15,000 visitors arrive in Hoshangabad.

Hoshangabad is classified as a Class II town and has a municipal council - The HNPP was established in 1869[2]. The municipality (or is it Municipal Council?) has 33 wards and 33 elected members, led by a Chairperson (Mayor) directly elected by the people. Day-to-day administration is led by Chief Municipal Officer (CMO) – an officer from State Municipal Services. He is supported by officers leading various departments, the main ones being Health, Engineering, Revenue and Accounts. There are more than 350 employees. The municipality is responsible for provision of basic services – water supply, sanitation, street-lighting and maintenance of roads, parks and recreational facilities, and planning and sanctioning

[1] Imperial Gazetteer of India available at http://dsal.uchicago.edu/reference/gazetteer/pager.html?objectid=DS405.1.I34_V13_197.gif

[2] Imperial Gazetteer of India available at <http://dsal.uchicago.edu/reference/gazetteer/pager.html?objectid=DS405.1.I34_V13_197.gif>

housing plans and layouts. Apart from State and Union Government grants and transfers, the main sources of revenue are property taxes, license fees and rent for market buildings.

About 15 percent households in the city lack access to any household sanitation facilities and while some of these households use public toilets, most have to resort to open defecation. About 11 percent households have pit type latrines, and another 74 percent households have Water Closet type latrines draining into septic tanks and pits. Safe disposal and cleaning arrangements for both the above types of on-site installations are not well-documented – however, there are examples observed of unsafe disposal of faecal matter in drains and nalas. Further, there is little data available on health impacts of sanitation and hygiene practices in the city. The six existing Public Sanitary Conveniences (public toilets, with a total of 90 toilet-seats) are highly inadequate to cater to the needs of the resident and the substantial floating population in the city. The GoMP Baseline survey had provided a preliminary indication of unwillingness of households without toilets to financially contribute to and make use of individual or community sanitation facilities. A similar engagement with households and communities is also required to understand what incentives will drive them to better manage their existing facilities (especially cleaning and safe disposal) or to upgrade to other options (e.g. sewerage) as is being considered by the HNPP. While HNPP has dedicated staff for solid waste management[3], the institutional capacities to develop and implement the City Sanitation Plan focussed on safe management of human excreta and associated hygiene behaviours, will need considerable improvements.

(For details, please refer to the *Situation Analysis of the Sanitation Scenario in Hoshangabad*; Hoshangabad Nagar Palika Parishad, Government of Madhya Pradesh and WSP-SA; Nov 2008)

1.3 City Sanitation Planning Process in Hoshangabad

The Government of Madhya Pradesh (GoMP) has also been one of the leading States in the urban sanitation sector, gradually building towards a state-wide approach through learning from city initiatives and externally-assisted projects. The UADD (urban Administration and Development Department)conducted a Baseline sanitation survey in cities (2008)[4], and launched the 'Integrated Urban Sanitation Programme (IUSP)[5]. **In 2008, the HNPP embarked on the path of becoming *Totally Sanitized*.** The timing for this could not have been any better as 2008 was The International year of Sanitation and the Government of India launched the 'National Urban Sanitation Policy' (NUSP). The Sanitation Cell[6] of GoMP and the WSP-SA have been supporting the HNPP in developing the City Sanitation Plan for the town. Hoshangabad is also covered under the National River Conservation Plan under which a scheme to construct sewerage network and sewage treatment plant has been sanctioned.

[3] The city has considerable challenges in solid waste management, and the vacant position of the Health Officer has made the situation worse.

[4] Under this, the GoMP carried out a detailed baseline survey to enumerate household sanitation arrangements in all 338 ULBs across the state.

[5] The IUSP was launched in February 2009. The aim of the programme was to bring under one umbrella all urban sanitation related programmes so that there are uniform guidelines and that the efforts bring about a positive change. The IUSP is in cohesion with Government of India's National Urban policy 2008. The goal of the program is to achieve totally sanitized, healthy and livable cities and towns and to enhance living standards of the communities with special emphasis on the urban poor. The programme is based on demand responsive principles and a provision of prize money has also been made to encourage participation and to perform the urban local bodies better.

[6] Supported by Department for International Development (DfID), Govt. of UK

The challenge before the city was to respond to the local situation by carrying out a series of activities following the principles of the National Urban Sanitation Policy.

National Urban Sanitation Policy (**NUSP)**

The Vision of the NUSP is:
All Indian cities and towns become totally sanitized, healthy and liveable; and ensure and sustain good public health and environmental outcomes for all their citizens with a special focus on hygienic and affordable sanitation facilities for the urban poor and women.

To transform Urban India into *community-driven, totally sanitized, healthy and livable cities and towns,* the policy sets out the following goals:

A AWARENESS GENERATION AND BEHAVIOUR CHANGE

B OPEN DEFECATION FREE CITIES

C INTEGRATED CITY-WIDE SANITATION

1. Re-orienting Institutions and Mainstreaming Sanitation
2. Sanitary and safe disposal: 100% of human excreta and liquid wastes must be disposed of safely
3. Proper Operations and maintenance (O&M) of all sanitary installations

The policy envisages the preparation of *State Sanitation Strategies* within the overall National Policy framework. In turn, cities are expected to prepare their city-wide sanitation plans that need to be prepared in a consultative and participatory manner, and using an incremental approach to addressing the issue of sanitation in a comprehensive city-wide manner.

Source: NUSP, 2008.

A number of steps have been completed since initiation of the City-wide Sanitation process in Hoshangabad town in June 2008:

1. Baseline Sanitation Survey (2008)
2. Initial reconnaissance visit and discussions with the Mayor and Chief Municipal Officer and council members
3. Preparation of Situational Analysis Report on Urban Sanitation in Hoshangabad (January 2009)
4. Presentation of Situational Analysis Report and consultations with Council Members (January 2009)
5. Discussion on implications of proposed centralised sewerage and sewage treatment scheme on sustainable operation maintenance and extension of sanitation services to households.
6. Discussions on possible sanitation options (Centralised Versus Decentralised Wastewater Treatment) for Hoshangabad town. June 2009
7. Presentation on Decentralised Wastewater Treatment Systems for municipal wastewater. July 2009
8. Community mobilisation piloting: committees formed in two municipals wards. The women members from these committees later assisted in validation of 'Baseline Sanitation Survey' and identified 2,625 households that lack individual sanitation facilities.
9. Submitted proposal to Government of India for financing construction of 2,625 individual household latrines under Integrated Low Cost Sanitation Scheme (ILCS).

This report forms tenth milestone on the way to achieving the goal of city-wide sanitation for Hoshangabad.

1.4 City Sanitation Strategic Technical Options

This report aims guiding through next steps in achieving the goal of total sanitation for Hoshangabad. The report analyses various city-wide or Strategic level sanitation technical options available for Hoshangabad and lays down road map for achieving total sanitation.

A total of five city-wide sanitation technical options are suggested. For each option, a detailed infrastructure gap has been estimated, based on standard norms. Subsequently, the finance requirement to bridge infrastructure gaps has been estimated. Also for each proposed option, indicative user fees have been estimated.

This is followed by a comparative analysis of investment requirements for each option. Thus, the document lays down options for the decision maker to choose most suitable city-wide sanitation from techno-financial perspective.

The suggested City-wide Sanitation Technical Options include:

1. Fully On-site Sanitation: Septic tanks or Twin Soak Pits
2. Fully off-site Sanitation: Settled (Small bore) sewerage
3. Part on-site (Septic tanks or Twin Soak Pits) / part off-site (Conventional Sewerage)
4. Simplified Sewerage with Decentralised Wastewater treatment
5. Mixed System that combines elements of the above in different parts of the city

The suggested sanitation options are independent of the already proposed sewerage and sewage treatment scheme under National River Action Plan (NRCP). Although Option-3 (Part on-site/ part off-site) is built similarly.

1.5 Strengthening Institutional Arrangements, Participation and Effective Communications

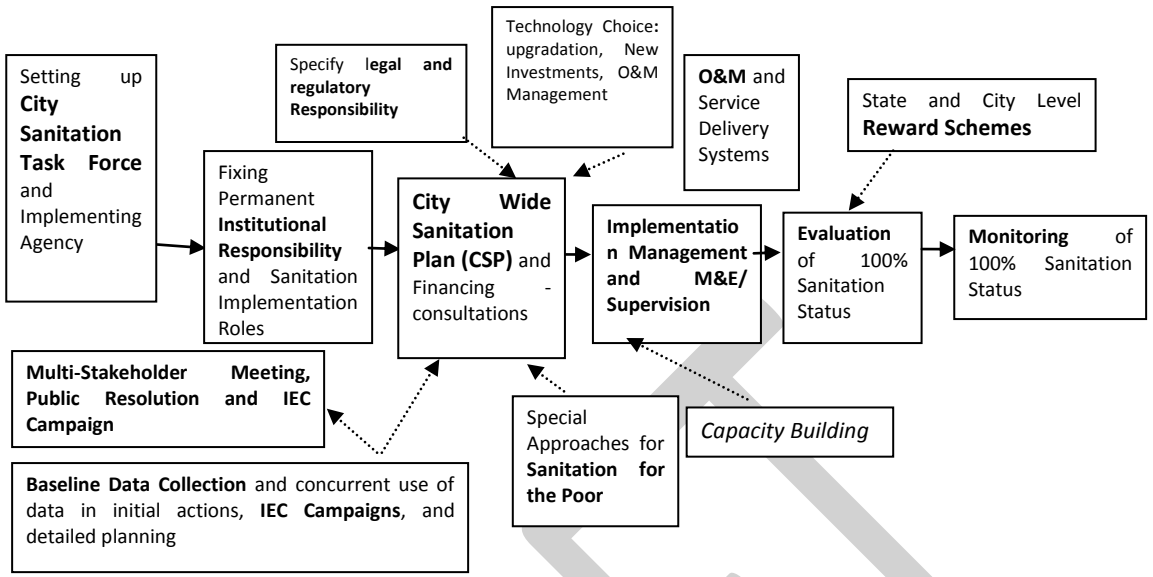
The report also briefly outlines the existing institutional arrangements and responsibilities within the HNPP, and highlights the importance setting up appropriate institutional mechanisms and community participation to ensure sustainable delivery of high quality sanitation services for Hoshangabad. The HNPP does not have staff and capacities for development and implementation of a City Wide Sanitation Plan – this needs to be addressed urgently.

As captured in the Situation Analysis and highlighted in the technical options discussions, there needs to be considerable engagement with households and communities on changing mindsets, and understanding their incentives to change behaviour and practices. A communication strategy has been drafted to create support for and facilitate effective implementation of city-wide, demand-based sanitation programs; and for generating awareness amongst urban households on sanitation and its linkages with health, economic productivity and the environment along with facilitating behaviour change towards adoption of safe sanitation practices among households.

1.6 Recommended Next Steps

As outlined in the NUSP, the generic elements of planning, implementation and M&E of City Wide Sanitation (Fig. 1.2), the process needs to be highly iterative and draw in inputs from one series of steps to another.

Fig (1.2): Generic Elements of Planning, Implementation and M&E of City Wide Sanitation



Source: NUSP, MoUD, GoI (2008)

The actions so far in Hoshangabad demonstrate an impressive coverage of the different dimensions of the above generic process. With this step of building scenarios for technology options and choosing the most suited one, another important dimension will be addressed. Additional dimensions viz. institutional capacities and communication strategy also need to be considered now.

In order to take forward this multi-pronged and iterative process of development and implementation of the Hoshangabad City Sanitation Plan, the following steps are recommended:

1. Presentation of the City-wide Strategic Sanitation Technical Options report to the HNPP (preliminary presentations made)
2. Training Workshop for Council members to detail out the CSP planning and implementation process
3. Series of meetings to be organized in different wards with ward sabha, SHGs and institutional associations
4. Final selection of city-wide sanitation technical option or combination/phases of options
5. Identification of gaps in rules/ legislation, drafting appropriate rules and approval of the same
6. Defining and operationalising institutional set-up to ensure sustainable sanitation service delivery
7. Finalisation of enumerated dataset on sanitation provisions including establishments, public space requirements, etc.
8. Action Plan at ward level with commitments from ward members and mohalla committee representatives
9. Dove-tailing household/establishment level action plan with fund flow and wastewater treatment works plan
10. Design of M& E System
11. Implementation (including slum sanitation- management of community toilets or individual toilet construction)

CHAPTER 2: CITY-WIDE SANITATION: COMPONENTS AND TECHNOLOGY OPTIONS

This chapter briefly describes the NUSP vision and CSP framework. This is followed by a brief description of existing environmental sanitation situation of the town, proposed NRCP (sewerage and sewage treatment scheme) and potential choices for upgrading.

2.1 NUSP Vision and City-wide Sanitation Planning

The National Urban Sanitation Policy envisions – *'All Indian cities and towns become totally sanitised, healthy and liveable and ensure and sustain good public health and environmental outcomes for all their citizens with a special focus on hygienic and affordable sanitation facilities for the urban poor and women'.*

As a starting point to achieving this vision, the policy provides a framework for city-wide sanitation. Generic elements of *planning, implementation and M&E* are presented in Figure (1.1) in the previous chapter. The purpose of the framework is to assist Urban Local Bodies, NGOs, community based organizations, citizens and private sector agencies in Govt. of India through a series of steps toward achieving the goal of 100 percent sanitation in any given city.

The CSP framework emphasises that- *though apparently linear, the process needs to be highly iterative and draw in inputs from one series of steps to another.*

Preparation of city-wide sanitation plan is an important step in the process. The purpose of the step is to build various scenarios for technology options and choosing the most suited one. It is important to deliberate on pros and cons of each option before final selection.

The CSP framework outlines tasks that the States and ULBs will need to undertake: "*States will need to determine time-frames and deadlines to achieve the goals mentioned in the National Urban Sanitation Policy and will need to spell out a detailed roadmap, including the incremental targets for achievement of goals. For example, to achieve the goal of open defecation free (ODF) by year 2011, a detailed plan for extending access will need to be formulated and implemented in a time-bound manner. All such steps will need to be spelt out and operationalized under the CSPs. While some of the activities in the sanitation plan may be possible to complete with little financial resources e.g. better utilization of existing facilities, improved management systems for septage cleaning, awareness generation; etc. whereas others e.g. reconditioning or laying new sewers, may be more resource-intensive. The CSP will need to be prepared keeping in view what the city can afford and finance. It will be better as far as possible to improve the effectiveness of existing facilities before embarking on expensive new investments. Further, thinking about the whole city, and not just some portions or just some facilities, will be necessary to achieve the goals in a comprehensive and systematic manner."*

2.2 Existing Environmental Sanitation Scenario in Hoshangabad

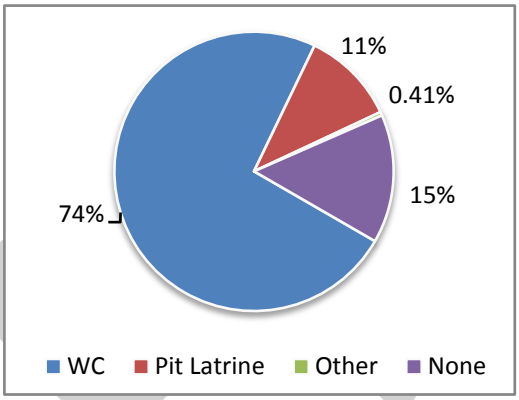
This section is largely based on situational analysis report- 'Sanitation Scenario in Hoshangabad (2008)'.

2.2.1 Human Excreta and liquid waste management

Household Sanitation

The findings of Baseline Sanitation Survey (2008) indicate that out of 15,515 surveyed households (within the HNPP area), nearly 85 percent households had access to individual sanitation facility. This included 74 percent (11,452) households accessing WC type latrines, a little less than 11 percent (1,688) households accessing pit type latrines and less than one percent (64) households accessing 'other' latrines.

Fig (2.1): Household Sanitation Arrangements (2008)



Source: Baseline Sanitation Survey (2008) Base: 15,515

About 15 percent households (2,311) lacked access to any household sanitation facilities. Reportedly, most of these households practiced open defecation; nonetheless, a few used public toilets.

The findings of the baseline sanitation survey conducted by GoMP (2008) were re-validated in 2009, which identified a total of 2,625 households lacking access to individual sanitation facility. Ward wise number of households lacking access to household sanitation is presented in Annex-B and possible sanitation options for these households are presented in Annex-C.

Sanitation Arrangements for floating population/ Public Sanitary Conveniences

As Hoshangabad is a district headquarter, an important agricultural trade centre, a town of religious significance and in close proximity to two places of tourist importance, it receives a number of visitors. On an average day the town receives about 15,000 visitors, which peaks to 100,000 to 150,000 during festive occasions. Providing adequate[7] public sanitary conveniences is therefore a critical requirement for maintaining sanitation in public places. However, existing facilities are highly inadequate. There are six public sanitary conveniences with an average capacity of about 15 seats per block (about 90 seats total). Currently, the HNPP is adding 90 more seats. For a daily average floating population of 15,000, daily toilet loading will be about 83 persons per seat. In addition, these facilities are also used by some of the local residents who currently lack access to household toilets.

[7] Though, there are no existing national or state level standards, a couple of programmes/ schemes and field surveys provide pointers for consideration while planning community/ public toilets. For planning purposes, GoI sponsored 'National Slum Development Programme' suggested – 35 users per day per seat; World Bank funded 'Mumbai Slum Sanitation Programme' adopted - 50 users per day per seat. Findings of community/ public toilet loading observations during evaluation of Mumbai SSP (TARU-WSP, 2005) indicate loading rates up to 100 persons per seat.

Although, there are no standard norms[8], daily toilet loading of 83 persons per toilet-seat appears to be high. Considering daily average operation time of about 12 hours, the loading rate translates in about 8 minutes per use. This may lessen further considering closure for cleaning of the toilet block etc.

Moreover, considering additional visitors on festive occasions and the requirement for resident population, available capacity is highly inadequate to meet the demand. ***This report analyses infrastructure gap and presents indicative estimate of the requirement to meet the demand of both user categories- floating population and resident community.***

Wastewater Generation, Collection, Treatment and Disposal

HNPP reports daily water supply level of 90 litres per person. In 2001, the population of Hoshangabad was 97,424. Considering annual growth of 4 percent (observed in 1991-2001 decade), the population in 2009 is expected to be about 128,000. Assuming a sewage return factor[9] of 0.80 (80 percent), the current wastewater generated can be estimated at 9.22 mld *[128,000 persons x 90 lpcd x 0.80 return factor x 1/1,000,000].*

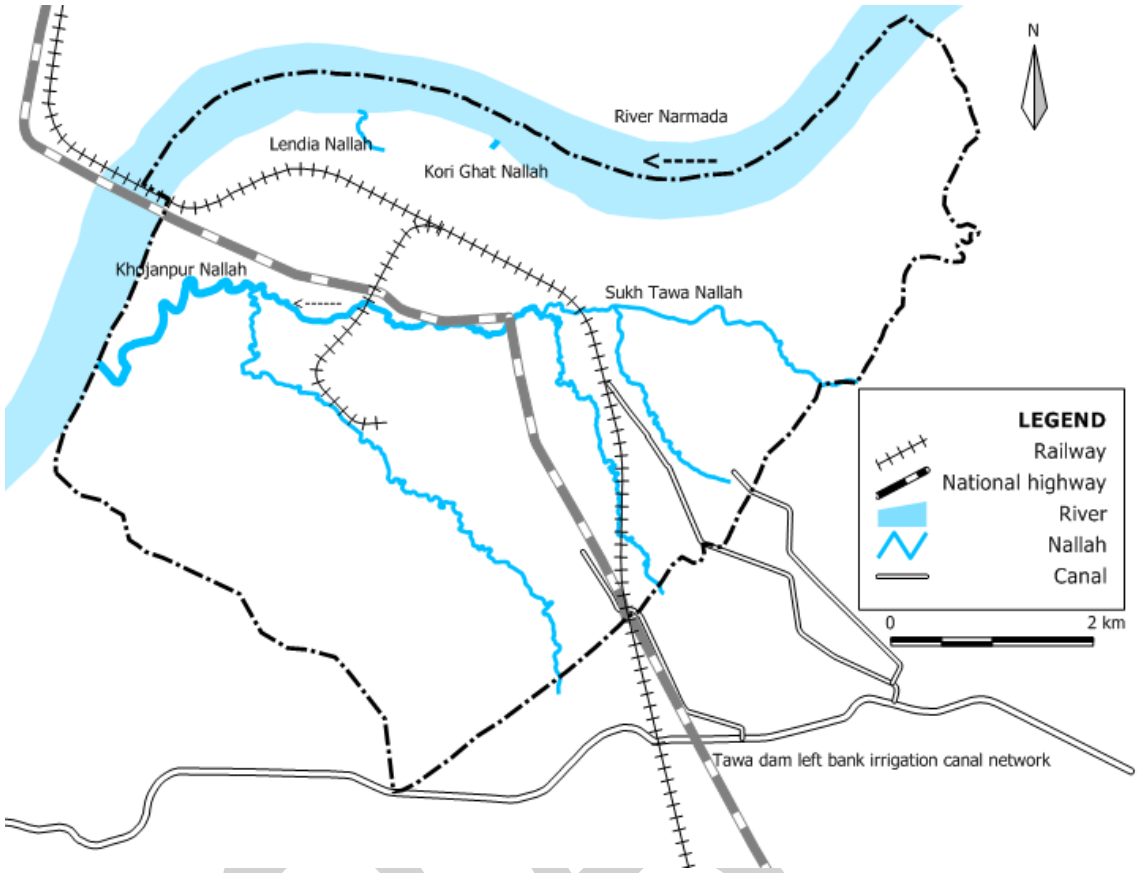
Hoshangabad is a non-industrial town. The municipal wastewater primarily consists of sullage and overflow from septic tanks. Wastewater is mainly disposed through roadside box drains – of which some sections are covered and in a few places choked with solid waste. In a few cases, latrines discharge directly into the drainage. This therefore causes a situation where the drainage system serves a dual purpose of carrying domestic wastewater (mainly sullage and overflow from individual septic tanks) as well as rainwater runoff. This is not a desirable situation and needs to be improved. ***The proposals contained in this report consider safe containment, treatment and disposal of human excreta and community liquid wastes.***

The topography of Hoshangabad town and the surroundings is such that the natural drainage system generally slopes towards north-west as shown in Fig (2.2) below. Domestic wastewater from the town is discharged into River Narmada through four major natural drains – ***Kori Ghat nallah***, ***Lendia nallah***, ***Sukh Tawa nallah*** **and** ***Khojanpur nallah*** (*Sukh Tawa nallah* discharges into *Khojanpur nallah*). The point where *Kori Ghat nallah* discharges into River Narmada is located upstream of most bathing ghats. This is not a desirable situation as thousands of devotees take bath in the river water. *Lendia nallah* and *Khojanpur nallahs* on the other hand join the river downstream of town. Of these two *nallahs*, *Khojanpur nallah* travels nearly 3 km (through agricultural fields) after leaving the densely populated areas of the town and before discharging in River Narmada.

[8] PSC loading norms are not reported by the CPHEEO and would ideally require Time-and-Use studies for estimation in light of local situation. Also, there is an implied trade-off between number of seats and estimated cost. It would be useful to examine some standards adopted in other cities and projects. The Mumbai Slum Sanitation Project had adopted a design norm of 50 persons per seat per day. Subsequently the larger cities in Maharashtra have adopted the same norm in their DCR. Back-of-envelope estimates would suggest that a loading of 24 is possibly most appropriate looking at the issue from a user perspective, unconstrained by budgets. The city of Hoshangabad should be free to adopt a scientifically established norm that could improve on the 50, suggested above. A norm of 35 user/ seat/ day for community toilets and 60 users/seat/ day for public toilets has been adopted for the purpose of CSP estimates.

[9] Sewage return factor is the unit quantity of sewage (wastewater) generated, expressed as a percentage (or proportion) of water supply. E.g. sewage return factor of 0.80 indicates that sewage generation is 80 percent of water supplied.

Fig. (2.2): Natural Drainage Network, Hoshangabad



Source: Sanitation Situation Analysis, Hoshangabad (2009)

Since the Kori Ghat nallah discharges upstream of bathing *ghats*, the GoMP, in mid-1980s, implemented a scheme to divert wastewater flow to *Lendia nallah*. The scheme is currently dysfunctional. In order to contain river pollution from municipal sewage, Hoshangabad town has been selected under National River Conservation Plan. In 2006, the National River Conservation Directorate approved a scheme to lay sewerage network and sewage treatment plant. Details of the scheme are presented below.

Proposed Sewerage and Sewage Treatment Scheme for Hoshangabad

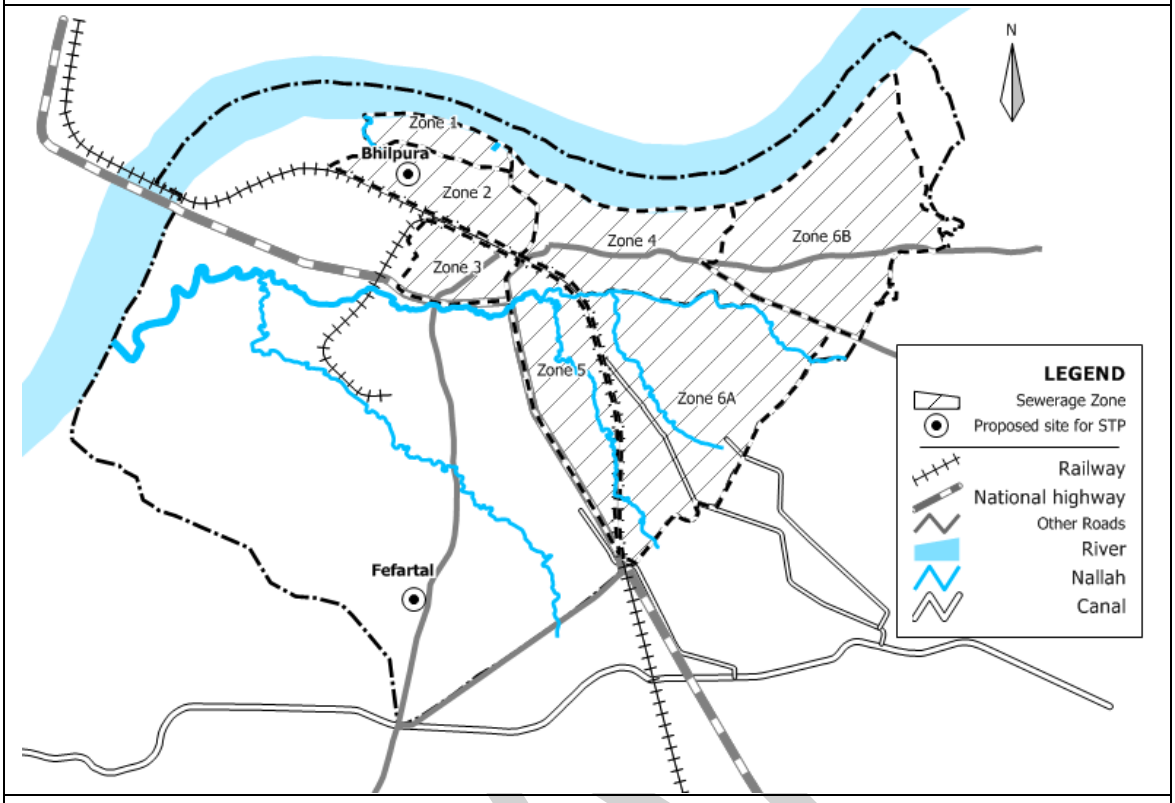
Hoshangabad is one of the towns taken up under Government of India's ambitious National River Conservation Plan (NRCP). Under the programme, a sewage collection and treatment scheme is proposed for Hoshangabad town. A detailed project report for the scheme has been prepared by Consulting Engineering Services (CES) on behalf of Environmental Planning & Coordination Organisation (EPCO), GoMP. The scheme was submitted to National River Conservation Directorate in 2006 and has been approved. The scheme broadly comprises of – trunk sewerage network, sewage pumping station and 2 sewage treatment plants (4 mld and 11 mld). Proposed wastewater treatment system consists of facultative pond followed by maturation pond. The scheme is estimated to cost about Rs 103 million; component-wise breakdown of costs are presented in Table (2.1) below.

Table (2.1): Components of proposed trunk sewerage and sewage treatment scheme for Hoshangabad		
S No	**Component**	**Estimated Cost (Rs in Million)**
1	Sewerage system including trunk sewerage network (15.54 km), pumping stations, pumping main and nallah tapping	54.76
2	Sewage Treatment Plants (2 Nos - 4 mld and 12 mld)	14.25
3	Low cost sanitation (community toilets – 2 Nos 10 seated)	1.34
4	Catchment Area Treatment	0.56
5	Land Acquisition	8.51
6	Public Participation	0.50
	Sub-total (@ 2002 Prices)	**79.92**
	Escalation up to 2006 excluding land cost	11.43
	Escalation up to 2008 excluding land cost	49.98
	Base cost (Excluding land cost)	**96.34**
	Centage (8%)	0.70
	Total Cost	**103.37**
Source: Hoshangabad Nagar Palika Parishad		

For slum communities, low cost sanitation has been proposed under the scheme. A provision of Rs 1.34 million has been made for the same. Only two public toilet blocks (with 10 seats each) are proposed under the scheme.

For the purpose of wastewater collection, the town has been divided in six sewerage zones based on drainage catchment. Wastewater from zone 1 and 2 is diverted to Bheelpura STP site, whereas, wastewater from remaining zones is diverted to Phephartaal STP site. Locations of the STP sites and sewage zones are shown in Figure (2.3) below. The proposed sewerage network does not cover wards Phephartaal, SPM (East), SPM (West) and part of Rasooliya ward.

Figure (2.3): Hoshangabad: Sewerage Zones and proposed Sewage Treatment Plant Sites



Note: STP – Sewage Treatment Plant

Source: Based on Hoshangabad municipal ward map, EPCO/ CES (2006) and Google Earth satellite Image

Septage Management

The HNPP has only one septage clearance vehicle to serve more than 11,000 septic tanks. Septage clearance service is provided on request of the household. The HNPP receives a request to clean only about 200 (or less than two percent of all) septic tanks every year. It is assumed that private cleaners also cater to the demands from residents to clean individual septic tanks. Although, not much is known about private septic tank cleaners, it can be safely interpreted that most of the septic tanks are not cleaned periodically. Hence, they may not be functioning appropriately, thus further aggravating the precarious sanitation situation of the town. The HNPP does not maintain record of septic tank user households and there is no monitoring of septage clearance. The septage removed from the tanks is reportedly disposed in the trenching ground or Khojanpur nallah. While a trenching ground acts as a temporary solution for the disposal of septage, However direct disposal into the Khojanpur nallah is hazardous to the environment and the citizens. The town lacks proper septage management.

Table (2.2): HOSHANGABAD – ESTIMATION OF WASTE GENERATED AND PROJECTIONS OF WASTE GENERATION TRENDS

Years	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Population (Thousand)	130.669	135.504	140.517	145.717	151.108	156.699	162.497	168.509	174.744	181.210	187.914	194.867	202.077
Per Capita Generation (Kg)	0.300	0.304	0.308	0.312	0.316	0.320	0.325	0.329	0.333	0.338	0.342	0.347	0.352
Quantity of MSW Generated (Tonnes)	39.201	41.192	43.284	45.482	47.793	50.220	52.771	55.451	58.268	61.227	64.337	67.605	71.039

Note: Population growth – 3.7 % per annum; Increase in per capita waste generation – 1.33 % per annum

2.2.2 Solid Waste Management

- Based on the field survey, discussions with the stakeholders and the per capita waste generation norms[10] for Hoshangabad city, it is estimated that about 40 - 45 metric tonnes (MT) of domestic solid waste is generated daily including waste from households, market waste and waste from other source. The total number of households in Honshangabad is estimated to be 24243[11].
- There is no organized large-scale system of door-to-door collection of MSW. Households are responsible for disposing the waste at designated collection points. HNPP is equipped with 155 dumper bins for waste collection – 55 containers of 4.5 cu.m (approx. 1.9 – 2.2 MT) capacity and 100 bins of 3 cu.m (approx. 1.3 MT) capacity each. These containers have a total capacity of approx. 300 MT which is significantly higher than the storage requirement of the city.

Figure (2.4): Bin

The major wards which have three or more containers of capacity of 4.5 cu.m are as follows:

Table (2.3): Number of containers per ward

S. No.	Ward No.	No. of Containers
1	3 (Ghat area)	3
2	1	3
3	28 (Bus stand)	3
4	14	3
5	18	4

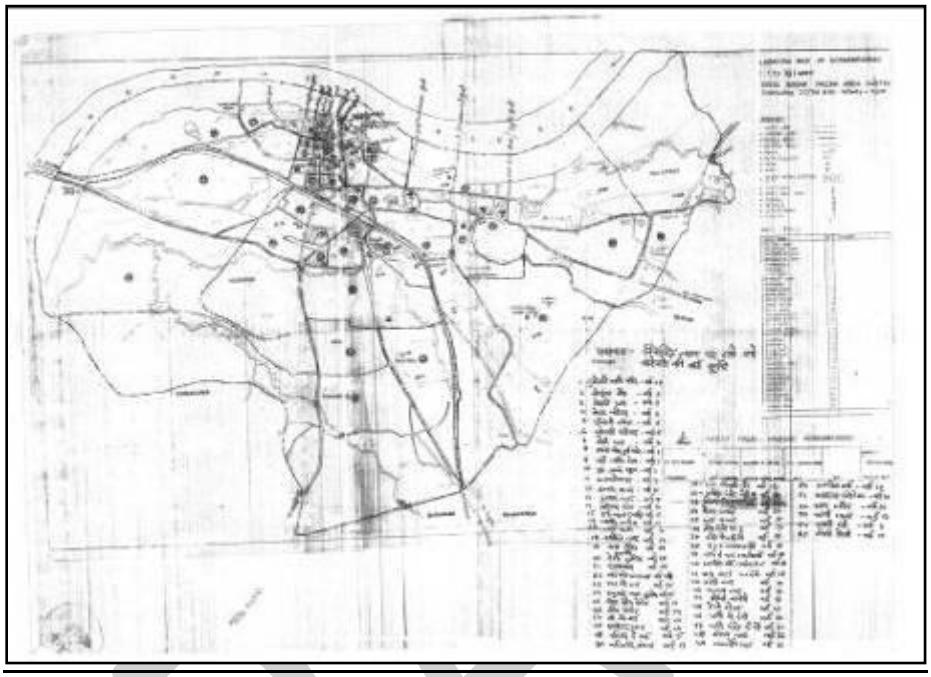
In addition to containers kept at designated locations, there are about 15 old masonry bins, which are being phased out. There are about 20 open collection points as well, from where the

[10] Refer estimation of waste generation, Table(2.2).
[11] Refer to Page 35 for estimates of number of households.

MSW is collected. These open collection points have been chosen by residents in some areas as the locations where HH waste is thrown.

Figure 2.5 illustrates the ward wise map of Hoshangabad with the major secondary collection points for MSW.

Figure (2.5): Hoshangabad Ward Map



- Less than 4% of the population is covered by door-to-door collection presently. Door–to-door (DTDC) collection system is being initiated in some wards with the assistance of NGOs/RWAs such as the Lions club, Sindhi Panchayat etc. Lions club has started an initiative for collection of plastics and is willing to provide 50% of the capital cost for purchasing 6 rickshaws for DTDC of MSW in select wards. HNPP has plans to go in for DTDC in majority of the wards in a phased manner and the body is working on the relevant tender documentation for achieving this.
- A recent household survey presents a bleak picture at primary collection and transfer end of the SWM chain. Analysis of responses from 15,515 households (in all 33 wards) indicates that a bulk (91 percent) of the households dispose garbage in the open (90 percent) or in drains (1 percent) as presented in Figure (3.6). Only a small proportion of households (about 9 percent) practice proper disposal – disposing in solid waste bins (a little over 8 percent) or door-to-door pick up (less than a percent).

  Ward wise data analysis indicates that the use of *solid waste bin* for garbage disposal is well practiced only in four municipal wards (*Janakpuri, Sadar Bazar, SPM East and SPM West*), where more than two-thirds of the households reported to use municipal solid waste bin. Among these, all household in SPM East ward use municipal solid waste bin. In contrast, nearly 22 percent households in *Rasooliya* ward dispose garbage in *drains*. Similar practice is adopted by about 8 percent households in Ramganj ward.

Table (2.4): Ward wise breakdown of Solid Waste Disposal Practices Adopted by Households

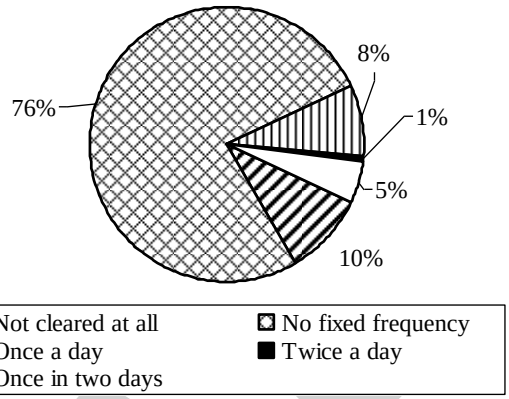
Ward No	Ward Name	Proportion of Households				Total Households
		Door to door collection	Disposed in Municipal Solid Waste Bin	Disposed in Open	Disposed in Drain	
1	Shashri Ward		3%	97%		347
2	Shanichara Ward		18%	82%		224
3	Jagdishpura Ward		28%	71%		401
4	Mangalwara Ward		3%	97%		237
5	Narayanganj Ward		23%	78%		200
6	Ramganj Ward	4%	10%	78%	8%	330
7	Azad Ward			100%		249
8	Subhashganj Ward	7%	53%	37%	3%	162
9	Balaganj Ward			100%		212
10	Ganeshganj Ward		71%	29%		128
11	Janakpuri Ward		100%			293
12	Sadar Bazar Ward			100%		371
13	Kothi Bazar Ward		11%	89%	1%	692
14	Tilak Ward			100%		510
15	Malakhedi Ward (North)			100%		762
16	Malakhedi Ward (South)			100%		805
17	Civil Line Ward		7%	92%		609
18	Housing Board Ward			100%		1,531
19	Anand Nagar Ward		1%	99%		1,418
20	Adamgarh Ward			100%		276
21	Phephartaal Ward			99%	1%	284
22	SPM Ward (East)		100%			112
23	SPM Ward (West)		88%	12%		277
24	Rasooliya Ward		1%	78%	22%	398
25	Rajendra Ward			100%		1,221
26	Rewaganj Ward		1%	99%		349
27	Bheelpura Ward			100%		358
28	Krishnapuri Ward		4%	96%		233
29	Gokulpuri Ward			100%		503
30	Gwaltoli Ward	2%	8%	91%		371
31	Govindpura Ward		26%	69%	5%	262
32	Gandhi Ward	1%	5%	94%		622
33	Tagore Ward		12%	88%		768
All Wards			**9%**	**90%**	**1%**	**1,5515**

Source: Sanitation Survey 2008, Hoshangabad Nagar Palika Parishad

To a question '*whether there is a fixed place for dust bin?*' majority (85 percent) of the respondent households replied negatively. Even among 1,442 regular dust bin user households, about 43 percent (627) agreed with this.

While 90 percent respondents agreed that the municipality clears the solid waste bins/ local dumping depot, a significant majority of 76 percent complained that the frequency of clearance is not fixed. About 9 percent respondents agreed that the bins are cleared daily. This included 8 percent households reporting clearance frequency of once a day and 1 percent households reporting a clearance frequency of twice a day. Remaining 5 percent households reported a solid waste frequency of once in two days as presented in Figure 2.6.

Figure (2.6): Citizen perception: Solid Waste Bin/ depot Clearance Frequency



Source: Sanitation Survey 2008 Base: 15,515 HH

- **Market Waste:** There are 17 market areas in the city with a total of 825 shops, 271 kiosks and 85 shops under construction. The market waste is collected in the similar fashion as the household MSW. Bins are placed at strategic points in the main market areas, where the MSW is generally thrown. The road sweepings from the market areas are also deposited into these bins.

- The Market Waste is collected in the morning between 7.30 a.m to 8.00 a.m daily,before the markets open. The main markets areas such as Itwara, Indira Chowk, Jayekem also undergo night sweeping at around 10 p.m.

- **Drain Cleaning:** The total length of the smaller drains in the city is 154 kms. In addition, there are 8 major storm water drains (SWDs) with a total length of 94 kms.

  The cleaning of the smaller drains is done manually periodically (twice a year) and the collected waste is dried in the open by the side of the drains before it is taken to the dumpsite. The larger SWDs are cleaned with the help of a JCB owned by the HNPP

  One of the major areas of concern for SWM in Hoshangabad is the open dumping on roads & pavements as well as dumping in the drains. It is estimated that a significant quantum of MSW gets into the open drains of the city, everyday. This affects the drainage system of the town adversely.

Fig (2.7): MSW dumped in open Drains

- **Road Sweeping:** Hoshangabad City has a total road length of 116.7 kms including major roads (Mukhya Marg) of 73.21 km length and medium/minor roads of 43.54 kms length. All roads are swept manually.

- Street sweeping is carried out in the entire municipal areas in the early morning time between 7a.m. to 8 a.m. In addition, Four or five major streets are swept twice (morning & late evening) daily. (The minor streets are swept only once daily.). The major streets such as The Satrasta (7 roads) Chowk & the streets in the major market areas are swept daily during the night time as well, at around 10 p.m. A team of about 50 Sanitary Workers (both full-time as well as part-time) are engaged in the night street sweeping operations

- **Solid Waste Management at the Ghats:** There are about 26 festive days in a year when the holy bath at the riverside "ghats' are undertaken by the tourists and the local people in large numbers. These days are Amavasya (once every month), Purnima (once every month), Makarsankranti (April) & Narmada Jayanti (Feb). The Ghats are cleaned a day in advance before the holy baths. A special team of 10-15 Sanitary Workers is employed at the Ghats throughout the day to supervise the collection of waste as well as to ensure that the pilgrims do not soil the Ghats. Routine cleaning is undertaking in the early morning as usual on that day. However on the subsequent day, a special gang of Sanitary Workers (about 60) is deployed in about 10 groups to collect waste and clean up the Ghats. They collect and clear the waste in 'Takhlas' (metal containers) which are carried on their heads. The collected waste is brought up to the roads (since there is no vehicular access to the ghats situated at lower positions) from where handcarts are used to transport it to the nearest vehicles (trucks). This operation goes on almost for the entire day. It is important to note that there are no collection bins at the ghats, barring a few old masonary structures, which are also not in use. Provision of appropriate bins may facilitate the task of cleaning the ghats.

- An important regulation has been passed banning plastics within 200 m distance from the ghats. This has been implemented recently in April, 2010. The relevant hoardings have been put up at all the Ghats highlighting this ban

- **Transportation of Waste:** Presently HNNP has 6 vehicles for transportation of MSW. Details of the trips undertaken by the vehicles on a daily basis are provided below:

Table (2.5): TRANSPORTATION OF MSW : PRESENT STATUS

SL.NO	VEHICLE	NOS.	TOTAL NO. OF TRIPS/DAY	Aug. Quantity per trip (Ton)	Approx. Quantity Transported Per day
1	Trucks	1	3	3	9
2	Tractor Trolleys	3	12	.75	9
3	Dumper Placers	2	10	1.5	15
				TOTAL	**33**

Source: HNNP

- The transportation of the MSW from the containers to the dumping site is undertaken with the help of 2 Dumper Placers, 1 truck and 3 tractor trolleys. The drivers of the transport vehicles as well as the transport staff are employed by HNNP. There is no in-house maintenance workshop for the vehicles and breakdowns are quite common & frequent. An average of 3-4 trips is undertaken by each vehicle for transporting the MSW.

  The above vehicle movement data indicates that approx. 33 TPD of waste are cleared on a daily basis – translating into a collection efficiency of over 75%. However, on-site observations seem to indicate that no more than 28 – 30 TPD are lifted every day. (Collection efficiency of approx. 70%)

Figure (2.8): MSW Transportation Vehicles

- **Disposal:** There is currently no treatment of waste collected. The MSW is dumped at a site which is located near the Idgah, close to the road leading to Bhopal. Although HNPP claims that 35-40 MT of MSW is collected and transported to the dumping site, where uncontrolled dumping take

place. The site measuring about 8 acres is strewn with plastics dumped all around the place. The maximum distance of the Idgah dumping site from any ward is 4km.

Fig. (2.9): MSW Disposal Site at Idgah

Squatters have built-up hutments at the site over the last few years. Surprisingly, not many rag–pickers or waste-collectors are in operation in the town. This is probably due to the fact that the avenues for extracting the commercial value for the recyclables such as plastics, paper and metals are limited.

- A new Site for disposal of MSW has been allotted to HNPP jointly with Itarsi ULB. The site, measuring about 14 acres, is located, at village Baikhedi on Harda Road about 19 kms from the city. The site is proposed to be developed as a common disposal site for the towns of Hoshangabad and Itarsi. The distance of the site from Itarsi is about 8 km. HNPP has budgeted about Rs. 50 Lakhs from the TFC funds for developing the site and for the facilities such as upgradation of the approach road, Fencing, Trenching, construction of residence for security personnel, tubewell etc. However the exact role and nature of participation from the Itarsi ULB is not very clear at the moment.

- **Institutional Set-up:** The organizational chart of the HNPP staff engaged in providing SWM services is as follows.

  Of the about 120 odd municipal staff on the rolls of HNPP, about 80 (63 sweepers and 15 supervisory staff) are directly, related to the SWM operation. In addition to the regular staff deployed for the SWM function, about 190 odd temporary staff is hired to provide the MSW collection & transportation services, as there is a ban on recruitment of new municipal staff. On the special occasions such as Amavasya and Poornima, when the number of pilgrims visiting the city to take a holy bath in the Narmada River at one of the seven major Ghats, goes up to 1 lakh and above, additional manpower is deployed for providing SWM services.

  As per the CPCB guidelines the recommended ratio of sanitary staff per thousand of population should be 2.1 for a city of the size of Hoshangabad. The present ratio in Hoshangabad (1.87 per 1000 population) is lower than the suggested norms.

TABLE (2.6): DETAILS OF STAFFING FOR PUBLIC HEALTH AND CONSERVANCY – HNPP			
S.No.	**Head**	**As per CHPHEEO Norms**	**Hoshangabad Status**
1.	Number of Sanitary Sweepers/Workers (Regular + Temporary)	250 to 375	213
2.	Sanitary Supervisors (Or Jamadar)	10	12
3.	Sanitary Sub –Inspector or Safai Daroga	5	2
4.	Sanitary Inspector	2 to 3	1
5.	Sanitation Officer	1	---
6.	Public Health/Env. Engineer Incharge (SWM)	1	1

- **Future Plans of HNNP for Improving SWM**: HNNP would like to use the new disposal site at Baikhedi only for disposing the inert waste from the town, given the long distance and the poor quality of the approach road. The ULB has plans to put a Vermi compost plant at the existing Idgah site, after cleaning it up. HNNP also proposes to implement a plastic bailing project to utilize the existing inventory of plastics at the Idgah site.

- **Financial Status of HNPP**

  A summary of receipts and expenditures of HNPP is provided at **Table 2.7.** The budget for 2008-09 indicates that the expenditure under the category Public Health & Services is Rs. 4.03 crores. A separate budget-line for SWM services is not provided. However, discussions with HNNP revealed the following figures for operational expenditure for solid waste management services in 2009-2010:

Table (2.7): Current operation and maintenance expenditures

S. No	Details	Amount (in Rs. '000s)
	SWM Permanent Staff	6270
	SWM Temporary Staff	5490
	Drain cleaning Staff	3140
	Fuel (80% of total)	1600
	Repairs	300
	Consumables	50
	TOTAL	**16850**

Source: HNNP

Thus, HNNP's operational expenditure in providing SWM services in 2009-10 was approx. Rs. 16.8 million. Assuming that 30 TPD of waste is collected on a daily basis (365 operational days per annum), this translates into an operational cost of Rs.1540 per ton for only collection and transportation services.

Table (2.8): HNNP Receipts and Expenditure (INR)

							Revised Budget	Sanctioned Budget	Estimated Budget
Head	**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**2006-07**	**2007-08**	**2007-08**	**2008-09**
Receipts									
Municipal Tax	*21,811,234*	*16,043,536*	*15,757,590*	*18,849,666*	*17,354,435*	*36,996,274*	*31,295,048*	*43,430,500*	*49,488,500*
Receipts under special Act	24,711	51,910	40,863	41,413	74,658	83,090	22,377	90,000	50,000
Revenue from sources other than property tax (license fees, rent for municipal buildings, markets)	*10,817,401*	*10,259,175*	*11,728,678*	*11,912,328*	*8,436,543*	*15,403,154*	*25,961,805*	*35,836,500*	*37,760,800*
Government Grants and Contribution (General and Special Purpose)	1,787,614	12,153,330	20,088,000	20,313,286	26,333,220	24,959,548	43,856,200	106,000,000	150,800,000
Water tax	*2,434,180*	*2,327,315*	*1,856,528*	*2,347,402*	*2,299,280*	*2,236,330*	*2,537,700*	*5,240,000*	*5,390,000*
Electricity/ Street Lights	15,600	9,450	36,900	392,464	152,047	175,090	195,720	500,000	500,000
Miscellaneous	1,070,707	373,175	302,937	457,113	972,866	825,686	2,052,197	1,125,000	2,480,000
Exceptional expenditure and Loans	1,211,530	1,057,429	2,039,255	1,215,631	2,869,086	1,301,769	8,042,000	1,300,000	9,000,000
Total	**39,172,977**	**42,275,320**	**51,850,751**	**55,529,303**	**58,492,135**	**81,980,941**	**113,963,047**	**193,522,000**	**255,469,300**
Brought Forward	868,568	1,334,680	1,481,530	3,908,181	5,315,100	6,914,211	6,905,686	10,173,400	22,777,000
Grand Total	**40,041,545**	**43,610,000**	**53,332,281**	**59,437,484**	**63,807,235**	**88,895,152**	**120,868,733**	**203,695,400**	**278,246,300**
Expenditure									
General Administration and Establishment	*5,569,228*	*6,285,698*	*5,745,170*	*6,703,389*	*8,271,740*	*9,335,360*	*10,564,180*	*11,176,000*	*14,863,500*
Social Security	4,360,027	6,904,911	6,182,954	5,408,928	5,945,129	8,989,499	10,111,040	16,972,300	20,089,200
Public Health and Services	*13,027,691*	*14,276,280*	*14,341,894*	*15,326,569*	*21,004,912*	*24,879,551*	*25,212,627*	*37,116,100*	*40,339,800*

Public Works	6,298,978	9,510,127	16,830,476	18,178,911	14,144,583	32,199,748	46,688,607	109,776,400	155,056,500
Education	627,486	591,511	570,469	578,781	732,202	680,952	650,700	755,500	1,100,900
Contribution and Grants									
Electricity				33,606		0	20,000	70,000	50,000
Miscellaneous	2,018,558	3,110,007	3,718,321	4,958,820	2,934,029	3,342,750	3,718,325	10,900,000	10,076,000
Special Expenditure and loans	6,804,897	1,449,936	2,034,816	2,521,580	3,860,429	2,561,606	4,396,107	6,951,600	13,820,000
Total	**38,706,865**	**42,128,470**	**49,424,100**	**53,710,584**	**56,893,024**	**81,989,466**	**101,361,586**	**193,717,900**	**255,395,900**
Balance (to be carried forward)	1,334,680	1,481,530	3,908,181	5,315,100	6,914,211	6,905,686	19,507,147	10,227,500	22,850,400
Grand Total	**40,041,545**	**43,610,000**	**53,332,281**	**59,025,684**	**63,807,235**	**88,895,152**	**120,868,733**	**203,945,400**	**278,246,300**
- (Property tax and Unified Tax)									
Revenue from own sources	35,062,815	28,630,026	29,342,796	33,109,396	28,090,258	54,635,758	59,794,553	84,507,000	92,639,300
Source: Hoshangabad Nagar Palika Parishad									

SWM Performance Indicators

1. Household Coverage: The Household coverage of SWM services in terms of percentage of Household covered the door-to-door collection is less than 4%. It is being done experimentally in two-three wards by external agencies i.e. Lions Club & Sindhi Panchayat.

2. Efficiency of collection of MSW: The efficiency of MSW collection in the city is estimated at about 70% with about 28 - 30 Tons of MSW being collected per day on an average, out of 42 tons of waste generated.

3. Extent of Segregation of MSW: The value for this indicator is nil as there virtually no segregation of MSW at the households, primary collection or secondary collection stage.

4. Extent of MSW recovered: The extent of MSW recovered is also nil as there is no processing operation in the SWM chain.

5. Extent of Scientific disposal of MSW: There is no scientific disposal of MSW in the city and only unscientific open dumping resorted to.

6. Extent of Cost recovery of SWM Services: The extent of cost recovery is almost negligible as there are no direct fees being collected by HNPP for SWM services. In a few wards, the door-to-door collection is being operationalised, the door-to-door collection fees are being collected by the agencies involved in the operation.

7. Efficiency Redressal of Customer Complaints: According to HNPP over 80% of complaints related to SWM services are redressed within 48 hours.

8. Staff per 1000 Population: The present indicators of Sanitary Staff per Thousand population in Hoshangabad is 0.64. If we include the contractual staff assuming they are all involved in the SWM activity, the value goes upto to 1.70, which is still lower than the CPCB norm of 2.1 SWM Staff per Thousand of population. The HNPP is thus understaffed if the compliance with the MSW management rules is the overall objective.

9. Cost per tonne of MSW: The exact breakup of the Municipal Costs for SWM operations is not available. However based on the discussions with the HNPP officials and the ballpark cost figures arrived at from the Budget indicate that approx. Rs. 1.7 crores is spent on SWM operations per annum. This translates into a figure of Rs. 1540 per ton of MSW handled (based on 30 TPD and 365 working days). In the existing scenario, with virtually very little compliance with the MSW management rules, this cost is on the higher side for a small city like Hoshangabad.

The overall performance of SWM services vis-à-vis the norm is presented in the table below:

Table (2.9): Current status of SWM services

Indicator	**Norm**	**HNNP**
Door to Door Collection	100%	Nil
Extent of Segregation of MSW	100%	Nil
Road Length per Sweeper	400 –600 m	461
Sweepers per 1000 population	3	1.87
Adequacy of Secondary Collection / storage System	100%	100%
Waste Collection Performance	100%	70%
Extent of Processing of MSW	100%	Nil
Extent of Scientific Disposal of MSW	100%	Nil

IDENTIFIED GAPS

- There is no integrated collection, transportation, treatment and disposal system for MSW in the town.
- The door to door collection system and MSW segregation is virtually non –existent in the city, although some preliminary efforts have been made in this regard.
- In spite of more than sufficient storage capacity, dumping of MSW in open spaces, roads, pavements as well as in the drains is a common practice – affecting the drainage system & the overall sanitation adversely.
- Lack of treatment, or processing facility.
- No means of safe disposal.

Fig (2.11): MSW collected at Ghats

- Even the plans being prepared by the HNPP for the MSW management in the town would not ensure a high degree of compliance with the MSWM rules, 2000.
- The new disposal site could be developed as a pilot for demonstrating a cluster approach in SWM at the State level. A comprehensive integrated plan for treatment and disposal of MSW for the 2 cities needs to be developed.

CHAPTER 3: CITY-WIDE SANITATION

This chapter describes city-wide sanitation options that feasible for Hoshangabad. For each option, a detailed infrastructure gap analysis has been presented. This is followed by indicative estimates of capital and operation and maintenance expenditure for each option. Indicative user charges to ensure efficient and sustainable service delivery have also been estimated. Last section presents a comparative analysis of household and public investments.

3.1 Aim and Vision for Hoshangabad

Sanitation is the means of collecting and disposing of excreta and community liquid wastes in a hygienic way so as not to endanger the health of individuals and community (WHO, 1987). Elledge (2002) defines sanitation as 'including the facilities and hygienic principles and practices related to the safe collection, removal, or disposal of human excreta'.

Environmental Sanitation includes aspects of excreta and wastewater disposal, together with wider environmental factors that impact on health, such as community water supplies, refuse collection and disposal, disease vectors, housing, food supplies and handling, atmospheric conditions and working conditions (WHO, 1987)

The National Urban Sanitation Policy (2008) defines **sanitation** as *safe management of human excreta, including its safe confinement treatment, disposal and associated hygiene-related practices.* The policy, though pertains *to management of human excreta and associated public health and environmental impacts,* recognises that integral solutions need to take account of other elements of environmental sanitation, i.e. solid waste management; generation of industrial and other specialized / hazardous wastes; drainage; as also the management of drinking water sup

In keeping with above mentioned definition of sanitation, the city-wide sanitation for Hoshangabad town shall aim at ensuring:

- *Access to improved sanitation facilities to its resident (including poor and slum dwellers) as well as visiting population*
- *Adequate infrastructure to ensure safe collection, treatment and disposal of human excreta and community liquid wastes*
- *Adequate infrastructure to ensure safe collection, treatment and disposal of municipal solid waste*
- *Institutional mechanisms to be able to manage and provide uninterrupted services on sustainable basis, and*
- *Adequate cost recovery to ensure self financing the operations*

Detailed infrastructure requirements to achieve this vision of environmental sanitation are categorised into two- 1) infrastructure for human excreta and liquid waste management, and 2) infrastructure and management systems for municipal solid waste management

3.2 City-wide Sanitation: Infrastructure Components for Human excreta and liquid waste management

The infrastructure required for city-wide sanitation broadly comprises of four components:

a) Improved Sanitation facilities for
   i. resident population including the poor and slum populations
   ii. floating population
b) Wastewater conveyance
c) Wastewater treatment;
d) Disposal/ reuse/ recycling of treated wastewater

Although these components appear distinct, there is an interdependence; especially, in the context of holistic and city-wide sanitation. It is important to consider all the components together to maximise the benefits.

3.3 CSP: Implementation Period, population coverage, norms and unit costs

Implementation Period

It is proposed to complete the implementation of gap infrastructure within five years. 2009 has been considered a base year and 2010 as CSP implementation beginning year. Thus, the CSP implementation can be expected to be completed by 2014.

Population Projection

During 1991 – 2001 decade, the population of Hoshangabad increased at a decennial growth rate of 37.4 percent. This translates into an annual growth rate of 3.74 percent. In absolute terms the population grew from 70,914 persons in 1991 to 97,424 persons in 2001. The 2001 census registered a total of 17,424 households. Thus, the average household size was 5.59 persons.

Table (3.1): Population Growth (1961-2001)

No.	Year	Population	Decennial Growth (percentage)	Remark
1	1991	70,914		
2	2001	97,424	37.4%	
3	2009	130,669		Base Year
4	2010	135,553	37.4%*	CSP START year
5	2014	156,986	37.4%*	CSP completion year

Notes:
* - Growth rate adopted for 2010 and 2015 population projection has been assumed to be the same as in 1991-2001 decade.
Source: Census of India

The population of Hoshangabad in 2010 is estimated at 135,553 persons as presented in Table (3.1) above. The population for 2010 is extrapolated based on growth rate in previous decade. Considering

same household size of about 5.59 persons, there would be about 24,243 households at the beginning of CSP implementation in 2010. For the analysis of options, a year preceding implementation 'START' is considered as a base year. Over the CSP implementation period, the population is estimated to increase by 21,433 to reach a total of 156,986 persons. During the CSP implementation period, about 3,835 households are estimated to be added to the town each year. Infrastructure gap analysis considers this addition.

Thus, estimated infrastructure gap includes:

- un-served population at beginning of CSP implementation, and
- incremental population added during the CSP implementation

Norms and Specifications

In order to estimate the gaps in infrastructure, it would necessary to define certain level of service and/or norm. Base service norms, specifications and assumptions used for infrastructure gap analysis are presented in Table (3.2) below.

Table (3.2): Base Norms, Specifications and Assumptions

No.	Component	Norm
		Unit
	Household sanitation infrastructure	
1	*Latrine connected to septic tank*	*1 per household*
2	*Grit and grease trap*	*1 per household*
B	**Public and Community Sanitary Conveniences**	
	Public Toilet	
1	*Users per Latrine Seat*	*60 users/ seat*
	Community Toilet	
2	*Users per Latrine Seat*	*35 users/ seat*
C	**Septage Clearance, Treatment and Disposal**	
1	*No of septic tanks cleared per vehicle per day*	*3 tanks per day per vehicle*
2	*Frequency of septage clearance from septic tank*	Once in 2 years
3	*Septage volume removed per tank*	*2 cum*
4	*No of operational days per annum*	*300 days*
	Sludge Drying Beds	
5	*Area per drying bed(average)*	*225 m*
6	*Dimensions of drying bed*	*15m x 15 m*
8	*Thickness of liquid sludge layer in drying bed*	*0.20 m*
9	*Septage Sludge Drying Cycle*	*10 days*
10	*Sludge volume per bed*	*45 cum*
D	**Wastewater Conveyance**	
1	*Street Collector Sewers*	*1.50 m / household*
2	*Branch Sewers*	*0.75 m / household*
3	*Trunk Sewers*	*0.40m /household*
E	**Waste Water Treatment and Disposal**	
1	*Reuse for irrigation/ garden/ parks*	*Tertiary*
2	*Disposal into river*	*secondary*

Source: Hoshangabad CSP Analysis, 2010

Estimation of infrastructure gaps needed to holistically sanitise the town is followed by estimation of indicative capital investment requirements. In order to estimate the capital investment requirements, unit costs for each infrastructure component were computed. The costs computations are based on

information collected from various infrastructure projects implemented in Indian cities over 1998-2006. These costs were then extrapolated for 2009 prices. Unit cost of various infrastructure component upgrading or new construction that is used for estimating financial requirements is presented in Table (3.3) below.

TABLE (3.3): CAPITAL AND OPERATION & MAINTENANCE COSTS OF SANITATION INFRASTRUCTURE

No.	Component	Capital Cost		Operation & Maintenance		
		Unit	Rate (Rs)	Unit	Rate (Rs)	Remarks
A	**Household Latrines**					
1	Upgrading other latrine to septic tank based	Rs/ unit	14,350			
2	WC Connected to Septic Tank	Rs/ unit	19,500			
3	WC Connected to Conventional Sewerage	Rs / unit	10,000			
4	Pit Latrine	Rs / unit	12,750			
5	Community Toilet Block / PSC	Rs / seat	39,900	Rs/ Seat/ Year	9,000	
	Cost per seat per household	*Rs / seat/ HH*	*5,700*			
6	Public Sanitary Convenience (PSC)			Rs/ Seat/ Year	11,250	
7	Constructing Soak pit for existing WC with Septic Tank	No	1,500			
8	WC Connected to Septic Tank with Soak pit	No	21,000			
9	Connecting Septic/ Interceptor tank effluent to small bore sewer	No	3,000			
10	WC Connected to Interceptor tank --> Small bore sewerage	No	16,000			
11	Upgrading Pit latrine to WC Connected to Conventional Sewer	No	4,000			
12	Upgrading Other Latrines to WC connected to Conventional Sewer	No	7,500			
13	Upgrading Other Latrines to WC with Septic tank with small bore sewerage	No	17,350			
14	Upgrading Other Latrines to WC connected to Septic tank with Soak pit	No	15,850			
15	Upgrading WC with Septic tank to WC Connected to Conventional Sewer	No	4,000			
B	**Septage Clearance and Treatment**					
1	Vacuum Trucks	Rs/vehicle	800,000	Rs/vehicle/ year	462,000	
2	Septage Sludge Drying Beds	Sqm	2,000	Rs/sqm /year	1,000	
3	Land	Hect				
4	Office and ancillary units	LS	1,500,000	Rs/ year	60,000	4% of Capital
5	Septic Tank Clearance charge			Rs/ HH	1,200	
6	Septic tank clearance (O&M cost)			Rs/ tank	560	
C	**Conventional Sewerage**					
1	Street collector sewer (generally 150 - 300 mm dia)	Rs/m	600	Rs/m/year	48	8% of Capital
2	Branch Sewer (400 mm to 800 mm)	Rs/m	1,400	Rs/m/year	112	8% of Capital
3	Trunk Sewer (800+ mm)	Rs/m	3,000	Rs/m/year	240	8% of Capital
D	**Small Bore Sewerage**					
1	Street collector sewer (generally 100 - 250 mm dia)	Rs/m	300	Rs/m/year	15	5% of capital
2	Branch Sewer (300 mm to 500 mm)	Rs/m	700	Rs/m/year	35	5% of capital

TABLE (3.3): CAPITAL AND OPERATION & MAINTENANCE COSTS OF SANITATION INFRASTRUCTURE

No.	Component	Capital Cost		Operation & Maintenance		
		Unit	Rate (Rs)	Unit	Rate (Rs)	Remarks
3	Trunk Sewer (500+ mm)	Rs/m	1,500	Rs/m/year	75	5% of capital
E	**Simplified Sewerage**					
1	Street collector sewer (generally 100 - 250 mm dia)	Rs/m	300	Rs/m/year	15	5% of capital
2	Branch Sewer (300 mm to 500 mm)	Rs/m	700	Rs/m/year	35	5% of capital
F	**Wastewater Treatment***					
1	Primary Treatment	Rs/mld	3,038,750	Rs/mld/year	364,650	12% of capital
2	Secondary Treatment	Rs/mld	8,206,000	Rs/mld/year	984,720	12% of capital
3	Tertiary Treatment	Rs/mld	18,937,154	Rs/mld/year	2,272,458	12% of capital
4	Decentralised Wastewater Treatment	Rs/mld	16,412,000	Rs/mld/year	328,240	2% of capital

Notes:

1. The costs of infrastructure (except wastewater treatment) are based on information collected from various infrastructure projects implemented in Indian cities over 1998-2006. These costs were then extrapolated for 2009 prices.

* - The wastewater treatment costs are based on CDM (2005) report for Hyderabad Metro Water Supply and Sewerage Board (HMWSSB)

Source: Hoshangabad CSP Analysis, 2010

3.4 City-wide Sanitation Options

Broadly five city-wide sanitation options can be thought of for Hoshangabad. These options along with possible household sanitation arrangements, wastewater conveyance, treatment and disposal are presented in Table (3.4) below.

Table (3.4): Possible City-wide Sanitation Options for Hoshangabad

Sanitation Option	Household sanitation Arrangement	Human Excreta/ community liquid waste	
		Conveyance and Treatment	Disposal
Fully on-site	• Domestic wastewater connected to septic tank or soak pit • Latrine connected to septic tank with soakaways • Pit latrines	Septage clearance and treatment (possibly consisting of a set of sludge drying beds)	Disposal of dried sludge cakes for fertiliser or landfill
Settled (small bore) sewerage	• All Domestic wastewater (including, kitchen, bathing and latrines) connected to septic tank/ interceptor tank • Pit latrines	• Small bore sewerage network • Secondary wastewater treatment • Septage clearance • Septage treatment at wastewater treatment plant	• Treated wastewater disposed in river or used for irrigation • Sludge disposed after treatment (disposal of dried sludge cakes for fertiliser or landfill)
Part on-site, part off-site	• Domestic wastewater connected to septic tank or sewerage • Latrine connected to septic tank with soakaways • Pit latrines • Latrines connected to sewerage network	• Secondary wastewater treatment • Septage clearance • Septage treatment at wastewater treatment plant	• Treated wastewater disposed in river or used for irrigation • Sludge disposed after treatment (disposal of dried sludge cakes for fertiliser or landfill)
Simplified sewerage	• All Domestic wastewater	• Simplified sewerage	• Treated wastewater

Table (3.4): Possible City-wide Sanitation Options for Hoshangabad			
Sanitation Option	**Household sanitation Arrangement**	**Human Excreta/ community liquid waste**	
		Conveyance and Treatment	**Disposal**
with decentralised wastewater treatment	(including kitchen, bathing and latrines) connected to sewerage network	network • Decentralised wastewater treatment plants	disposed in river or used for irrigation or used for watering parks
Mixed System	• Depending upon local area sanitation arrangements	• A mix of conventional sewerage, simplified or small bore sewerage • Septage treatment • Centralised and decentralised wastewater treatment	• Treated wastewater disposed in river or used for irrigation or used for watering parks, depending on level of treatment • Sludge disposed after treatment (disposal of dried sludge cakes for fertiliser or landfill)
Source: Hoshangabad CSP Analysis, 2010			

The decision on the final city-wide sanitation option can be tricky and hence the final choice should be well informed. At the basic minimum, the final choice must be economically viable, financially affordable (both capital and operating costs), environmentally reliable and sustainable in the long run.

A detailed table showing applicable sanitation component within each of the above option is presented in Table (3.5) below.

TABLE (3.5): SANITATION COMPONENTS FOR VARIOUS CITY-WIDE SANITATION OPTIONS						
No.	**Sanitation Component**	**Sanitation Option**				
		Fully On-site Sanitation	**Settled Sewerage**	**Part on-site, Part off-site**	**Simplified sewerage with DEWATS***	**Mixed System**
A	**Household Sanitation**					
A1	**New Construction**					
1	WC Connected to Septic Tank	✓	✓	✓		
2	WC Connected to Conventional Sewerage			✓		
3	WC Connected to Septic Tank with Soakaway	✓	✓	✓		✓
4	WC Connected to Septic/ Interceptor Tank with Small bore sewerage		✓			✓
5	WC Connected to Simplified Sewerage				✓	✓
6	Twin Pit Latrine	✓	✓	✓	✓	✓
A2	**Upgrading**					
1	Constructing Soakaway for existing WC with Septic Tank	✓		✓		✓
2	Connecting Septic tank effluent to small bore sewer		✓			
3	Upgrading WC with Septic tank to WC Connected to Conventional Sewer			✓		
4	Upgrading WC with Septic tank to WC Connected to Simplified Sewer				✓	✓
5	Upgrading Other Latrines to WC connected to Septic tank with Soak-away	✓		✓		✓
6	Upgrading Other Latrines to WC with Septic tank with small bore sewerage		✓			
7	Upgrading Other Latrines to WC connected to Conventional Sewer			✓		
8	Upgrading Other Latrines to WC connected to Simplified Sewer				✓	✓
9	Upgrading Pit Latrine to WC connected to			✓		

TABLE (3.5): SANITATION COMPONENTS FOR VARIOUS CITY-WIDE SANITATION OPTIONS						
No.	Sanitation Component	Sanitation Option				
		Fully On-site Sanitation	Settled Sewerage	Part on-site, Part off-site	Simplified sewerage with DEWATS*	Mixed System
	Conventional Sewer					
A3	**Improving Coverage for households lacking individual sanitation arrangements**					
1	WC connected to conventional sewerage			✓	✓	
2	WC connected to simplified sewerage				✓	✓
3	WC Connected to Interceptor tank --> Small bore sewerage		✓			
4	Pit Latrines built for households currently lacking sanitation facilities	✓	✓	✓	✓	✓
5	Households currently lacking sanitation facilities start using community toilet blocks	✓	✓	✓	✓	✓
B	**Community/ Public Sanitary Conveniences**					
1	Community Sanitary Conveniences (Community Toilet Blocks)	✓	✓	✓	✓	✓
2	Public Sanitary Conveniences (Public Toilet Blocks)	✓	✓	✓	✓	✓
C	**Wastewater/ Septage Conveyance**					
C1	**Wastewater Conveyance**					
1	Conventional Sewerage Network			✓		
2	Small Bore Sewerage Network					
3	Simplified Sewerage Network		✓			✓
C2	**Septage Clearance and Transport**	✓	✓			
D	**Liquid Waste treatment**					
1	Wastewater Treatment		✓	✓	✓	✓
2	Septage Treatment	✓				✓

Notes:
* - DEWATS – Decentralised Wastewater Treatment Systems
Source: Hoshangabad CSP Analysis, 2010

Across all the sanitation options listed above, the requirement of Community/ Public Sanitary conveniences remain similar. Their financial implications also remain same and hence, these are dealt separately after the discussion on city-wide sanitation options.

3.4.1 Fully On-site Sanitation: Septic tank with Soakaways or Pit latrines

System Description

As the name suggests, fully on-site sanitation arrangement will involve on-plot treatment and disposal of entire domestic wastewater. This is achieved by using on-plot sanitation technologies - septic tank and soak pits to receive and treat entire wastewater flow from the household. However, the septage (sludge from septic tanks) is removed and transferred to another location for further treatment and final disposal.

Under this option following household / public sanitation and wastewater treatment and disposal arrangements are made:

- Household sanitation arrangement
  - **Option 1- Septic Tank with soak-away**: entire domestic wastewater discharge resulting from bathing, washing, cooking, cleaning and latrine usage etc is treated in septic tank. The septic tank effluent is disposed in dispersion trenches or circular soak pits. Septage is periodically cleared and taken away to a common treatment facility.

    ***Note**: The design of septic tank and soak-away system should consider load of entire household wastewater. Existing septic tanks may not have been designed for this. In such case, it is advised*

that a team of engineers to undertake technical evaluation and determine septage clearance interval.

- **Option 2- Twin Soak pits**: wastewater from latrine is discharged into pit latrines. sullage domestic wastewater (resulting from bathing, washing, cooking, cleaning etc.) is also disposed into soak pits. To ensure uninterrupted and proper functioning, the system must have a set of two pits.

In both cases, it would be necessary to construct a small grit and grease trap before the wastewater (other than latrine wastewater) disposes into the septic tank or soak pit.

Existing household sanitation arrangements are upgraded in accordance with city-wide sanitation approach. These include:

- Construction of soak-away for existing WC with septic tank
- Upgrading Other Latrines to WC connected to septic tank with soak-away

- Public / Community Sanitary Conveniences: In case of public sanitary conveniences, a septic tank based on-site system with soak pit (for effluent disposal) can be considered.
- Septage (septic sludge) Management:
  Set-up efficient septage collection systems that can either be operated by the municipality or private agency. However, the municipality will have to institute appropriate regulation and monitoring mechanisms to ensure that – septic tanks are properly built, septage is cleared regularly and safely treated and disposed.
  Suggested septage treatment consists of septage drying beds consisting of sand filters for dewatering the sludge. This requires low capital and has low O&M and technical requirements; thus, it can be operated easily. The dried sludge cakes can be used as fertilisers[12].

This option, if implemented correctly, will ensure that the city drainage network will be used only for carrying rainwater run-off.

Infrastructure Gaps

Indicative investment requirements for this option can be analysed by estimating infrastructure requirement and funds required to bridge the gaps. The infrastructure requirements to achieve the goal of sanitation adopting 'fully on-site sanitation' approach are grouped separately for each component- household sanitation, public sanitation arrangements and septage management.

Household Sanitation Arrangements

At the household level, year-on-year change in sanitation arrangements is presented in Table (3.6) below.

Table (3.6): Indicative Change in Household Sanitation Arrangements over CSP Implementation Period

Sanitation Arrangement	*Baseline Survey*	*Pre-CSP Year (Starting Reference)*	CSP Implementation Period				
	2008	***2009***	**2010**	**2011**	**2012**	**2013**	**2014**
WC Connected to Septic Tank	*11,452*	17,250	14,237	8,882	3,788	880	
WC Connected to Septic Tanks with Soak-pits		0	3,498	9,393	15,089	18,672	20,310
Pit Latrine	*1,688*	2,543	3,109	4,371	5,888	7,071	7,697
Other Latrines	*64*	96	48	18	4		
Community Toilet User Households		0	783	624	382	177	73
Households practicing Open Defecation	*2,311*	3,481	2,568	1,861	941	269	
Total Households	***15,515****	**23,370**	**24,243**	**25,149**	**26,092**	**27,069**	**28,080**

[12] The dried sludge shall be tested for suitability as fertilizer.

Notes:
* - Baseline survey covered only 15,515 households.
1. For household projection, refer earlier section on population projections.
Source: Hoshangabad CSP Analysis, 2010

In order to achieve this change, the three categories of households – 1) new construction, 2) households where sanitation arrangements requires upgradation, and 3) households currently lacking access to sanitation facilities – will have to either construct new facility or upgrade their existing sanitation facilities. Household category-wise details of upgrading/ new construction of household sanitation arrangements are presented in Table (3.7) below.

Table (3.7): Indicative Infrastructure Requirements: Household Sanitation

Household Category and Infrastructure Requirement	Proportion of households		No of households					
	Start	Completion	CSP Implementation Period					Total
	2010	2014	2010	2011	2012	2013	2014	
New Construction			*873*	*906*	*942*	*976*	*1011*	*4708*
WC Connected to Septic Tank*	50%	0%	437	340	235	122	0	1134
WC Connected to Septic Tank with Soak-pits	0%	75%	0	170	353	549	758	1830
Pit Latrine	25%	20%	218	215	212	207	202	1054
Community Toilet user households	10%	5%	87	79	71	61	51	349
Households practicing Open Defecation	15%	0%	131	102	71	37	0	341
Upgrading existing sanitation arrangements			*3,498*	*5,725*	*5,343*	*3,034*	*880*	
Constructing Soak pits for existing WC with Septic Tank	20%	100%	3,450	5,695	5,329	3,030	880	18,384
Upgrading Other Latrines to WC connected to Septic tank with Soak pits	50%	100%	48	30	14	4	0	96
Households lacking access to sanitation facilities								
Pit Latrines built for households currently lacking sanitation facilities	10%	95%	348	1047	1305	976	424	4,100
Households currently lacking sanitation facilities start using community toilet blocks	20%	5%	696	545	311	116	22	
Households continuing to practice open defecation	70%	0%	2437	1759	870	232	0	

Notes:
* - It is assumed that in the initially, due to lack of awareness on rules, some households may construct septic tanks without soak-pits.
- Some of the community toilet user households will gradually switch over to using individual household latrines.
Source: Hoshangabad CSP Analysis, 2010

Septage Management (including treatment)

Under fully on-site sanitation approach, no separate wastewater treatment facility will be necessary as all the wastewater will be disposed on-site. Only the septage (septic sludge) will have to be safely removed for further treatment and final disposal. As mentioned earlier (in Norms, specifications, Assumptions and Unit Costs), septage clearance frequency is assumed to be once in 2 years and volume decanted per clearance is considered to be about 2 cubic meter (Cum). Further it is assumed that each vehicle will clear 3 tanks per day and the vehicle will operate for 300 days per year [13]

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[13] The assumption is made considering that the Hoshangabad Nagar Palika will engage private service providers as well and that the services will be available to the household even on some of the holidays considering user convenience.

In order to provide uninterrupted service to the nearly 20,665 households that will be using septic tanks, about 11 trucks will be required, which would have to be operated for about 300 days every year to service all the households.

Table (3.8) Computations: Septic Tanks cleared, septage volume and sludge drying beds	
Septage clearance vehicles	• As discussed above, a total of 11 (***eleven***) septage clearance vehicles will be needed. The HNPP already has one septage clearance vehicle • To efficiently manage septage clearance, 10 (***ten***) additional vehicles will have to be purchased • *Out of this, 9 (**nine**) vehicles will be purchased in year-1, whereas 10th (**tenth**) vehicle can be purchased in year-4.*
Tanks cleared per year	$No\ of\ septic\ tanks\ cleared\ per\ year = 11\ trucks \times 3\ tanks \times 300\ days$ $No\ of\ septic\ tanks\ cleared\ per\ year = \mathbf{9,900}$
Daily septage volume	$Daily\ septage\ volume = 11\ trucks \times 3\ tanks \times 2\ cum/day$ $Daily\ septage\ volume = \mathbf{66\ m^3}$
Septage drying bed	$Single\ Drying\ bed\ area = 12 \times 12m$ $Single\ Drying\ bed\ area = 120\ m^2$ $Max.Septage\ depth = 0.30\ m = 30\ cm = 300\ mm$ $Capacity\ per\ bed = 36\ m^3$ $Daily\ requirement\ of\ beds\ (Nos) = 66\ m^3/36\ m^3$ $Daily\ requirement\ of\ beds\ (Nos) = 2$ • Considering a drying cycle of 10 days, a total of 20 drying beds are suggested
Indicative Site Area	$Total\ Site\ Area = SD\ bed\ area + 10\%\ of\ SD\ bed\ area + area\ for\ office\ and\ dried\ sludge\ storage + area\ for\ ancilliary\ units$ $Total\ Site\ Area = (2{,}880 + 288 + 5{,}000 + 2{,}250)\ m^2$ $Total\ Site\ Area = 10{,}418m^2$
Source: Hoshangabad CSP Analysis, 2010	

The septage is proposed to be converted to sun-dried sludge cakes by dewatering on sand filter beds. Land requirement of about 10,500 m^2 (1.05 Hectare) has been estimated. Over most of the year, the septage drying time is expected to be about 7 days; however, an average of 10 days are considered to accommodate longer drying periods during rainy season. A total of 20 drying beds are proposed, considering longer drying time in wet season. The sludge drying beds could possibly be located at the Solid Waste processing site.

Indicative Investment Requirements

Indicative investment requirements to construct the infrastructure are estimated based on the unit costs and estimated infrastructure quantities. These are presented in Table (3.8) below. Indicative estimates suggest that, over the CSP implementation period, households will have to invest about **Rs 155 million**. A little less than half of this investment will be for new construction of sanitation facilities. Households already having access to individual sanitation facilities will have to invest about Rs 29 million in upgrading. In order to increase coverage, more than Rs 52 million will be needed. Most of these households will be urban poor, needing financial assistance (in the form of either subsidy or soft loan).

Septage clearance equipment and construction of treatment facility is estimated to cost about Rs 15.84 million. This is excluding the cost of land required for septage treatment facility.

TABLE (3.9): COMPONENT-WISE INDICATIVE INVESTMENT REQUIREMENTS, O&M COSTS AND USER CHARGES

No.	Component	Unit	Year Wise Costs					
			2010	2011	2012	2013	2014	*Total*
A.	**Households**		24,243	25,149	26,089	27,065	28,076	
B.	**Household Sanitation Arrangements**							
i.	New Construction	Rs in Mn	11.30	12.94	14.70	16.55	18.49	**73.98**
ii.	Upgrading of existing facilities	Rs in Mn	5.94	9.02	8.22	4.61	1.32	**29.10**
iii.	Increasing coverage for un-served households	Rs in Mn	4.44	13.35	16.64	12.44	5.41	**52.28**
	Total Household Investment	**Rs in Mn**	21.67	35.31	39.55	33.60	25.22	**155.35**
C.	**Septage Clearance and Treatment**							
i.	*Septic tank user households*	*Nos*	*17,735*	*18,275*	*18,877*	*19,552*	*20,310*	
ii.	*Septic tanks cleared*	*Tanks/year*	8,868	9,138	9,439	9,776	10,155	
iii.	Septage Clearance Equipment	Rs in Mn	7.20			0.80		*8.00*
iv.	Construction of septage treatment facility	Rs in Mn	7.84					*6.45*
	Total Capital Investment	***Rs in Mn***	***15.04***			***0.80***		***15.84***
v.	Annual O&M of septage clearance equipment	Rs in Mn	4.92	4.92	4.92	5.41	5.41	
vi.	Annual O&M of septage treatment facility	Rs in Mn	0.47	0.47	0.47	0.47	0.47	
	Annual O&M Expenditure	*Rs in Mn*	*5.39*	*5.39*	*5.39*	*5.88*	*5.88*	
	Indicative Septic tank clearance charge	*Rs/ tank*	***608***	***590***	***571***	***602***	***579***	

Note:
1. In case of Septage Treatment Facility and Wastewater Treatment Facility, O&M expenditure starts only after construction is completed

Source: Hoshangabad CSP Analysis, 2010

Annual O&M cost of septage clearance equipment and treatment facility is expected to be about Rs 5.88 million in year 5 (fully functional and effectively operated system). This can be met from user charges levied at the rate of Rs 600 per tank.

Key benefits and challenges of 'fully on-site sanitation' approach for Hoshangabad are presented in Table (3.10).

Table (3.10): Fully On-site Sanitation: Benefits and Challenges	
Benefits	**Challenges**
• Low public investment (less demanding on public resources) • Can be easily set-up • Will not lead to wastage of the private investment already made in septic tank construction • Citywide sanitation can be achieved faster	• Risk of groundwater pollution will have to be evaluated as the HNPP draws groundwater for municipal water supply • Finding place for constructing soak pits in all households will be a challenge • HNPP will need to institute septage management system[14] • New rules and regulations[15] relating to septage management will have to be introduced
Source: Hoshangabad CSP Analysis, 2010	

3.4.2 Settled (Small bore) Sewerage: Septic/interceptor tank connected to small bore sewerage network

System Description

In this option, the internal wastewater plumbing is modified to divert all household liquid wastes (including bathing, washing, cooking and latrine waste) and disposed in an on-plot septic tank or interceptor tank. Households constructing new individual sanitation facilities should be encouraged to construct interceptor tanks[16]. Some households could continue to use pit latrines. In both cases, it would be necessary to install/construct a small grit and grease trap before the wastewater (other than latrine wastewater) disposes into the septic tank or soak pit. The septage (sludge from septic or interceptor tanks)) is removed for further treatment and final disposal.

A small diameter sewer pipe is laid at flatter gradient (see CPHEEO Manual on sewerage and sewage treatment for more details) to carry the effluent from septic tanks. Since the sewer pipes do not carry solids, flatter gradient and smaller diameter are sufficient. Flatter gradient also saves from deeper excavations; hence substantial cost reduction.

Under this option following household / public sanitation and wastewater treatment and disposal arrangements will be possible:

[14] This shall broadly include maintaining a record of all households/ institutions using septic tanks, dates of last septage clearance, issuance of notice for timely clearance and periodic inspections. The system shall also include technical clearance of septic tank designs and inspection during construction for new properties coming up in the town.

[15] Current septage clearance practice is to respond to a call from property owner. This will have to change to proactive septage clearance system to be put in place and practiced. Also, HNPP will need to decide on septage clearance service charges.

[16] Interceptor tank is similar to septic tank, however with a single chamber and lesser hydraulic retention time (hence smaller size). Reference literature –

- Reed, R. A. (1995). *Sustainable sewerage. Guidelines for community schemes*. Intermediate Technology Publications in association with Water, Engineering Development Centre, London

- Household sanitation arrangement

  - **Option 1- Septic/ Interceptor Tank connected to small bore sewerage network**: All domestic wastewater discharge resulting from bathing, washing, cooking, cleaning and latrine usage etc. is partially treated in septic tank/ interceptor tank. The septic tank/ interceptor tank effluent is disposed into small bore sewerage network for further treatment and final disposal. Septage is periodically cleared and taken away to a common treatment facility.
  - **Option 2- Twin Pit Latrine**: wastewater from latrine is disposed into soak pits. Other domestic wastewater (resulting from bathing, washing, cooking, cleaning etc.) is also disposed into soak pits. A minimum of two pits will be necessary to ensure proper, uninterrupted functioning of the system.

  In both cases, a grit and grease trap is constructed before the wastewater (other than latrine wastewater) disposes into the septic tank or soak pit.

- Public / Community Sanitary Conveniences: In case of public sanitary conveniences, a septic / interceptor tank based on-site system is constructed. Septic/ interceptor tank effluent is disposed into small bore sewerage network for further treatment and final disposal.
- Septage (septic sludge) Management:
  An efficient septage collection system needs to be set up that can be operated by the municipality or a private agency. However, the municipality will have to institute appropriate regulation and monitoring mechanisms to ensure that – septic tanks are properly built, septage is cleared regularly and transported to wastewater treatment site for further treatment and final disposal.
- Settled sewage conveyance: septic/ interceptor tank effluent is disposed into a network of small bore sewer pipes for centralised or decentralised treatment and final disposal.
- Wastewater treatment: Prior to final disposal, the collected wastewater should be adequately treated to meet effluent discharge standards *(refer discharge standards listed in the beginning of the document)*.

Note: in case of space constraints, such as in slum settlements, group septic / interceptor tanks could be considered.

In this case, city drainage network will be used only for carrying rainwater run-off.

Infrastructure Gaps

The infrastructure requirement to achieve the goal of sanitation, adopting 'Settled (small bore) sewerage system is grouped separately for each component- household sanitation, public sanitation arrangements and septage management.

Household Sanitation Arrangements

At the household level, year-on-year change in sanitation arrangements is presented in Table (3.11).

Table (3.11): Indicative Change in Household Sanitation Arrangements over CSP Implementation Period

Sanitation Arrangement	*Baseline Survey*	*Pre-CSP Year*	CSP Implementation Period				
	2008	***2009***	**2010**	**2011**	**2012**	**2013**	**2014**
WC Connected to Septic Tank	*11,452*	*17,250*	*15,099*	*9,966*	*4,471*	*1,072*	*0*
WC Connected to Septic/ Interceptor Tank discharging to Small Bore Sewer	*0*	0	2,609	8,702	15,433	20,013	22,069
Pit Latrine	*1,688*	2,543	3,109	3,952	4,847	5,534	5,937
Other Latrines	*64*	96	75	44	17	3	0
Community Toilet User Households	*0*	0	783	624	382	177	73
Households practicing Open Defecation	*2,311*	3,481	2,568	1,861	941	269	0

Table (3.11): Indicative Change in Household Sanitation Arrangements over CSP Implementation Period							
Sanitation Arrangement	***Baseline Survey***	***Pre-CSP Year***	**CSP Implementation Period**				
	2008	***2009***	**2010**	**2011**	**2012**	**2013**	**2014**
Total Households	***15,515****	***23,370***	***24,243***	***25,149***	***26,091***	***27,068***	***28,079***
Notes: * - Baseline survey covered only 15,515 households. 1. For household projection, refer earlier section on population projections. *Source*: Hoshangabad CSP Analysis, 2010							

In order to achieve this change, the three categories of households – 1) new construction, 2) households where sanitation arrangements need upgrading, and 3) households currently lacking access to sanitation facilities – will have to either construct new facility or upgrade existing facilities. Household category-wise details of upgrading/ new construction of household sanitation arrangements are presented in Table (3.12).

Table (3.12): Indicative Infrastructure Requirements: Household Sanitation								
Household Category and Infrastructure Requirement	**Proportion of households**		**No of households**					
	Start	**Completion**	**CSP Implementation Period**					**Total**
	2010	**2014**	**2010**	**2011**	**2012**	**2013**	**2014**	
New Construction			*873*	*906*	*940*	*976*	*1,011*	*4,706*
WC Connected to Septic Tank	50%	0%	437	340	235	122	0	*1,134*
WC Connected to Interceptor tank --> Small bore sewerage	0%	75%	0	170	353	549	758	*1,830*
Pit Latrine	25%	20%	218	215	212	207	202	*1,054*
Community Toilet User Households	10%	5%	87	79	71	61	51	
Households practicing Open Defecation	15%	0%	131	102	71	37	0	
Upgrading existing sanitation arrangements			*2,609*	*5,504*	*5,757*	*3,535*	*1,075*	*18,480*
Connecting Septic/ Interceptor tank effluent to small bore sewer	15%	100%	2588	5473	5730	3521	1072	*18,384*
Upgrading Other Latrines to WC with Septic tank with small bore sewerage	22%	100%	21	31	27	14	3	*96*
Households lacking access to sanitation facilities								
WC Connected to Interceptor tank --> Small bore sewerage	0%	50%	0	419	621	496	223	*1,759*
Pit Latrines built for households currently lacking sanitation facilities	10%	45%	348	628	683	480	201	*2,340*
Households currently lacking sanitation facilities start using community toilet blocks	20%	5%	696	545	311	116	22	
Households continuing to practice open defecation	70%	0%	2437	1759	870	232	0	
Notes: - Some of the community toilet user households will gradually switch over to using individual household latrines. *Source*: Hoshangabad CSP Analysis, 2010								

Wastewater Conveyance

In order to transport the effluent from septic/ interceptor tanks a network of small-bore sewer pipes will have to be laid. Septic/ Interceptor tanks, if effectively maintained, remove some or all of the suspended solids in the effluent and dampen peak flows. This allows the design of downstream sewerage network to be relaxed, resulting in considerable savings in both capital and operating costs. About 22,069 households are expected to be connected to small bore sewerage network by year 5. Assuming a certain length of street collector, branch and trunk sewerage per household, total network length is estimated.

Broad estimates suggest that a total of about 58 km long sewer network will have to be laid to be able to connect 22,069 households. The total investment requirement for laying small bore sewerage network is estimated at Rs 34.75 million as presented in table (3.13).

Table (3.13): Indicative estimate of small bore sewerage network and investment requirement

Sewerage	Range of pipe diameter (mm)	Unit length / household (m)	Households served	Total Length (m)	Unit rate (Rs/ m)	Total Amount (Rs)
Street collector sewer pipes	100 – 250	1.50	22,069	33,104	300	9,931,200
Branch sewer pipes	300 – 500	0.75	22,069	16,552	700	11,586,400
Trunk sewer pipes	500+	0.40	22,069	8,828	1,500	13,242,000
Total (Rs)						**34,759,600**

Note:
Above estimates assume that there is no need of sewage pumping and the soil to be excavated for sewer laying is soft (i.e. not hard rock etc.). Any additional requirement arising out of sewage pumping requirement of additional expenditure for excavation has to be computed and investment estimates revised accordingly.
Source: Hoshangabad CSP Analysis, 2010

Wastewater Treatment

Under the system, entire wastewater collected through the network of small bore sewers will have to be treated prior to disposal (or reuse/ recycling). The treatment plant is proposed to serve about 79 percent of the town population in 2020. The rate of water supply is assumed to remain same, i.e. 90 litres/capita/day (lpcd). Considering a sewage return factor of about 0.80, the quantity of wastewater can be estimated to be about 11 mld (million litres per day).

$$Q = \frac{P_y \times HH_{Sew} \times W \times R}{1000{,}000}$$

Where, Q = Wastewater flow in mld

P_y = Population in design year (in this case 2020) = 195,653

HH_{Sew} = Households connected to sewerage system as % of total households = 0.786

W = daily per capita water supply = 90 lpcd

R = Sewage return factor = 0.80 (or 80 percent of water supply)

$$Q = \frac{195{,}653 \times 0.786 \times 90 \times 0.80}{1000{,}000}$$

$$Q = 11.07\ mld$$

In order to achieve the discharge standards, collected wastewater will have to be treated to secondary treatment level. The average cost of secondary treatment is assumed to be about Rs 8.206 million per mld. Thus, 11 mld plant is likely to cost about Rs 90.87 million.

$$Cost\ of\ treatment\ plant = 11.07\ mld \times Rs\ 8.21\ Mn/mld$$
$$= Rs\ 90.87\ Mn$$

Septage Management

Under the settled (small bore) sewerage approach, septage (septic sludge) will have to be safely removed for further treatment. Septage can be treated at the wastewater treatment plant. No separate treatment plant will be necessary; however, proper septage collection and transportation system will have to be put in place.

As discussed earlier (in Norms, specifications, Assumptions and Unit Costs), septage clearance frequency is assumed to be once in 2 years and volume decanted per clearance is considered to be about 2 cubic meter (Cum). Further it is assumed that each vehicle will clear 3 tanks per day and the vehicle will operate for 300 days per year.

By Year 5, nearly 20,665 households will be using septic tanks. To provide uninterrupted service to these households, about 12 trucks will be required, which would have to be operated for about 300 days every year.

TABLE: 3.14 Computations: Tanks cleared and septage removal trucks	
Septage clearance vehicles	• As discussed above, a total of 12 (***twelve***) septage clearance vehicles will be needed. The HNPP already has one septage clearance vehicle • To efficiently manage septage clearance, 11 (***eleven***) additional vehicles will have to be purchased • *Out of this, 9 (**six**) vehicles will be purchased in year-1, whereas 10^{th} (**tenth**) and 11^{th} (**eleventh**) vehicle can be purchased in year-3 and year-4 respectively.*
Tank clearance frequency	Once in two years
Tanks cleared per year	$No\ of\ septic\ tanks\ cleared\ per\ year = 12\ trucks \times 3\ tanks \times 300\ days$ $No\ of\ septic\ tanks\ cleared\ per\ year = \mathbf{10,800}$
Source: Hoshangabad CSP Analysis, 2010	

Indicative Investment Requirements

Indicative investment requirements to achieve city-wide sanitation using settled (small bore) sewerage based and off-site wastewater treatment approach are presented in Table (3.15) below. Indicative estimates suggest that, over the CSP implementation period of 5 years, households will have to invest about Rs 180 million. The household investment component is more or less equally split among new construction, upgrading existing sanitation arrangements and improving coverage for households lacking access. The HNPP will have to think of innovative mechanisms for financing individual latrines for poor households.

Wastewater conveyance system and wastewater treatment plant for this option is estimated to cost about Rs. 34.76 million and Rs 90.87 million respectively. A separate Septage management facility will not be required, as the Septage can be treated in the same wastewater treatment plant site.

Septage clearance equipment is estimated to cost about Rs 12 million. Annual O&M cost of septage clearance equipment is expected to be about Rs 5.54 million in year 5 (fully functional and effectively operated system). This can be met from user charges levied at the rate of Rs 525 per tank.

TABLE (3.15): COMPONENT-WISE SUMMARY OF FINANCES: SETTLED (SMALL BORE) SEWERAGE

S #	Component		Year wise Cost					
		Unit	2010	2011	2012	2013	2014	*Total*
A	**Households Benefitted**	Nos	24,243	25,149	26,089	27,065	28,076	
B	**Household/ Private Capital Investment**							
B.1	**Household Sanitation Arrangements**							
i.	New Construction	Rs (Mn)	11.30	12.09	12.93	13.80	14.70	*64.83*
ii.	Upgrading of existing facilities	Rs (Mn)	8.13	16.96	17.66	10.81	3.27	*56.82*
iii.	Increasing coverage for un-served households	Rs (Mn)	4.44	14.71	18.64	14.06	6.13	*57.98*
	Total Household Investment	*Rs in Mn*	*23.87*	*43.76*	*49.24*	*38.66*	*24.10*	***179.63***
C	**Public Investment, O&M Expenditure and Recovery**							
C.1	**Wastewater Conveyance and Treatment**							
	Households Served	Nos	2,609	8,702	15,433	20,013	22,069	
i.	Small Bore Sewerage Network	Rs (Mn)	3.48	10.43	10.43	6.95	3.48	*34.76*
ii.	Construction of wastewater treatment facility	Rs (Mn)	27.25	36.34	27.25			*90.87*
	Capital Investment		*30.73*	*46.76*	*37.68*	*6.95*	*3.48*	***125.62***
iv.	O&M of Small Bore Sewerage Network	Rs (Mn)	0.17	1.56	2.73	3.52	3.91	
v.	O&M of Wastewater treatment facility	Rs (Mn)	0.00	0.00	10.90	10.90	10.90	
	Annual O&M Expenditure		*0.17*	*1.56*	13.64	14.42	14.81	
	Indicative user fees per household	Rs/ Yr					***671.00***	
C.2	**Septage Clearance and Treatment**							
i.	*Septic tank user households*	Nos	17,708	18,668	19,904	21,085	22,069	
ii.	*Septic tanks cleared*	*Tanks/ Yr*	8,854	9,334	9,952	10,543	11,035	
iii.	Septage Clearance Equipment	Rs (Mn)	7.20		0.80	0.80		*8.80*
	Capital Investment		*7.20*		*0.80*	*0.80*		***8.80***
iii.	O&M of septage clearance equipment	Rs (Mn)	4.62	4.62	5.08	5.54	5.54	
	Annual O&M Expenditure		4.62	4.62	5.08	5.54	5.54	
	Indicative Septic tank clearance charge	*Rs/ tank clearance*	***525***	***500***	***510***	***525***	***510***	

Note:

1. In case of wastewater treatment plant, O&M expenditure begins in completion year
2. No separate septage treatment facility is proposed. Septage can be treated at the wastewater treatment plant site

Source: Hoshangabad CSP Analysis, 2010

The key benefits and challenges of 'fully on-site sanitation' approach for Hoshangabad are presented in Table (3.16).

Table (3.16): Settled (small bore) Sewerage: Benefits and Challenges	
Benefits	**Challenges**
• Add on to the existing system rather than creating a complete new system • Demand on public resources is high compared to fully-on-site system • No risk of groundwater contamination • Can easily achieve NRCP objectives	• Households end up paying for wastewater conveyance and treatment as well as septage clearance • HNPP will need to institute septage management system • New rules and regulations relating to septage management will have to be introduced • Convincing households to modify/ upgrade existing toilets and plumbing system
Source: Hoshangabad CSP Analysis, 2010	

3.4.3 Part on-site (septic tank, pit latrines) and part off-site (conventional sewerage) system

System Description

Under the option, a combination of both on-site and off-site sanitation technologies are deployed to achieve the goal of city-wide sanitation. The most important rationale being that fully off-site sanitation system is nearly impossible to construct, at least in the context of rapidly growing cities and towns. Although fully off-site treatment may be possible; it may not be economically and financially viable to cover entire town. Moreover, majority of the households have already invested in construction of on-site disposal arrangements such as septic tanks or pit latrines.

In area covered with sewerage network, effort should be made to connect all households to the sewerage network. Households not covered by the sewerage network need to be served with on-site sanitation systems such as pit latrines or septic tanks (followed by soak pits). In these households, entire domestic wastewater should be disposed in on-site sanitation system.

Under this option following household / public sanitation and wastewater treatment and disposal arrangements will be possible:

- Household sanitation arrangement
  - **Option 1- WC connected to conventional sewerage network**: entire domestic wastewater discharge resulting from bathing, washing, cooking, cleaning and latrine usage etc is discharged into conventional sewerage network.
  - **Option 2- WC connected to septic tank**: entire domestic wastewater discharge resulting from bathing, washing, cooking, cleaning and latrine usage etc is partially treated in septic tank. The septic tank effluent is disposed into a soak pit and septage is periodically cleared and taken away to a common treatment facility.
  - **Option 3- Twin soak pits**: All domestic wastewater (including, bathing, washing, kitchen and latrine) is disposed off directly into soak pits.. A minimum of two pits will be necessary to ensure proper, uninterrupted functioning of the system.

    In both option 2 and 3, a grit and grease trap is constructed before the wastewater (other than latrine wastewater) disposes into the septic tank or soak pit.

Public / Community Sanitary Conveniences: In case of public sanitary conveniences, wastewater discharge is directly disposed into the sewerage network for further treatment and final disposal.

- Septage (septic sludge) Management:
  For the households served by on-site sanitation system – septic tanks, it is proposed to set-up an efficient septage collection system that can be operated by the municipality or the private agency. However, the municipality will have to institute appropriate regulation and monitoring mechanisms to ensure that – septic tanks are properly built, septage is cleared regularly and safely treated and disposed. The septage can be treated at the wastewater treatment plant proposed under this option; no separate septage treatment facility will be necessary.
- Wastewater conveyance: domestic wastewater disposed into the sewerage network is transported to the treatment site for treatment and final disposal.
- Wastewater treatment: Prior to final disposal, the collected wastewater has to be adequately treated (secondary level) to meet disposal standards. The septage cleared from the septic tanks should also be treated at the treatment plant site.

In this case, city drainage network will be used only for carrying rainwater run-off.

Infrastructure Gaps

The infrastructure requirement to achieve the goal of sanitation, adopting a mixed sanitation system consisting of on-site as well as off-site sanitation system is grouped separately for each component- household sanitation, public sanitation arrangements and septage management.

Household Sanitation Arrangements

At the household level, year-on-year change in sanitation arrangements is presented in Table (3.15) below. By 2014, conventional sewerage network is expected to serve about 18,500 households. Remaining about 10,000 households will be served with on-site sanitation system.

Table (3.17): Indicative Change in Household Sanitation Arrangements over CSP Implementation Period

Sanitation Arrangement	*Baseline Survey*	*Pre-CSP Year*	CSP Implementation Period				
	2008	***2009***	**2010**	**2011**	**2012**	**2013**	**2014**
WC Connected to Conventional Sewer		0	0	4,064	10,256	15,478	18,438
WC Connected to Septic Tank	*11,452*	17,250	16,824	12,327	6,090	1,568	0
WC Connected to Septic Tanks with Soak-away		0	911	2,625	4,505	5,761	6,204
Pit Latrine	*1,688*	2,543	3,109	3,630	3,914	3,815	3,366
Other Latrines	*64*	96	48	18	4	1	0
Community Toilet User Households		0	783	624	382	177	73
Households practicing open defecation	*2,311*	3,481	2,568	1,861	941	269	0
Total Households	***15,515****	***23,370***	***24,243***	***25,149***	***26,092***	***27,069***	***28,081***
Notes:							
* - Baseline survey covered only 15,515 households.							
1. For household projection, refer earlier section on population projections.							
Source: Hoshangabad CSP Analysis, 2010							

In order to achieve this change, the three categories of households – 1) new construction, 2) households where sanitation arrangements need upgrading, and 3) households currently lacking access to sanitation facilities – will have to either construct new facility or upgrade existing facilities. Household category-wise details of upgrading/ new construction of household sanitation arrangements are presented in Table (3.18) below.

Table (3.18): Indicative Infrastructure Requirements: Household Sanitation								
Household Category and Infrastructure Requirement	Proportion of households		No of households					
	Start	Completion	CSP Implementation Period					Total
	2010	2014	2010	2011	2012	2013	2014	
New Construction			*873*	*906*	*942*	*976*	*1012*	*4709*
WC Connected to Septic Tank	50%	0%	437	340	235	122	0	1,134
WC Connected to Conventional Sewerage	0%	50%	0	159	329	512	708	1,708
WC Connected to Septic Tank with Soak pit	0%	25%	0	11	24	37	51	123
Pit Latrine	25%	20%	218	215	212	207	202	1,054
Community Toilet User Households	10%	5%	87	79	71	61	51	349
Households practicing Open Defecation	15%	0%	131	102	71	37	0	341
Upgrading existing sanitation arrangements			*911*	*5022*	*6849*	*5234*	*2332*	
Constructing Soak away for existing WC with Septic Tank	5%	50%	863	1,682	1,849	1,218	392	6,004
Upgrading WC with Septic tank to WC Connected to Conventional Sewer	0%	50%	0	3,155	4,623	3,426	1176	12,380
Upgrading Other Latrines to WC connected to Septic tank with Soak-pit	50%	25%	48	21	7	1	0	77
Upgrading Other Latrines to WC connected to Conventional Sewer	0%	75%	0	9	7	2	1	19
Upgrading Pit Latrine to WC connected to Conventional Sewer	0%	20%	0	155	363	587	763	1,868
Households lacking access to sanitation facilities								
New WC connected to conventional sewerage	0%	55%	0	586	870	695	312	2,463
Pit Latrines built for households currently lacking sanitation facilities	10%	40%	348	461	435	281	112	1,637
Households currently lacking sanitation facilities start using community toilet blocks	20%	5%	696	545	311	116	22	
Households continuing to practice open defecation	70%	0%	2,437	1,759	870	232	0	
Notes:								
* - It is assumed that in the beginning, due to lack of awareness on rules, some households may construct septic tanks without soak-pits.								
- Some of the community toilet user households will gradually switch over to using individual household latrines.								
Source: Hoshangabad CSP Analysis, 2010								

Wastewater Conveyance

A conventional underground sewerage network is proposed for collection of domestic wastewater. About 13,500 households are expected to be connected to the network by year 5. Assuming a certain length of street collector, branch and trunk sewerage per household, total network length is estimated. Broad estimates suggest that a total of about 56 km long sewer network will have to be laid to be able to connect about 18,500 households (i.e. nearly a third of the total households in the town, by 2014). The total investment requirement for laying conventional sewerage network is estimated at about Rs 67 million as presented in Table (3.19).

Table (3.19): Indicative estimate of conventional sewerage network and investment requirement						
Sewerage	Range of pipe diameter (mm)	Unit length / household (m)	Households served	Total Length (m)	Unit rate (Rs/ m)	Total Amount (Rs)
Street collector sewer pipes	150 – 300	1.5	18,438	31,925	600	19,154,700
Branch sewer pipes	350 – 800	0.75	18,438	15,962	1400	22,347,150
Trunk sewer pipes	800+	0.4	18,438	8,513	3,000	25,539,600
				56,400		**67,041,450**
Note:						
Above estimates assume that there is no need of sewage pumping and the soil to be excavated for sewer laying is soft (i.e. not hard rock etc.). Any additional requirement arising out of sewage pumping requirement or additional expenditure for excavation has to be computed and investment estimates revised accordingly.						
Source: Hoshangabad CSP Analysis, 2010						

Wastewater Treatment

Under the system, entire wastewater collected through the sewerage network will have to be treated prior to disposal (or reuse/ recycling). The treatment plant is proposed to serve about 70 percent of the town population in 2020. The recommended water supply for sewered network areas is about 135 lpcd to ensure effective flushing of the conventional sewerage network. For the purpose of analysis, it is assumed that in sewered areas water is supplied at the rate of 135 lpcd. For other households, water supply level s assumed to be about 90 lpcd. Thus, an average water supply is estimated to be about 117 lpcd. Considering a sewage return factor of about 0.80, the quantity of wastewater can be estimated to be about 11 mld (million litres per day).

$$Q = \frac{P_y \times HH_{Sew} \times W \times R}{1000{,}000}$$

Where, Q = Wastewater flow in mld

P_y = Population in design year (in this case 2020) = 195,653

HH_{Sew} = Households connected to sewerage system as % of total households = 60%

W = average daily per capita water supply = 110 lpcd

R = Sewage return factor = 80% (or 80 percent of water supply)

$$Q = \frac{195{,}653 \times 100\% \times 117 \times 0.80}{1{,}000{,}000}$$

$$Q = 18.30\ mld$$

In order to achieve the discharge standards, collected wastewater will have to be treated to secondary treatment level. The average cost of secondary treatment is assumed to be about Rs 8.21 million per mld. Thus, 18.30 mld plant is estimated to cost about Rs 150.28 million.

$$Cost\ of\ treatment\ plant = 18.30\ mld \times Rs\ 8.21\ Mn/mld$$
$$= Rs\ 150.28\ Mn$$

Exact estimation of number of plants and capacity of each will have to be determined based on detailed topographic surveys to demarcate drainage zones. Availability of land will be another critical factor in decision to locate the wastewater treatment plant.

Septage Management

Under the part on-site part off-site city-wide sanitation approach, septage (septic sludge) will have to be safely removed for further treatment. Septage can be treated at the same wastewater treatment plant. No separate treatment plant will be necessary; however, proper septage collection and transportation system will have to be put in place.

As discussed earlier (in Norms, specifications, Assumptions and Unit Costs), septage clearance frequency is assumed to be once in 2 years and volume decanted per clearance is considered to be about 2 cubic meter (Cum). Further it is assumed that each vehicle will clear 3 tanks per day and the vehicle will operate for 300 days per year.

In the first year of CSP implementation, more than 17,000 households will have septic tank based on-site sanitation arrangements. However, by Year-5 the number of households using on-site sanitation will reduce to about 6,200, as some will connect to sewerage network. Septage removal requirement of these households can be met by 3 trucks. However, in order to meet requirement in year-1, about 9 septage removal trucks will be needed. The estimate accounts for all 9 trucks. However, the HNPP can decide to rationalise the number of trucks deployed by increasing operational days per year; alternatively, private cleaners could be engaged.

Indicative Investment Requirements

Indicative investment requirements to achieve city-wide sanitation by adopting part on-site part off-site approach are presented in Table (3.20) below. Indicative estimates suggest that, over the CSP implementation period, households will have to invest about Rs 168 million. More than a third (about Rs 67 Mn) of the spending is in upgrading existing household sanitation arrangements; households constructing new sanitation facilities will spend about a third (about Rs 55 Mn); and a little less than a third (about Rs 45 Mn) of the spending will be in increasing access to un-served households.

The wastewater conveyance system and wastewater treatment plant are estimated to cost about Rs. 67 million and Rs 150 million respectively. Since the wastewater treatment plant is already proposed, separate septage treatment facility is not suggested. The septage can be treated at the wastewater treatment plant site. Annual operation and maintenance of the wastewater conveyance and treatment system is expected to be about Rs. 23 million. For each served households, this translates to about Rs 1,270 per annum.

Septage clearance equipment is estimated to cost about Rs 7 million. Annual O&M cost of septage clearance equipment is expected to be about Rs 5 million in year-1. This is expected to reduce to about 3 million by year 5. A rationalised charge of Rs 550 per tank per clearance shall be sufficient to meet annual O&M expenditure.

TABLE (3.20): COMPONENT WISE SUMMARY OF FINANCES: PART ON-SITE PART OFF-SITE SANITATION

No.	Component		Year wise Cost					
		Unit	2010	2011	2012	2013	2014	*Total*
A	**Population/ HH Benefitted (City-wide)**							
i.	Households Benefitted	Nos	24,243	25,149	26,089	27,065	28,076	
ii.	Population Benefitted	Persons	1,35,553	1,40,620	1,45,876	1,51,329	1,56,986	
B	**Household/ Private Capital Investment**							
B.1	**Household Sanitation Arrangements**							
i.	New Construction	Rs (Mn)	11.30	11.19	11.08	10.92	10.73	55.21
ii.	Upgrading of existing facilities	Rs (Mn)	2.06	16.16	22.88	17.91	8.35	67.36
iii.	Increasing coverage for unserved households	Rs (Mn)	4.44	11.74	14.25	10.53	4.55	45.50
	Total Household Investment	*Rs (Mn)*	***17.79***	***39.09***	***48.21***	***39.36***	***23.63***	***168.08***
C	**Public Investment, O&M Expenditure and Recovery**							
C.1	**Wastewater Conveyance and Treatment**							
	Households Served	*Nos*	*0*	*4,064*	*10,256*	*15,478*	*18,438*	
ii.	Conventional Sewerage Network	Rs (Mn)	6.70	20.11	20.11	13.41	6.70	67.04
iii.	Construction of wastewater treatment facility	Rs (Mn)	45.08	60.11	45.08	0.00	0.00	150.28
	Capital Investment		***51.79***	***80.22***	***65.20***	***13.41***	***6.70***	***217.32***
vi	O&M of Conventional Sewerage Network	Rs (Mn)	0.54	2.15	3.75	4.83	5.36	
vii	O&M of Wastewater treatment facility	Rs (Mn)	0.00	0.00	18.03	18.03	18.03	
	Annual O&M Expenditure	Rs (Mn)	**0.54**	**2.15**	**21.79**	**22.86**	**23.40**	
	Indicative user fees	*Rs/HH/Yr*					***1,269***	
C.2	**Septage Clearance and Treatment**							
	Households Served	*Nos*	*17,735*	*14,952*	*10,595*	*7,329*	*6,204*	
	No of septic tanks cleared annually	No/ year	8,868	7,476	5,298	3,665	3,102	
i.	Septage Clearance Equipment	Rs (Mn)	7.2					***7.20***
iv.	Annual O&M Expenditure	Rs (Mn)	4.92	3.94	2.95	1.97	1.47	
	*Indicative Septic tank clearance charge**	Rs/ tank	**555**	**526**	**557**	**537**	**476**	

Notes:

- In case of wastewater treatment plant, O&M expenditure begins in completion year;
- No separate septage treatment facility is proposed. Septage can be treated at the wastewater treatment plant site
- * - As existing septic tanks are connected to sewerage, the overall number of households using septic tanks reduces, the HNPP will have to accordingly withdraw some of the septage clearance trucks from the fleet.

Source: Hoshangabad CSP Analysis, 2010

The key benefits and challenges of 'part on-site part off-site' approach for Hoshangabad are presented in Table (3.21).

Table (3.21): Part on-site part off-site Sewerage: Benefits and Challenges	
Benefits	**Challenges**
• Most of the wastewater is treated off-site • Demand on public resources is high compared to fully-on-site system • Less risk of groundwater contamination	• Both capital and O&M intensive option • Households end up paying for wastewater conveyance and treatment as well as septage clearance • HNPP will need to institute septage management system • New rules and regulations relating to septage management will have to be introduced • Convincing households to modify/ upgrade existing toilets and plumbing system • High on operation and maintenance. Power outages may interrupt wastewater treatment
Source: Hoshangabad CSP Analysis, 2010	

3.4.4 Simplified Sewerage with Decentralised Wastewater Treatment

System Description

Under the option, a simplified sewerage network is laid to collect the wastewater from the households. The network is spread through most of the town. Wastewater is collected at different locations, where it is treated before final disposal or reuse. Drainage zone and land availability for decentralised wastewater treatment plant are primary defining criteria for locations of treatment plants. Sewerage network is designed and planned basing on simplified sewerage principles (refer CPHEEO Manual of Sewerage and Sewage Treatment).

A detailed topographical and land availability survey will be necessary to determine required number of decentralised wastewater treatment plants. In area covered with sewerage network, effort should be made to connect all households to the sewerage network. The estimation assumes that about 8 percent households will be served by on-site sanitation systems – mainly pit latrines. Under this option following household / public sanitation and wastewater treatment and disposal arrangements will be possible:

- Household sanitation arrangement
  - **Option 1**: entire domestic wastewater discharge is disposed into simplified sewerage network.
  - **Option 2**: entire domestic wastewater (including bathing, washing, kitchen and latrine) is disposed directly into soak pits. A minimum of two pits will be necessary to ensure proper, uninterrupted functioning of the system. A grit and grease trap is constructed before the wastewater (other than latrine wastewater) disposes into the septic tank or soak pit.

Public / Community Sanitary Conveniences: In case of public sanitary conveniences, wastewater discharge is directly disposed into the small bore sewerage network for further treatment and final disposal.

- Wastewater conveyance: domestic wastewater disposed into the simplified sewerage network is transported to the treatment site for treatment and final disposal.
- Wastewater treatment: prior to final disposal, the collected wastewater has to be adequately treated (secondary level) to meet disposal standards. The septage cleared from the septic tanks should also be treated at the treatment plant site.

In this case, city drainage network will be used only for carrying rainwater run-off.

Infrastructure Gaps

The infrastructure requirement to achieve the goal of sanitation, adopting a simplified sewerage and decentralised wastewater treatment based sanitation system is grouped separately for each component- household sanitation, public sanitation arrangements and septage management.

Household Sanitation Arrangements

At the household level, year-on-year change in sanitation arrangements is presented in Table (3.22) below. By 2014, simplified sewerage network is expected to serve more than 26,012 households (more than 90 percent). Remaining households will be served with on-site sanitation system.

Table (3.22): Indicative Change in Household Sanitation Arrangements over CSP Implementation Period

Sanitation Arrangement	*Baseline Survey*	*Pre-CSP Year*	CSP Implementation Period				
	2008	***2009***	**2010**	**2011**	**2012**	**2013**	**2014**
WC Connected to Simplified Sewerage		0	174	5,702	14,399	22,002	26,239
WC Connected to Septic Tank	*11,452*	17,250	17,687	13,605	7,037	1,881	0
Pit Latrine		2,543	2,935	3,286	3,297	2,731	1,768
Other Latrines	*1,688*	96	96	72	36	9	0
Community Toilet User Households	*64*		783	624	382	177	73
Households practicing Open Defecation	2311	3,481	2,568	1,861	941	269	0
Total Households	***15,515****	***23,370***	***24,243***	***25,150***	***26,092***	***27,069***	***28,080***
Notes:							
* - Baseline survey covered only 15,515 households.							
1. For household projection, refer earlier section on population projections.							
Source: Hoshangabad CSP Analysis, 2010							

In order to achieve this change, the three categories of households – 1) new construction, 2) households where sanitation arrangements need upgrading, and 3) households currently lacking access to sanitation facilities – will have to either construct new facility or upgrade existing facilities. Household category-wise details of upgrading/ new construction of household sanitation arrangements are presented in Table (3.23).

Table (3.23): Indicative Infrastructure Requirements: Household Sanitation

Household Category and Infrastructure Requirement	Proportion of households		No of households					
	Start	Completion	CSP Implementation Period					Total
	2010	2014	2010	2011	2012	2013	2014	
New construction			*873*	*906*	*942*	*976*	*1,011*	*4,708*
WC Connected to Septic Tank*	50%	0%	437	340	235	122	0	1,134
WC Connected to Simplified Sewerage	0%	75%	0	170	353	549	758	1,830
Pit Latrine	25%	20%	218	215	212	207	202	1,054
Community Toilet User Households	10%	5%	87	79	71	61	51	349
Households practicing Open Defecation	15%	0%	131	102	71	37	0	341
Upgrading existing sanitation arrangements				*4,813*	*7,587*	*6,308*	*2,928*	*21,636*
Upgrading WC with Septic tank to WC Connected to Simplified Sewerage	0%	100%	0	4422	6803	5278	1881	*18,384*
Upgrading Other Latrines to WC connected to Simplified Sewerage	0%	100%	0	24	36	27	9	*96*
Upgrading Pit Latrine to WC connected to Simplified Sewerage	0%	50%	0	367	822	1236	1366	*3,791*
Households lacking access to sanitation facilities								
New WC connected to simplified sewerage	5%	35%	174	545	683	513	223	*2,138*
Pit Latrines built for households currently lacking sanitation facilities	5%	10%	174	503	621	463	201	*1962*

Table (3.23): Indicative Infrastructure Requirements: Household Sanitation								
Household Category and Infrastructure Requirement	Proportion of households		No of households					
	Start	Completion	CSP Implementation Period					Total
	2010	2014	2010	2011	2012	2013	2014	
Households currently lacking sanitation facilities start using community toilet blocks	20%	55%	696	545	311	116	22	
Households continuing to practice open defecation	70%	0%	2437	1759	870	232	0	
Notes:								
* - It is assumed that in the beginning, due to lack of awareness on rules, some households may construct septic tanks without soak-pits.								
- Some of the community toilet user households will gradually switch over to using individual household latrines.								
Source: Hoshangabad CSP Analysis, 2010								

Wastewater Conveyance

A simplified underground sewerage network is proposed for collection of domestic wastewater. About 29,000 households are expected to be connected to the network by year-5. Assuming a certain length of street collector and branch sewerage per household, total network length is estimated. Broad estimates suggest that a total of about 55 km long sewer network will have to be laid to be able to connect 29,000 households. The total investment requirement for laying small bore sewerage network is estimated at Rs 22 million as presented in Table (3.24) below.

Table (3.24): Indicative estimate of simplified sewerage network and investment requirement						
Sewerage	Sewer pipe		Households served	Total Length (m)	Unit rate (Rs/ m)	Total Amount
	Diameter (mm)	Length / household (m)				
Street collector sewer pipes	100 - 250	1.5	26,239	44,037	300	13,211,100
Branch sewer pipes	300 - 500	0.75	26,239	11,980	700	8,385,825
Total (Rs)						**21,596,925**
Note:						
Above estimates assume that there is no need of sewage pumping and the soil to be excavated for sewer laying is soft (i.e. not hard rock etc.). Any additional requirement arising out of sewage pumping requirement or additional expenditure for excavation has to be computed and investment estimates revised accordingly.						
Source: Hoshangabad CSP Analysis, 2010						

Wastewater Treatment

Under the system, entire wastewater collected through the sewerage network will have to be treated prior to disposal (or reuse/ recycling). The treatment plant is proposed to serve about 92 percent of the town population in 2020. It is assumed that water supply level will continue to be about 90 lpcd. Considering a sewage return factor of about 0.80, the quantity of wastewater can be estimated to be about 11 mld (million litres per day).

$$Q = \frac{P_y \times HH_{SEW}\ W \times R}{1000{,}000}$$

Where, Q = Wastewater flow in mld

P_y = Population in design year (in this case 2020) = 195,653

HH_{Sew} = Households connected to sewerage system as % of total households = 93%

W = average daily per capita water supply = 90 lpcd

R = Sewage return factor = 0.80 (or 80 percent of water supply)

$$Q = \frac{195{,}653 \times 0.93 \times 90 \times 0.80}{1{,}000{,}000}$$
$$Q = 13.10\ mld$$

In order to achieve the discharge standards, collected wastewater will have to be treated to secondary treatment level. However, in this particular case, the wastewater is proposed to be treated to tertiary level. The average cost of decentralised wastewater treatment is assumed to be about Rs 16.41 million per mld. Thus, for treating about 13.10 mld wastewater, decentralised wastewater treatment plants are estimated to cost about Rs 215 million.

$$Cost\ of\ treatment\ plant = 13.10\ mld \times Rs\ 16.41\ Mn/mld$$
$$= Rs\ 215.01\ Mn$$

Exact estimation of number of plants and capacity of each will have to be determined based on detailed topographic surveys to demarcate drainage zones. Availability of land will be another critical factor in decision to locate the wastewater treatment plant.

Indicative Investment Requirements

Indicative investment requirements to achieve city-wide sanitation by adopting simplified sewerage and decentralised wastewater treatment based approach are presented in Table (3.25) below. Indicative estimates suggest that, over the CSP implementation period, households will have to invest about Rs 190 million. Nearly half (89 Mn) the expenditure is estimated to incur on upgrading existing sanitation arrangements. The remaining 50 percent expenditure is estimated to be incurred on new construction (Rs 54 Mn) and extending coverage (Rs 46 Mn) to un-served households.

Wastewater conveyance system and decentralised wastewater treatment plants are estimated to cost about Rs. 21.60 million and Rs 215 million respectively. Annual operation and maintenance of wastewater conveyance and treatment is estimated to cost about 5.38 Mn. This will translate to about Rs 205 per annum per household.

TABLE (3.25): COMPONENT WISE SUMMARY OF FINANCES: SIMPLIFIED SEWERAGE WITH DECENTRALISED WASTEWATER TREATMENT

No.	Component	Unit	Year wise Cost					Total
			2010	2011	2012	2013	2014	
A	**Population/ HH Benefitted (City-wide)**							
i.	**Households Benefitted**	HH	**24,243**	**25,150**	**26,092**	**27,069**	**28,080**	
ii.	Population Benefitted	Persons	1,35,553	1,40,620	1,45,876	1,51,329	1,56,986	
B	**Household/ Private Capital Investment**							
B.1	**Household Sanitation Arrangements**							
i.	New Construction	Rs (Mn)	11.30	11.07	10.82	10.51e	10.16	53.85
ii.	Upgrading of existing facilities	Rs (Mn)		19.34	30.77	26.26	13.06	89.42
iii.	Increasing coverage for unserved households	Rs (Mn)	3.96	11.86	14.75	11.03	4.79	46.40
	Total Household Investment	Rs (Mn)	*15.26*	*42.27*	*56.33*	*47.80*	*28.00*	***189.67***
C	**Public Investment, O&M Expenditure and Recovery**							
C.1	**Wastewater Conveyance and Treatment**							
	Households Served	HH	*174*	*5,702*	*14,399*	*22,002*	*26,239*	
i	Simplified Sewerage Network	Rs (Mn)	2.16	6.48	6.48	4.32	2.16	21.60
ii	Construction of wastewater treatment facility	Rs (Mn)	64.50	86.00	64.50			215.01
	Capital Investment		**70.19**	**103.05**	**81.55**	**11.37**	**5.68**	***236.61***
iii.	O&M of simplified Sewerage Network	Rs (Mn)	0.11	0.43	0.76	0.97	1.08	

TABLE (3.25): COMPONENT WISE SUMMARY OF FINANCES: SIMPLIFIED SEWERAGE WITH DECENTRALISED WASTEWATER TREATMENT								
No.	**Component**	**Unit**	**Year wise Cost**					**Total**
			2010	**2011**	**2012**	**2013**	**2014**	
iv.	O&M of Wastewater treatment facility	Rs (Mn)			4.30	4.30	4.30	
	Annual O&M Expenditure		***0.11***	***0.43***	***5.06***	***5.27***	***5.38***	
	Indicative User Fees	Rs/HH/Yr					**205**	
Note: In case of wastewater treatment plant, O&M expenditure begins in completion year *Source*: Hoshangabad CSP Analysis, 2010								

The key benefits and challenges of 'simplified sewerage and decentralised wastewater treatment' approach for Hoshangabad are presented in Table (3.26).

Table (3.26): Simplified Sewerage and Decentralised Wastewater Treatment: Benefits and Challenges	
Benefits	**Challenges**
• Most of the wastewater is treated off-site • No need to augment a water supply • Low maintenance • No risk of groundwater contamination • No dependence on power supply for operation • Simple operation and maintenance	• Both capital intensive system • Households will have to invest substantial amount in upgrading • Convincing households to modify/ upgrade existing toilets and plumbing system
Source: Hoshangabad CSP Analysis, 2010	

3.4.5 Mixed System

Under the option, a mix of all options is promoted, provided that households have access to improved sanitation facilities and human excreta and community liquid wastes are treated and safely disposed. The combination of deployed sanitation technologies includes – on-plot sanitation arrangements (septic tanks with soak-away and twin pit latrines) and off-plot sanitation technology (simplified sewerage with decentralised wastewater treatment systems).

Under this option, following household/ public sanitation and wastewater treatment and disposal arrangements are made.

- Household sanitation arrangement
  - **Option 1- Simplified sewerage network**: entire domestic wastewater discharge resulting from bathing, washing, cooking, cleaning and latrine usage etc is discharged into simplified sewerage network. Collected wastewater is treated at a number of decentralised wastewater treatment plants prior to final disposal.
  - **Option 2- Septic tank with soak-away**: entire domestic wastewater discharge resulting from bathing, washing, cooking, cleaning and latrine usage etc is partially treated in septic tank. The septic tank effluent is disposed into a soak pit and septage is periodically cleared and taken away to a common treatment facility.
  - **Option 3- Twin soak pits**: All domestic wastewater (including, bathing, washing, kitchen and latrine) is disposed off directly into soak pits.. A minimum of two pits will be necessary to ensure proper, uninterrupted functioning of the system.

    In both option 2 and 3, a grit and grease trap is constructed before the wastewater (other than latrine wastewater) disposes into the septic tank or soak pit.

Public / Community Sanitary Conveniences: In case of public sanitary conveniences, wastewater discharge is either disposed into the sewerage network for further treatment and final disposal or treated at a localised decentralised wastewater treatment plant.

- Septage (septic sludge) Management:
  For the households served by on-site sanitation system – septic tanks, it is proposed to set-up an efficient septage collection system that can be operated by the municipality or private agency. However, the municipality will have to institute appropriate regulation and monitoring mechanisms to ensure that – septic tanks are properly built, septage is cleared regularly and safely treated and disposed. The septage can be treated at a separate septage treatment facility.
  Suggested septage treatment consists of septage (/sludge) drying beds consisting of sand filters for dewatering/ sun-drying. The system demand is low on both capital as well as O&M expenditure. Also it does not require high skills, it can be operated easily. Dried sludge cakes can be used in agriculture for soil conditioning; however, it shall be tested for suitability.
- Wastewater conveyance: domestic wastewater disposed into the sewerage network is transported to the decentralised wastewater treatment sites for treatment and final disposal.
- Wastewater treatment: Prior to final disposal, the collected wastewater has to be adequately treated (secondary level) to meet disposal standards. The septage cleared from the septic tanks should also be treated at the treatment plant site.

Infrastructure Gaps

Indicative investment requirements for this option can be analysed by estimating infrastructure requirements and funds required to bridge the gaps. The infrastructure requirement to achieve the goal of sanitation, adopting a mix of sanitation systems is grouped separately for necessary components- household sanitation, wastewater conveyance and treatment including septage management.

Household Sanitation Arrangements

At the household level, year-on-year change in sanitation arrangements is presented in Table (3.27) below. By 2014, simplified sewerage network (with decentralised wastewater treatment plants) is expected to serve about 10,800 households (about 40 percent). Remaining about households will be served with a mix of on-site sanitation technologies.

Table (3.27): Indicative Change in Household Sanitation Arrangements over CSP Implementation Period

Sanitation Arrangement	*Baseline Survey*	*Pre-CSP Year*	CSP Implementation Period				
	2008	*2009*	2010	2011	2012	2013	2014
Household Sanitation Arrangements							
WC Connected to Simplified Sewer		0	0	2,185	5,594	8,666	107,07
WC Connected to Septic Tank	*11,452*	17,250	16,824	12,327	6,091	1,568	0
WC Connected to Septic Tanks with Soak-away		0	911	4,379	8,867	12,171	13,544
Pit Latrine	*1,688*	2,543	3,109	3,755	4,212	4,217	3,754
Other Latrines	*64*	96	48	18	4	0	0
Community Toilet User Households	2,311	0	783	624	382	177	73
Households practicing Open Defecation	***15,515****	3,481	2,568	1,861	941	269	0
Notes:							
* - Baseline survey covered only 15,515 households.							
1. For household projection, refer earlier section on population projections.							
Source: Hoshangabad CSP Analysis, 2010							

In order to achieve this change, the three categories of households – 1) new construction, 2) households where sanitation arrangements need upgrading, and 3) households currently lacking access to sanitation facilities – will have to either construct new facility or upgrade existing facilities. Household category-wise details of upgrading/ new construction of household sanitation arrangements are presented in Table (3.28) below.

Table (3.28): Indicative Infrastructure Requirements: Household Sanitation

Household Category and Infrastructure Requirement	Proportion of households		No of households					
	Start	Completion	CSP Implementation Period					Total
	2010	2014	2010	2011	2012	2013	2014	
New Households			**873**	**906**	**942**	**976**	**1,011**	**4,708**
WC Connected to Septic Tank	50%	0%	437	340	235	122	0	1134
WC Connected to Simplified Sewerage	0%	40%	0	91	188	293	404	976
WC Connected to Septic Tank with Soakaway	0%	35%	0	79	165	256	354	854
Pit Latrine	25%	20%	218	215	212	207	202	1,054
Community Toilet User Households	10%	5%	87	79	71	61	51	349
Households practicing Open Defecation	15%	0%	131	102	71	37	0	341
Upgrading			**911**	**5,022**	**6,861**	**5,281**	**2,411**	
Constructing Soakaway for existing WC with Septic Tank	5%	65%	863	3,365	4,314	3,046	1019	12,607
Upgrading WC with Septic tank to WC Connected to Conventional Sewer	0%	35%	0	1,472	2,157	1,599	549	5,777
Upgrading Other Latrines to WC connected to Septic tank with Soakaway	50%	50%	48	24	9	2	0	83
Upgrading Other Latrines to WC connected to Simplified Sewer	0%	50%	0	6	5	2	0	13
Upgrading Pit Latrine to WC connected to Simplified Sewer	0%	20%	0	155	376	632	843	2,006
Improving Coverage for unserved households			**3,481**	**3,351**	**2,485**	**1,324**	**445**	
New WC connected to Simplified sewerage	0%	55%	0	461	683	546	245	1,935
Pit Latrines built for households currently lacking sanitation facilities	10%	40%	348	586	621	430	178	2,163
Households currently lacking sanitation facilities start using community toilet blocks	20%	5%	696	545	311	116	22	
Households continuing to practice open defecation	70%	0%	2,437	1,759	870	232	0	

Notes:

* - It is assumed that in the beginning, due to lack of awareness on rules, some households may construct septic tanks without soak-pits.

- Some of the community toilet user households will gradually switch over to using individual household latrines.

Source: Hoshangabad CSP Analysis, 2010

Wastewater Conveyance

A simplified underground sewerage network is proposed for collection of domestic wastewater. About 11,000 households are expected to be connected to the network by year-5. Assuming a certain length of street collector and branch sewerage per household, total network length is estimated. Broad estimates suggest that a total of about 29 km long sewer network will have to be laid to be able to connect nearly 11,000 households. The total investment requirement for laying simplified sewerage network is estimated at Rs 12.71 million as presented in Table (3.29).

Table (3.29): Indicative estimate of simplified sewerage network and investment requirement

Sewerage	Sewer pipe		Households served	Total Length (m)	Unit rate (Rs/ m)	Total Amount
	Diameter (mm)	Length / household (m)				

Table (3.29): Indicative estimate of simplified sewerage network and investment requirement						
Sewerage	Sewer pipe		Households served	Total Length (m)	Unit rate (Rs/ m)	Total Amount
	Diameter (mm)	Length / household (m)				
Street collector sewer pipes	100 - 250	1.5	10,800	19,550	300	5,864,850
Branch sewer pipes	300 - 500	0.75	10,800	9,775	700	6.842,325
Total (Rs)						**12,707,175**
Note:						
Above estimates assume that there is no need of sewage pumping and the soil to be excavated for sewer laying is soft (i.e. not hard rock etc.). Any additional requirement arising out of sewage pumping requirement or additional expenditure for excavation has to be computed and investment estimates revised accordingly.						
Source: Hoshangabad CSP Analysis, 2010						

Wastewater Treatment

Under the system, entire wastewater collected through the sewerage network will have to be treated prior to disposal (or reuse/ recycling). The treatment plants s proposed to serve about 92 percent of the town population in 2020. It is assumed that water supply level will continue to be about 90 lpcd. Considering a sewage return factor of about 0.80, the quantity of wastewater can be estimated to be about 7 mld (million litres per day).

$$Q = \frac{P_y \times HH_{SEW}\ W \times R}{1000{,}000}$$

Where, Q = Wastewater flow in mld

P_y = Population in design year (in this case 2020) = 195,653

HH_{Sew} = Households connected to sewerage system as % of total households = 50%

W = average daily per capita water supply = 90 lpcd

R = Sewage return factor = 0.80 (or 80 percent of water supply)

$$Q = \frac{195{,}653 \times 0.50 \times 90 \times 0.80}{1{,}000{,}000}$$

$$Q = 7.05\ mld$$

In order to achieve the discharge standards, collected wastewater will have to be treated to secondary treatment level. However, in this particular case, the wastewater is proposed to be treated to tertiary level. The average cost of decentralised wastewater treatment is assumed to be about Rs 16.41 million per mld. Thus, for treating about 8.50 mld wastewater, decentralised wastewater treatment plants are estimated to cost about Rs 115 million.

$$Cost\ of\ treatment\ facilities = 7.05\ mld \times Rs\ 16.41\ Mn/mld$$

$$= Rs\ 115.60\ Mn$$

Exact estimation of number of decentralised plants and capacity of each will have to be determined based on detailed topographic surveys to demarcate drainage zones. Availability of land will be another critical factor in decision to locate the wastewater treatment plant.

Septage Management (including treatment)

Under mixed sanitation approach, decentralised wastewater treatment is proposed. It would not be possible to treat septage at the decentralised wastewater treatment plants. Hence a separate septage treatment facility will be needed. The septage (septic sludge) will have to be safely removed for further treatment and final disposal. As mentioned earlier (in Norms, specifications, Assumptions and Unit Costs), septage clearance frequency is assumed to be once in 2 years and volume decanted per clearance is considered to be about 2 cubic meter (Cum). Further it is assumed that each vehicle will clear 3 tanks per day and the vehicle will operate for 300 days per year.

In year-1 the system has to serve about 17,500 households, which will reduce to about 13,500 households by year-5. In order to provide uninterrupted service, initially about 10 trucks will be required, which would have to be operated for about 300 days every year to service all the households. The requirement of trucks will reduce to about 8 trucks in year-5.

Indicative Investment Requirements

Indicative investment requirements to achieve city-wide sanitation by adopting simplified sewerage and decentralised wastewater treatment based approach are presented in Table (3.30) below. Indicative estimates suggest that, over the CSP implementation period, households will have to invest about Rs 162 million. More than 51 Mn expenditure is estimated to incur on upgrading existing sanitation arrangements. The remaining expenditure is estimated to be incurred on new construction (Rs 63 Mn) and extending coverage (Rs 47 Mn) to un-served households.

Wastewater conveyance system and decentralised wastewater treatment plants are estimated to cost about Rs. 13 million and Rs 116 million respectively. Annual operation and maintenance of wastewater conveyance and treatment is estimated to cost about 3 Mn. This will translate to about Rs 275 per annum per household.

TABLE (3.30): COMPONENT WISE SUMMARY OF FINANCES: MIXED SANITATION SYSTEM

No.	Component	Unit	Year wise Cost					Total
			2010	2011	2012	2013	2014	
A	**Population/ HH Benefitted (City-wide)**							
i	Households Benefitted	Nos	24,243	25,149	26,089	27,065	28,076	
ii	Population Benefitted	Persons	1,35,553	1,40,620	1,45,876	1,51,329	1,56,986	
B	**Household/ Private Capital Investment**							
B.1	**Household Sanitation Arrangements**							
i	New Construction	Rs (Mn)	11.30	11.94	12.63	13.32	14.05	***63.25***
ii	Upgrading of existing facilities	Rs (Mn)	2.05	11.98	16.78	13.54	7.096	***51.46***
iii.	Increasing coverage for unserved households	Rs (Mn)	4.44	12.08	14.75	10.94	4.72	***46.93***
iv	*Total Household Investment*	*Rs (Mn)*	***17.79***	***36.00***	***44.16***	***37.81***	***25.87***	***161.63***
C	**Public Investment, O&M Expenditure and Recovery**							
C.1	**Wastewater Conveyance and Treatment**							
i	*Households Served*	*Nos*	*0*	*2,185*	*5,594*	*8,666*	*10,707*	
ii	Simplified Sewerage Network	Rs (Mn)	1.27	3.81	3.81	2.54	1.27	*12.71*
iii.	Construction of decentralised wastewater treatment facilities	Rs (Mn)	34.68	46.24	34.68			*115.60*
iv	*Capital Investment*		***35.95***	***50.05***	***38.49***	***2.54***	***1.27***	***128.31***
v	O&M of Conventional Sewerage Network	Rs (Mn)	0.06	0.25	0.44	0.57	0.64	
vi	O&M of Wastewater treatment facilities	Rs (Mn)	0.00	0.00	2.31	2.31	2.31	
vii	*Annual O&M Expenditure*		***0.06***	***0.25***	***2.76***	***2.88***	***2.95***	
viii	*Indicative user fees*	*Rs/HH/Yr*					***275***	
C.2	**Septage Clearance and Treatment**							
i	*Households Served*	*Nos*	*17,735*	*16,706*	*14,958*	*13,739*	*13,544*	
ii	No of septic tanks cleared annually	No/ year	8,868	8,353	7,479	6,870	6,772	
iii.	Septage Clearance Equipment	Rs (Mn)	7.20					
iv	Construction of septage treatment facility	Rs (Mn)	7.84					
	Capital Investment		**15.04**					***15.04***
v	Annual O&M of septage clearance equipment	Rs (Mn)	4.92	4.43	3.94	3.94	3.94	
vi	Annual O&M of septage treatment facility	Rs (Mn)	0.47	0.47	0.47	0.47	0.47	
vii	Annual O&M Expenditure	Rs (Mn)	***5.39***	***4.90***	***4.41***	***4.41***	***4.41***	
viii	*Indicative Septic tank clearance charge**	Rs/ tank	***608***	***587***	***589***	***642***	***651***	

Notes:

- In case of wastewater treatment plant, O&M expenditure begins in completion year;
- No separate septage treatment facility is proposed. Septage can be treated at the wastewater treatment plant site

* - As existing septic tanks are connected to sewerage, the overall number of households using septic tanks reduces, the HNPP will have to accordingly withdraw some of the septage clearance trucks from the fleet.
Source: Hoshangabad CSP Analysis, 2010

The overall operation and maintenance expenditure on septage clearance is expected to be about Rs 4.40 million in year 5 to serve about 13,500 households. This translates to about Rs 650 per septic tank clearance.

The key benefits and challenges of mixed sanitation approach for Hoshangabad are presented in Table (3.32).

Table (3.31): Mixed Sanitation Arrangements: Benefits and Challenges

Benefits	Challenges
• No need to augment a water supply • Low maintenance • Improvements can be implemented incrementally- allows better financial planning based on availability • No dependence on power supply for operation • Very low operation and maintenance cost- hence low burden on users. • Simple operation and maintenance	• Capital intensive system, especially for wastewater treatment facilities. However, an overall balance is struck with a mixed approach • Households will have to invest substantial amount in upgrading
Source: Hoshangabad CSP Analysis, 2010	

3.5 Community and Public Sanitary Conveniences

Infrastructure requirement for public and community sanitary conveniences are estimated separately as these remain common across all the options. As mentioned earlier on an average day the town received about 15,000 visitors, which peaks to over 100,000 on festive occasions. As mentioned earlier, there are a total of 12 public toilet blocks having 180 latrine seats (considering an average of 15 seats per block). Although exact details are not available, some local residents are also said to use these toilet blocks. Thus, the existing public sanitary conveniences are highly inadequate. In order to provide efficient and effective service, it would be necessary to augment the capacity by adding new seats.

Although more than 100,000 persons visit the town on festive occasions, it will not be economically viable to create capacity to serve peak day visitor count. It is therefore, proposed to create a capacity for about 15,000 average daily visitors. Considering a norm of 60 users per latrine seat per day for public toilets, a total of 250 seats will be needed to meet the requirements 15,000 visitors.

The overall aim of the HNPP is to achieve a goal of open defecation free city within five years. This can be achieved by improving access to either household sanitation facilities or common facilities for unserved population. In order to serve resident unserved population community sanitary conveniences are proposed to be built. In year-1 of the CSP implementation, it is estimated that about 783 households will need to be served through community toilet blocks. As the CSP implementation progresses, this requirement will reduce to about 60 households in year-5.

The ultimate target of the HNPP is to ensure access to individual household latrine for all or most its resident population. However, this may not be possible within first year of the programme itself. As the CSP implementation more and more households build individual latrines. This would lead to reducing the

load on community sanitary conveniences, which could then be increasingly used to serve for floating population. This will reduce the visitor load on public toilets.

The requirement of latrine seats for public and community sanitary conveniences has been estimated as:

- Floating population: 70 seats
- Resident households using community toilets: 112 seats

Estimated capital, operation & maintenance expenditure and indicative user fee has been presented in Table (3.32).

TABLE (3.32): INDICATIVE INVESTMENT REQUIREMENTS, O&M COSTS AND USER CHARGES FOR PUBLIC/ COMMUNITY SANITARY CONVENIENCES

Sl #	Component	Unit	Year Wise Costs					
			2010	2011	2012	2013	2014	*Total*
A.	**Public Sanitary Conveniences**							
i.	Floating population served (including persons served by existing PSCs)	Persons	12,270	13,530	14,370	14,790	15,000	
ii.	Construction of public sanitary conveniences	Rs in Mn	0.98	0.84	0.56	0.28	0.14	***2.79***
	Annual O&M of public sanitary conveniences	*Rs in Mn*	*2.30*	*2.54*	*2.69*	*2.77*	*2.81*	
	Indicative minimum user charge	Rs/ use	***0.51***	***0.51***	***0.51***	***0.51***	***0.51***	
B.	**Community Sanitary Conveniences**							
i.	Households Served	No of HH	783	496	320	149	66	
ii.	Construction of community sanitary conveniences	Rs in Mn	4.47					***4.47***
	Annual O&M of community sanitary conveniences	*Rs in Mn*	*1.008*	*1.008*	*1.008*	*1.008*	*1.008*	
	Indicative minimum user charge per household	Rs/ month	***110****					

Note:
* - Rs. 110 per month may be unaffordable for poor households. It may therefore be necessary to combine public and community sanitary conveniences to promote cross-subsidising O&M costs.
Source: Hoshangabad CSP Analysis, 2010

The financial analysis presented above indicates that sustainable and self-financed O&M of public sanitary conveniences can be ensured if per use fee of 50 paise is collected. On the other hand in order to ensure self financed O&M, community toilet users will need to pay about Rs 110 per household per month. For a family of 5, this turns out to be nearly 75 paise per use. This tariff will not be affordable to slums dwellers and thus may be encouraged to opt for open defecation.

In order to rationalise the user charge for local residents, options for cross-subsidising should be explored. One of the possibilities is to build common block (rather than separate/ distinct) for floating and resident population. The HNPP may have to implement rules to limit user charges for local residents. This may be possible by introducing a system of family pass.

The indicative user fee has been estimated considering pooling of resources from all toilet blocks in the town. However, in practice it is best to work out the economics of individual toilet block, so that they function independent of other toilet blocks. Thus, actual user fee may be higher or lower that average threshold estimated above. Moreover, the financials shall be reviewed from time to time and user fee revised as necessary.

3.6 Comparison of Suggested Sanitation Options

A comparative analysis of all five suggested sanitation options is presented in Table (3.33) below. By the end of CSP implementation in 2014, more than 28,000 households (nearly 157,000 persons) will benefit from improved city-wide sanitation. All approaches aim at safe handling, treatment and disposal of human excreta and community liquid wastes. It also serves the purpose of reducing discharge of pollutant load in Narmada River.

The estimated household/ private investment, for analysed five sanitation options, ranges between Rs 155 million for 'fully On-site' system to about Rs 190 million for 'simplified sewerage' system. In all options, the average expenditure per households for new construction is highest; it ranges from about Rs 13,000 to Rs 16,000. Average per household expenditure for upgrading existing facilities is lowest (about Rs 1,500) for 'fully on-site' system and highest (about Rs 4,900) for 'simplified sewerage' system. In case of un-served households, average per household expenditure ranges from about Rs 9,500 to Rs 11,900.

TABLE (3.33): COMPARISON OF INVESTMENT REQUIREMENTS OF FOUR CITY-WIDE SANITATION OPTIONS

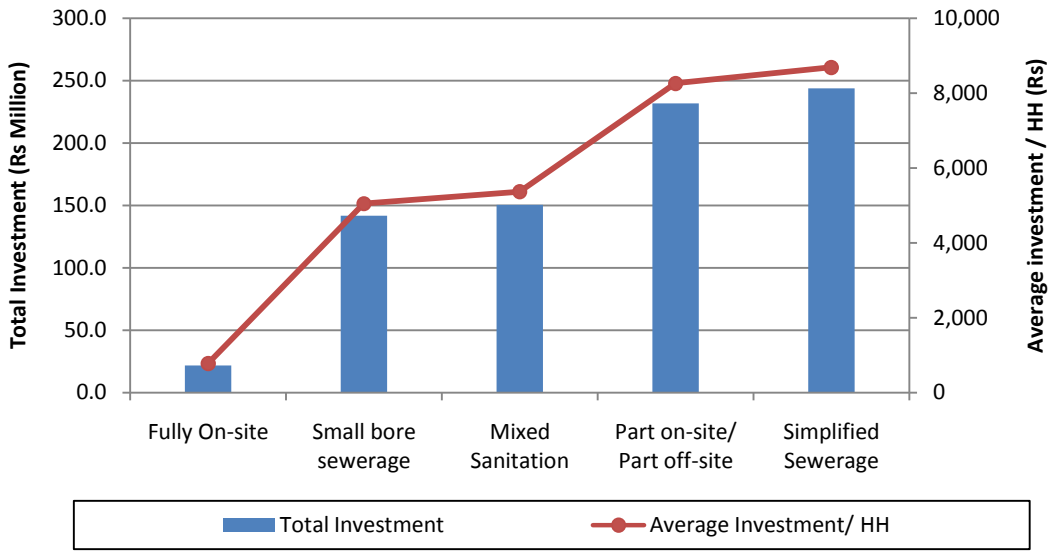
No.	Component	Unit	Sanitation Approach				
			Fully On-site	Small bore sewerage	Part on-site/ Part off-site	Simplified Sewerage	Mixed Sanitation
A	**Household/ Private Capital Investment**						
A.1	**Household Sanitation Arrangements**						
i	New Construction	Rs (Mn)	73.98	64.83	55.21	53.85	63.25
ii	Upgrading of existing facilities	Rs (Mn)	29.10	56.82	67.36	89.42	51.46
iii	Increasing coverage for un-served households	Rs (Mn)	52.28	57.98	45.50	46.4	46.93
iv	**Household Investment**	**Rs (Mn)**	**155.36**	**179.63**	**168.08**	**189.67**	**161.63**
B	**Public Investment, O&M Expenditure and Recovery**						
B.1	**Wastewater Conveyance and Treatment**						
i	Households Served	HH		22,069	18,438	26,239	10,707
ii	Sewerage Network	Rs (Mn)		34.76	67.04	21.6	12.71
iii	Wastewater treatment facility	Rs (Mn)		90.87	150.28	215.01	115.60
iv	**Public Capital Investment 1**	**Rs (Mn)**		**125.63**	**217.32**	**236.61**	**128.31**
v	O&M of Sewerage Network	Rs (Mn)/ Yr		3.91	5.36	1.08	0.64
vi	O&M of Wastewater treatment facility	Rs (Mn)/ Yr		10.9	18.03	4.3	2.31
vii	*O&M Expenditure*	*Rs (Mn)/ Yr*		*14.81*	*23.40*	*5.38*	*2.95*
viii	**Indicative User Fees: wastewater conveyance and treatment**	**Rs/HH/Yr**		**671**	**1,269**	**205**	**275**
B.2	**Septage Clearance and Treatment**						
i	Septic tank user households	Nos	20,310	22,069	6,204		13,544
ii	Septic tanks cleared	Tanks/year	10,155	11,035	3,102		6,772
iii	Septage Clearance Equipment	Rs (Mn)	8.0	8.8	7.2		7.2
iv	Construction of septage treatment facility	Rs (Mn)	6.45				7.8
v	**Public Capital Investment 2**	**Rs (Mn)**	**14.5**	**8.8**	**7.2**		**15.0**
vi	Annual O&M of septage clearance equipment	Rs (Mn)	5.41	3.7	1.476		3.9
vii	Annual O&M of septage treatment facility	Rs (Mn)	0.47				0.5
viii	Annual O&M Expenditure	Rs (Mn)	5.9	3.7	1.5		4.4
ix	**Indicative Septic tank clearance charge***	Rs/ tank	**579**	**335**	**476**		**651**
B.3	**Public Sanitary Conveniences**						
i	Floating population served (including persons	Persons	15,000				

TABLE (3.33): COMPARISON OF INVESTMENT REQUIREMENTS OF FOUR CITY-WIDE SANITATION OPTIONS							
No.	Component	Unit	Sanitation Approach				
			Fully On-site	Small bore sewerage	Part on-site/ Part off-site	Simplified Sewerage	Mixed Sanitation
	served by existing PSCs)						
ii	Construction of public sanitary conveniences	Rs (Mn)	2.79				
iii	**Public Capital Investment 3**	**Rs (Mn)**	**2.79**				
iv	O&M of public sanitary conveniences	Rs (Mn)	2.81				
v	Indicative minimum user charge	Rs/ Use	0.51				
B.4	**Community Sanitary Conveniences**						
i	Households Served	Nos	from about 783 HH in Year-1 to about 60+ HH in Year-5				
ii	Construction of community sanitary conveniences	Rs (Mn)	4.47				
iii	**Public Capital Investment 3**	**Rs (Mn)**	**4.47**				
iv	O&M of community sanitary conveniences	Rs (Mn)	1.008				
v	Indicative minimum user charge	Rs/HH/ Month	110				
	Summary						
C	**Population/ HH Benefitted (Year: 2014)**						
i	Households Benefitted	HH	28,076				
ii	Population Benefitted	Persons	1,56,986				
D	**Total capital investment (Public + Private)**	**Rs (Mn)**	**174.3**	**318.5**	**397.1**	**430.8**	**309.4**
E	**Private Investment**						
I	City-wide Total	Rs (Mn)	155.4	179.6	168.1	189.7	161.6
i	City-wide average per household	Rs/ HH	5,534	6,398	5,987	6,756	5,757
ii	Average per household constructing new facilities	Rs/ HH	15,714	13,770	11,728	11,438	13,434
iii	Average per household upgrading existing facilities	Rs/ HH	1,575	3,075	3,645	4,839	2,784
iv	Average per un-served household*	Rs/ HH	10,696	11,862	9,309	9,493	9,601
F	**Public Investment**						
i	Public investment Total	Rs (Mn)	21.7	141.7	231.8	243.9	150.6
ii	**Average public investment per household**	Rs/ HH	***773***	***5,047***	***8,255***	***8,686***	***5,364***
Note:							
* - septic tanks clearance frequency is considered as once in two years.							
Source: Hoshangabad CSP Analysis, 2010							

The summary of financial analysis has been represented in the Fig (3.1) below. It can be clearly seen that public investment in 'Fully On-site' option is the least (about Rs 22 million) among all options. For off-site systems (fully or partly), public investment for wastewater conveyance and treatment is estimated at about Rs 142 Mn for small bore sewerage, Rs 232 Mn for 'part on-site/ part off-site' system, about Rs 244 Mn for simplified sewerage and decentralised treatment based system, and about Rs 151 million for mixed sanitation system. Although simplified sewerage and decentralised treatment based system is capital intensive, it is the cheapest on annual O&M (as seen in later charts).

On the lower end of the spectrum, the public investment translates to less than Rs 800 per household for on-site sanitation option and nearly Rs 8,700 per household on the higher end of spectrum in case of simplified sewerage option. Per household investment for small bore sewerage and mixed sanitation options is about Rs 5,000 and for part on-site/ part off-site sanitation option is estimated at Rs 8,300.

Figure (3.1): Indicative Investment (Households and Public) Estimates for Various City-wide Sanitation Options, Hoshangabad



Note:

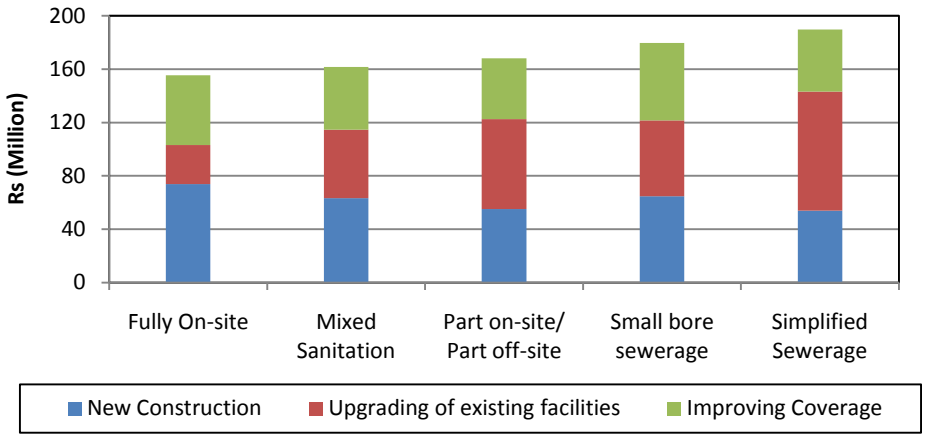
* - Sanitary Convenience or Public/ Community Toilet block

Investments in a) Septage clearance and treatment, b) Public/ Community Toilet blocks, and c) Wastewater Transportation and Treatment infrastructure are collectively referred as ***'Public Investments'***

Source: Hoshangabad CSP Analysis, 2010

Indicative estimates of private (household) investment for various sanitation options are presented in Figure (3.2). These range from about 155 million for 'fully on-site' system to about Rs 190 million for 'simplified sewerage' option. Mobilising the residents to invest huge amount in sanitation will need a systematic awareness campaign.

Figure (3.2): Indicative Estimate of Private (household) Investment for Various City-wide Sanitation Options, Hoshangabad



Notes:

*Household investment in either new construction of upgrading household sanitation facilities is referred as **'Private Investments'***

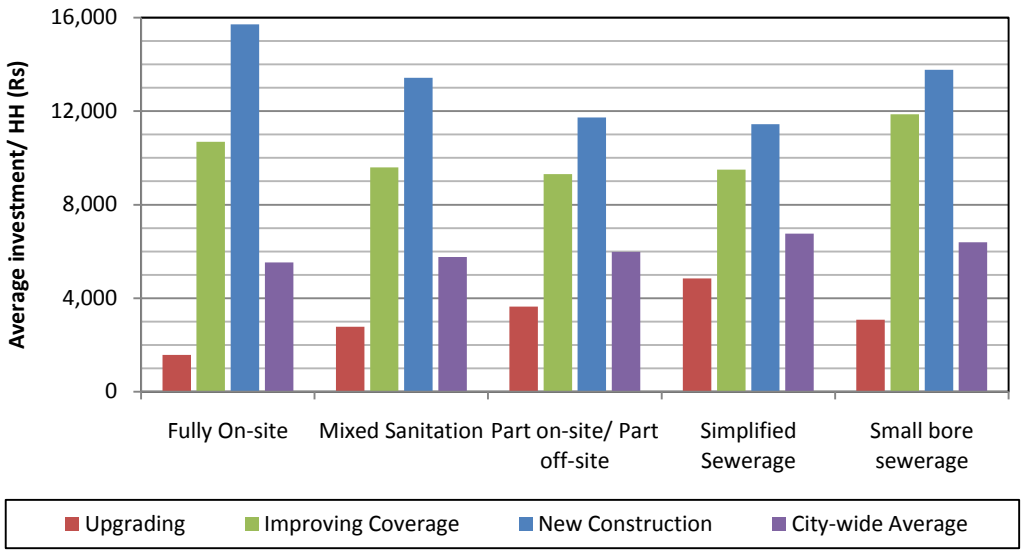
Source: Hoshangabad CSP Analysis, 2010

The average investment per household for fully on-site sanitation options is the lowest at Rs 5,534. Within this option the existing households have to invest only about Rs 1,575 in upgrading existing facilities, whereas the new construction is likely to cost nearly Rs. 16,000 as presented in Figure (3.3) below.

At the other end of spectrum is simplified sewerage option, wherein an average per household investment is likely to be about Rs 7,000. In this case average expenditure for existing households is likely to be about Rs 4,900. New construction and improving coverage is likely to cost about Rs 11,500 and Rs 9,500 respectively.

The mixed sanitation option appears much rationalised across the three categories of households- new construction (~ Rs 13,500/ HH), upgrading (~Rs 2,800/HH) and improving coverage (~Rs 9,600).

Figure(3.3): Indicative Average Private (Household) Investment for Various Sanitation Options



Source: Hoshangabad CSP Analysis, 2010

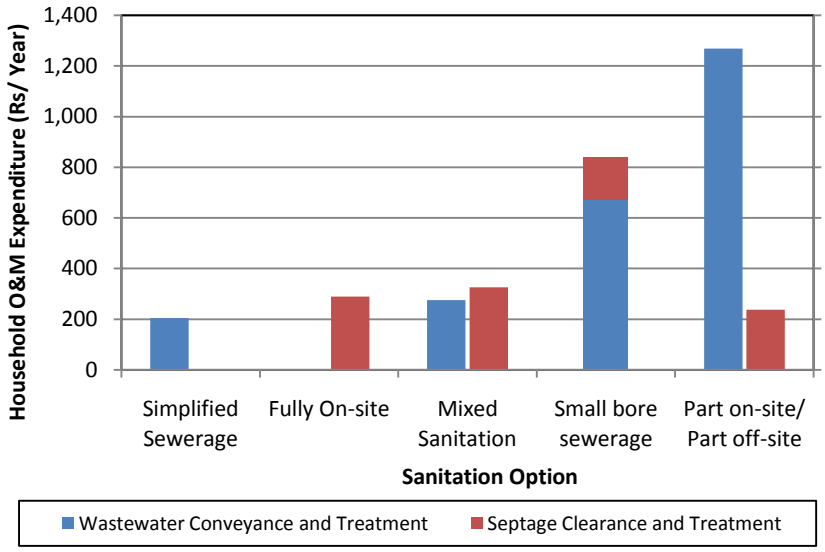
In terms of public investments, 'Simplified Sewerage' based option is most expensive in terms of capital investments. However, as we see in Fig (3.4), it is interesting note that the 'Simplified Sewerage' option is one of the two low cost options in terms of operation and maintenance. It is comparable with 'Fully On-site' city-wide sanitation approach. In case of 'part on-site/ part off-site' approach, households connected to sewerage network would be required to pay about Rs 1,269 per year and households using septic tank will have to pay about Rs 240 per year (considering cleaning interval of two years).

In case of 'small bore / settled sewerage' sanitation option, the households connected to the network have to pay about Rs 840 per year. This will include Rs 670 for wastewater conveyance and treatment and about Rs 170 for septage clearance.

Under the 'Simplified sewerage' based sanitation option, each household has to pay a little over Rs 200 per year. In case of mixed sanitation option, sewer connected households will have to pay about Rs 275 per year and households using septic tanks will need to pay about Rs 325 annually for septic tank clearance.

In case of part on-site/ part off-site option, households connected to septic tanks will pay about Rs 240 per year, whereas households connected to conventional sewerage network will have to pay about Rs 1,270 per annum. This translates to more than Rs 100 per month. As outlined in the situational analysis report, collection of user charges will be a major challenge for the HNPP.

Fig (3.4): Indicative User Fees Needed to Self-finance Sustainable O&M of the city-wide Sanitation Services



Source: Hoshangabad CSP Analysis, 2010

3.7 PROPOSED SYSTEM IMPROVEMENTS for Solid Waste Management

3.7.1 Population and Solid Waste Projections

As per the CPHEEO norms and the background material for Manual of SWM prepared by NEERI in 1996, the average per capita generation of MSW per day for the towns' upto 5 lakhs population is 210 gms. The typical growth in per capita generation in MSW (according to TERI) is 1.33% per annum. Using the above norms, the daily per capita generation of MSW in Hoshangabad in 2009 works out to 249 gms. However due to the large daily floating population in the city (10 – 15,000 per day), the per capita generation of MSW has been considered as 300 gms per day, for the purposes of estimation.

The past decadal growths in the population are presented in Table 3.34 below:

S. No.	Year	Population	Decadal Growth in Population (%)
1	1971	29,434	
2	1981	46,300	57.3
3	1991	70,914	53.2
4	2001	97,424	37.3

The average decadal growth over the period 1971-2001 has been 49.3%. However, following trends in the past decade, the growth rate in the period 2001 – 2010 is assumed to be 3.74 percent. The population of Hoshangabad in 2010 is estimated at 135,553 persons, and assuming that there is no change in overall household size, it is estimated that there would be about 24,243 households.

Some of the observations & issues on the demographics are as follows:

- 40 percent of families fall Below Poverty Line.
- Lack of Infrastructure to accommodate the increasing population
- High percentage of illiterate females.

Projections in waste quantity are presented in Table (2.2).

3.7.2 The MSWM Rules 2000 highlight the following desirable characteristics of waste management systems:

- 100% Door to Door Collection, using containerised carts or small vehicles
- No burning of wastes at any stage
- Provision of easy to operate storage facility / bins
- Minimal manual or multiple handling of wastes
- Daily clearance of MSW
- Covered transportation of MSW
- Biodegradable wastes shall be processed by appropriate biological processing for stabilization of wastes
- Mixed waste containing recoverable resources shall follow the route of recycling
- Energy recovery including RDF can be used for processing wastes
- Minimum waste to be transferred to landfill site and maximise value of output generated
- Land filling to be restricted to:

- non-biodegradable, inert waste and other waste that are not suitable either for recycling or for biological processing
- pre-processing rejects from waste processing facilities
- residues of waste processing facilities

3.7.3 Proposed System Improvements: The system improvements proposed focus on the following aspects:

- Organization of door to door collection of waste (with community participation)
- Provision of storage bins at appropriate locations to eliminate collection of waste on ground
- Daily removal of waste from all collection /storage bins
- Minimizing manual handling of waste using simple hydraulic system mounted vehicles
- Development of simple treatment facility
- Phased development of safe landfill facility

3.7.4

The proposed system improvements take into account the existing equipment available with HNNP, and their optimum deployment, so as to minimize additional expenditure, both capital and operational. Moreover, the capacity of HNPP to implement the SWM action plan has also been an important consideration.

Table 3.35: Proposed system improvements

S. No	SWM Activity	Proposed System
1	Primary (D-to-D) Collection	Mechanised auto-tippers, with 5 member collection crew each, to collect waste from households. Auto-tippers to tip waste directly into dumper bins
1 (a)	Collection from Market Places	Dedicated 2 member team for each market to sweep & collect waste once in morning and once in afternoon
1 (b)	Drain cleaning	Dedicated 6 member team to clean all drains once a month
1 (c)	Road Sweeping	Two member teams organized into beats. Major roads to be swept daily; minor roads once in two days
3.	Secondary Storage	Use of existing 4.5 Cu M. dumper bins
4	Secondary Transportation	Deployment of existing dumper placers. To be augmented to ensure daily clearing of wastes
5	Treatment	Phased reclamation of dump at Idgah; establishment of compost facility
6	Disposal	Development of Scientific landfill site at Bhaikhedi

The requirements for each activity, in terms of man-power and equipment are detailed below.

3.7.5 Estimation of System Requirements: Collection and Transportation

Door-to-door Collection: In order to introduce DTDC, and prevent accumulation of wastes on the roads, in open spaces and in drains, fully mechanized auto tippers are to proposed for collection of wastes from households. In this system the auto tipper along with collection crew stops at the street/locality and the household bin is picked up by a collection crew from the premises with the help of bucket/push cart. Auto tippers provide a better coverage of households, over a larger area with better efficiency. Auto tippers also tip the waste directly into the larger bins directly. Segregation of wastes is not proposed initially, but may be introduced gradually over a period of 5 – 7 years, once the DTDC system is well established.

As estimated in the following table each auto tipper will cover about 1000 households every day under door to door collection system.

Table- 3.36: Estimation of Households Covered by Auto Tipper

Item	Quantity
Households covered by each collection crew	200
Total number of collection crew with each auto tipper	5
Number of Households Covered by each Auto Tipper	1000 HH/Day

The total number of households in HNNP area is about 24,243. Auto tipper consists of one driver and 5 helpers shall be given time schedule and route map for door to door collection. After entering in to the collection area the auto tipper will blow the horn or vigil. The helpers of the auto tippers will go to the households with buckets/bins of 40 litre capacity to collect the waste from the households and place the same into the auto tippers. The auto tipper move slowly or stop at a particular point till the street households are covered by the helpers of the auto tippers. After the full load the auto tipper will move to the nearest dumper bin and unload the waste. Thus to implement 100% door to door collection system in HNNP area it is required to deploy 25 Auto Tippers as estimated below.

Table-3.37: Requirement of Auto Tippers in HNNP

Description	No.
Number of households	24243
Number of households covered by one auto tipper	1000
Number of auto tippers required	25
Considering 10% additional requirement	**28**
Number of helpers /push carts required along with auto tippers	**125**

Collection from Market Places: It is proposed that all important markets in HNNP be swept on daily basis. As indicated by HNNP there are 17 markets in Hoshangabad. These markets typically operate between 9AM to 9PM. It is proposed that dedicated two-person sweeping teams be deployed at each market for sweeping, collecting waste from shops, and depositing the waste in

the collection bins provided. This may be done twice during the day – once in the morning hours and once in the afternoon hours. As presented below a dedicated sweeping crew of 34 with 17 pushcarts is required for market sweeping.

Table 3.38: Requirements for Market Sweeping

Details	**Numbers**
No. of markets	17
Sweeping teams/shift	1
No. of shifts	1
Total sweeping teams required	17
Total sweeping crew required	**34**
No. of pushcarts required	**17**

Drain Cleaning: It is proposed that drain cleaning activities be carried out on systematic manner with a dedicated crew and proper cleaning and lifting schedule. It is proposed that drains be cleaned once in a month. A team of drain cleaning crew will be constituted, along with one tractor. It is proposed that each drain cleaning staff shall be allotted 1km length of drain daily, on an average. Thus as estimated below total crew of 6 with 1 tractor are required for effective drain cleaning in HNNP. The drain cleaning waste shall be transported directly to the landfill site.

Table-3.39: Requirements for Drain Cleaning

Details	**Numbers**
Total length of drains in HNNP	154 km
Average drain length per crew	1 km
Frequency of cleaning	Once a month (29 days)
No. of crew required	**6**
No. of tractors required	**1**

The larger SWDs may continue to be cleaned with the help of the JCB.

Street Sweeping: Street sweeping practices may be organized according to well planned “beats”, so as to increase efficiencies. It is proposed to assign 500 mts to each sweeper on the major roads, in the city centre including commercial & important areas; and 750 – 1000 mts per sweeper on medium or minor roads, in residential and low density areas. If most of the households, shops and establishments are covered through door to door collection, hardly any domestic waste is expected to be on the streets to be picked by the street sweepers – thus allowing them to focus on sweeping the streets.

The total road length in the city is 116.75 kms, of which major roads constitute 73.2 kms; and minor roads constitute 43.5 kms. It is proposed that major roads be swept on a daily basis, whereas medium / minor roads are swept on alternate days. The resulting number of beats is presented in the table below:

Table 3.40: Distribution of Road Length & Beat Allocation for Street Sweeping

Location	Road Length, km	Beat Length, m	No. of Beats	Frequency	Crew	Extra members	Teams
Major roads	73.21	500	147	All Seven Days	147	21	84
Medium and minor roads	43.54	1000	44	Alternate day	22	4	13
Total	**116.75**		**191**		**169**	**25**	**97**

The workers engaged in street sweeping will be equipped with a long handle broom, metal plate and tray, and one containerized pushcart with 4 bins of 40 litre capacity each, so that the waste is transferred easily to dumper containers.

The sweepers will work in 2 member teams in the beats allotted to them. Each two member team will share one push cart, and will carry out the following:

- Sweeping two 'single beat' lengths by one team (one person sweeping and one person lifting the sweepings immediately)
- Collecting the sweepings in the pushcarts
- Depositing the sweeping waste in the nearby container
- Cleaning the container stations with in the beat length
- Emptying litter bins in the area
- Curb side collection from shops/establishments along the road/street

97 push carts will be required. The waste collected in the carts is disposed into the nearest dumper bins.

Secondary Collection and Transportation: The main objective of the secondary collection system is to store the waste temporarily and transport it as quickly as possible. In order to promote single handling system, it is desirable to discontinue any current open (land) and static (masonry bins) collection system. Since HNNP currently has 55 dumper placer bins of 4.5 Cu.M capacity, and 100 dumper bins of 3 Cu.M capacity, it is proposed to deploy these to the fullest extent for collection and storage of waste. The number of bins required is estimated below:

Table 3.41: Requirement of Dumper Bins

Volume of each bin, m^3	4.5
Capacity of each bin, MT	1.95
Quantity of waste generation, TPD	42
Number of dumper bins required	22
Additional bins (10%)	3
Empty bins required with dumper placers	3
Total No. of Dumper Bins Required	**28**

Note: Density of waste is assumed at .43T/Cu.M

Transportation of waste stored in the dumper bins will be undertaken by dumper placers, in order to avoid manual handling. HNNP is already equipped with 2 single bin dumper placers. It is proposed that HNNP procure two additional dumper placers, in order to meet the transportation requirements, as estimated below:

Table -3.42: Requirement of Dumper Placers

Number of Dumper Bins	22
Number of trips perform by each dumper placer (2 shifts)	8
Number of bins covered by Dumper placer daily	8
Number of Dumper placers required	3
Additional Dumper Placers Required during Breakdowns and to cater to waste generated by pilgrim population	1
Total Number of Dumper Placers Required	**4**

The waste will be transported to the dumping ground near Idgah, part of which is proposed to be re-claimed in order to establish waste treatment facilities (refer later)

Manpower Requirements: The above proposed system will enable HNNP to meet the regulatory requirements for collection, storage and transportation of MSW generated in the city. The total man-power (operations only) required is summarized in the table below:

Table 3.43: Manpower Requirement

Staff	**Total Estimated Requirement**
Auto Drivers	25
Auto Helpers	125

Street Sweepers	194
Market Sweepers	34
Drain Cleaners	6
Drain Cleaning Tractor Drivers	1
DP Drivers	7
DP Helpers	7
Total	**399**

As presented above, the increased level of operations for door-to-door, secondary collection and transportation entail significant additional manpower. Moreover, there is a freeze on new recruitments to municipal staff.

As per the information provided by HNNP, the city has operational sanitation staff strength (for SWM operations) of 73, including 10 drivers. This is supplemented by administrative and supervisory staff of approx. 10. The permanent staffs are currently augmented through contract staff – approx. 190 workers hired on a daily basis.

In order to rationalize the system, it is proposed that HNNP undertake operations to fully deploy it's current permanent staff and equipment; and outsource the balance activities to private operators under performance based contracts. Since DTDC is a newly proposed activity, it may be best to out-source this to private sector altogether. Moreover, since dumper bins, dumper placers, drivers and helpers are available with HNNP, the activities relating to secondary transportation may be retained by municipal staff. Similarly, drain cleaning activities may be retained by ULB staff. Street sweeping, an activity with a large requirement of man-power may be divided between HNNP and private operators, with HNNP clearly demarcating areas under it's jurisdiction.

The proposed deployment of man-power is presented in the table below:

Table 3.44: Manpower deployment

Staff	**Total Estimated Requirement**	**Proposed HNNP Staff**	**Proposed Private Operator(s)Staff**	**% undertaken by private operator(s)**
Auto Drivers	25	0	25	100
Auto Helpers	125	0	125	100
Street Sweepers	194	52	140	75
Market Sweepers	34	0	34	100
Drain Cleaners	6	6	0	0
Drain Cleaning Tractor Drivers	1	1	0	0
DP Drivers	7	7	0	0

DP Helpers	7	7	0	0
Total	**399**	**73**	**326**	

Thus all of drain cleaning, secondary collection and transportation activities; and 25% of street sweeping activities may be undertaken by HNNP current permanent staff. All primary collection and transportation, market cleaning and 75% of street sweeping activities are to be outsourced to private sector. Streets assigned to HNNP staff must be clearly demarcated, in order to avoid disputes over jurisdictions and responsibilities.

3.7.6 Costing

Capital Cost: These are presented in the table below:

Table-3.45: Capital Cost

Primary & Secondary Collection					
S. No.	**Vehicle/Equipment to be procured**	**No.**	**Unit Cost, Rs.**	**Amount, Private Operator (Rs.)**	**Amount, HNNP (Rs.)**
1	Auto Tippers	28	230000	6325000	
2	Push Carts (with Auto Tipper)	125	1500	187500	
3	Dumper Bins	28	0		0
4	Dumper Placers (single)	2	1050000		2100000
5	Tractors (Drain Cleaning)	0	0		0
	Sub-Total			**6512500**	**2100000**
Street and Market Sweeping					
S. No.	**Vehicle/Equipment to be procured**	**No.**	**Unit Cost, Rs.**	**Amount, Private operator (Rs.)**	**Amount, HNNP(Rs.)**
1	Push Carts (Street Sweeping)	97	10000	720000	250000
2	Push Carts (Mkt. Sweeping)	17	10000	170000	0
3	Equipment per sweeper	228	500	87500	26500
	Sub-Total			**977500**	**276500**

Operations and Maintenance (O & M) Costs: These are presented in the table below:

Table3.46: Operation & Maintenance Cost (Private Operator)

Component	No. of Units	Basis	Annual O&M Cost, Rs.
Auto Tippers	28	Maintenance Cost @ Rs. 1800/Month/Vehicle	148500
		Operation Cost - Fuel @ 18 km/ litre, and assumed travel of 5 km/ day	
		Operation Cost - Fuel @ 6 km/ litre, and assumed travel of 35 km/ day	
Pushcarts (Markets)	17	Rs.300/Annum/Unit	5100
Pushcarts (Street Sweeping)	72	Rs.300/Annum/Unit	21600
Replacement of Equipment for sweeper	175	500/sweeper, replaced every 6 months	175000
Sub-Total			**350200**
Salaries		@ Rs. 1124500 per month	**13494000**

Table-3.47: Operation & Maintenance Cost (HNNP)

Component	No. of Units	Basis	Annual O&M Cost, Rs.
Tractors	1	Maintenance Cost @ 5000 /Annum	30920
		Operation Cost - Fuel @ 6 km/ litre, and assumed travel of 12 km/ day	
Dumper Placers	4	Maintenance Cost @ 1500/vehicle/Annum	538560
		Operation Cost - Fuel @ 4 km/ litre, and assumed travel of 36 km/ vehicle/day	
Pushcarts (Street Sweeping)	25	Rs.300/Annum/Unit	7500
Dumper Bins	28	Rs.600/Annum/Unit	16800
Replacement of Equipment for	53	500/sweeper, replaced every 6 months	53000

Component	No. of Units	Basis	Annual O&M Cost, Rs.
sweeper			
Sub-Total			**646870**
Salaries		As indicated by HNNP for 2009-10	**6270000**

Tipping Fee, and HNNP Outflows: Based on the system assumptions and cost estimations outlined above, HNNP would be required to pay the private operator(s) a fee of approx. Rs. 970/ ton of waste handled, in order to ensure the operator a reasonable return on investment. Payment will be made on the basis of weight of waste reaching the Idgah grounds (as weighed by the weigh bridge installed at the grounds), and will include payments for handling additional quantities of waste generated by pilgrims to the town, as outlined below

Additional Services for Waste generated by Visitors: Hoshangabad is an important pilgrim destination, and rough estimates suggest that approx. 100000 – 150000 pilgrims visit the town, almost on a monthly basis. The quantum of additional waste generated by pilgrims has been estimated on the following basis:

- No. of visitors (assumed): 125000
- Average length of stay (days): 1
- Per capita waste generated (kgs/capita/day): 0.15
- Total additional waste generated (TPD): 18.75
- No. of festive days/annum: 10
- Additional waste generated per annum (Tons): 187.5
- Increase in waste generation (% per annum): 2%

Most of the waste generated by visitors will be deposited directly in bins located in the areas frequented by them in the city (ghats, religious precincts, guest houses…etc). It is assumed that the private operator(s) contracted for primary collection will augment services on these special days, in order to ensure that this waste is finally deposited in the dumper bins which will be lifted by HNNP staff for transportation to the Idgah grounds. The operator will be paid at the same rate (Rs. 970/Ton of waste handled) for this additional service.

HNNP outflows for establishing and sustaining the proposed collection and transportation system over a 7 year period are presented in the table below. These include payments to the private operator, as well as HNNP capital investments in the system; and O & M expenses.

As indicated, HNNP's outflows, towards O & M for primary collection and transportation; and secondary collection and transportation are estimated to be Rs. 219.7 lakhs in the first year of operations (20010-11). Additional capital expenditure, towards procuring 2 dumper placers, of Rs. 23.77, is also proposed.

HNNP's current revenue expenditure towards SWM is Rs. 168.5 lakhs. The proposed system represents an increase of approx. 51 lakhs per annum over current spends – for comprehensive services including DTDC of wastes; regular sweeping of roads and cleaning of drains; and lifting of all wastes on a daily basis. Assuming that 42 TPD waste, and all additional waste generated by visitors is handled, this translates into a per ton cost of Rs. 1416 per ton, which compares favourably with the current per ton cost of Rs. 1540.

The additional spend by HNNP can be covered by levying a small user charge on various categories of users, including a service charge on pilgrims. Responsibility for collection of user charges should be given to the private operators, since it is best undertaken alongside DTDC. The service charge from pilgrims may be collected from vehicles at the entry point to the town. The potential revenue that may be generated is presented in the table below:

Table 3.48: Potential revenue generation								
No	**Item Description**	**Cost (Rs. Lakh)**						
		Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**
	Payments to Private Operator							
1	Payment to private operator @ Rs. 970 / Ton, assuming 42 TPD	148.701	151.675	170.2	173.6	194.8	198.7	222.9
2	Extra for visitor waste (@ Rs. 485/Ton handled)	1.819	1.855	2.081	2.123	2.382	2.430	2.726
	HNNP Operations (incl. secondary collection and transportation)							
3	O & M expenditure (excl. permanent staff salaries)	6.47	6.79	7.13	7.49	7.86	8.25	8.67
4	Permanent staff salaries	62.70	65.84	69.13	72.58	76.21	80.02	84.02
	Total Outflow, Primary Collection & Transportation; Secondary Collection and Transportation	219.69	226.16	248.52	255.78	281.22	289.36	318.31
	Capital expenditure for additional system requirements)	23.77			2.5			

Assumptions:

- Tipping fee increases @ 10% every 2 years
- Waste quantity increases @ 2% every year
- Manpower costs increase @ 5% every years
- Cost of fuel, repair and maintenance; and replacement of equipment increase @ 3% every year

Table 3.49 User Charges and Revenues

No	Category of User	Number	Proposed Charge (Rs/month)	Potential Revenue (Rs./annum)
1	Shops	910	35	382200
2	Kiosks	271	10	32520
3	APL Households	15000	20	3600000
4	Pilgrims	125000	5	6250000
	TOTAL (Rs.)			**10264720**

Assuming even 50% collection efficiency in the initial stages, revenues of approx. 26 lakh may be collected. The shortfall will be borne by the state.

3.7.7 Estimation of System Requirements: Treatment and Disposal

Waste collected is currently being dumped at the grounds at Idgah, over an area of approx. 8 acres. It is proposed that approx 4 acres of the site be reclaimed in order to establish a segregation unit and a 30 TPD aerobic composting unit (generating approx. 5TPD compost). The balance land may be used for disposing rejects in the immediate future; and may be reclaimed once a scientific landfill facility, to be shared with Itarsi ULB, is established at the new site at Baikhedi. It is estimated that about 40% of the total waste, in form of processing rejects and inserts, would require sanitary land-filling.

The system requirements and costs implied in establishing the compost facility are outlined below:

Table 3.50: System requirement for a composting facility

No	Description	Number/Area	Rate	Total (Rs. '000)
1	Reclamation (sqm)	16000	40	640
2	Earthwork Excavation (cu.m)	16000	80	1280
3	Foundation (sqm)	8000	200	1600
4	Boundary Wall (m)	120	5000	600
5	Weigh bridge	1	1000000	1000
6	Pre-Engineered Building for Waste Segregation, recycling and composting (sqm)	3000	2000	6000
7	Waste Sieving machinery	1	1200000	1200
8	Waste Grinding Machines	1	200000	200
9	Packing Machinery	1	500000	500
10	Misc Assets	Lump sum		200
	TOTAL (Rs '000)			**13220**

The annual operation and maintenance costs for the unit are presented below:

Table 3.51: Operation and maintenance cost requirements

S. No	Description	Number/Area	Rate	Total (Rs. '000)
1	Admn. Staff -1manager	1	120000	120
2	Supervisor	1	70000	70
3	Driver - JCB	1	60000	60
4	Labour and Security	10	48000	480
5	Power,25 kw ,4 hrs daily ,365 days	30000	4	120
6	Water	600	5	3
7	Fuel,10 litres per day,365 days	3650	36	131.4
	Packing 500 bags 10 kg each daily	182500	2	365
8	Misc. expenses	300	500	150
	TOTAL (Rs '000)			**1499.4**

Operations of the compost facility will generate revenues through the sale of recovered materials and compost. It is estimated that approx. 1ton of plastic will be recovered daily, sale of which (@ Rs. 1 per kg), will generate approx. Rs. 3.5 lakh per annum. Sale of compost produced at the plant, at the rate of Rs. 2 per kg) will generate an estimated income of Rs. 36.5 lakh per annum. This, however, will require active state support, working through fertilizer companies to ensure off-take on a regular basis. Thus the plant will generate revenues of approx. Rs. 40 lakh per annum.
It is proposed that the compost plant be developed through local private sector participation. It may be necessary for the ULB to support establishment through an initial grant / loan.

An estimated 14 – 16 tons of rejects will require being disposed on a daily basis. This translates into approx.5500 tons per annum. While processing of wastes generates revenues, land-filling of rejects is a cost centre, with economies of scale being realized while handling quantities of at least 300 TPD. It is thus not viable for HNNP to attempt to develop a SLF site independently. It is thus proposed that discussions and studies be initiated to explore the possibility of a regional landfill facility being established at the site at Baikhedi, with the participation of Itarsi, and any other ULB's within a reasonable travel distance of 20 – 15 kms. This should be initiated at the earliest, in order to enable HNNP to address all activities in the SWM chain in the manner stipulated in the regulations.

CHAPTER 4: INSTITUTIONAL DESIGN OPTIONS FOR HOSHANGABAD SANITATION PLAN

This note explores the possible options for a suitable institutional design that would manage the planning and implementation of the City Sanitation Plan, and in process set up or advise on adequate systems for monitoring and regulation of sanitation in the city. Given the already formulated Integrated Urban Sanitation Program (IUSP) guidelines, the note seeks to place the situation of sanitation management in Hoshangabad in context and examine the sanitation program management needs with IUSP guidelines as a starting element.

Current Institutional Arrangements

The HNPP has 33 wards with 33 elected members, led by a Chairperson (Mayor), directly elected by the people. The Nagar Palika, through the President-in-council, the advisory committees for different departments and any consultative committees appointed by the general body, is responsible for the administration of the urban area. The executive for this elected body is led by Chief Municipal Officer (CMO) – an officer from State Municipal Services (Executive cadre). The Chief Municipal Officer is supported by officers leading various departments; the key municipal departments include – Health, Engineering, Revenue and Accounts. HNPP has a sanctioned strength of 357 employees. Most of these positions are filled but the Health Officer position has been vacant for a while.

Legal Provisions: The legislative powers provided under the Madhya Pradesh Bhoomi Vikas Niyam, 1984 provide for building requirements and the mandated provision of toilet[17] and bath facilities in such buildings that are meant to house or allow public entry. Since the building plan approval process requires the Urban Development Authority to approve the building plan and the Municipal authority to provide a completion certificate, the rules implicitly envisage that there is a municipal database and requisite monitoring. However, in practice, the staff of the Municipality is unable to do this (i.e to complete the full cycle, update database and monitor), owing to their workload. The Madhya Pradesh Municipalities Act (MPMA) provides the urban local body with powers (by notification) to ensure safe sanitation provisions in each building or land parcel within the city and also provides for penal provisions in case of non-compliance. However, these penal provisions are not very significant. The Municipal body is also empowered to raise revenue through taxes on property, water supply provision, tax on private latrines, tax on drainage provision and a cess for all buildings to pay for public facilities and city cleaning arrangements.

Current Staffing of Health Department: Within the HNPP, the Health department consists of one Sanitary Inspector, one Supervisor, 8 Ward Supervisors, and 235 *Safai Karmacharis*. One hundred and eleven of the Safai Karmacharis are contracted on daily wages. With the position of the Health Officer vacant, the Sanitary Inspector oversees the functions of the department under the guidance of the CMO. This team of municipal staff manages the daily collection and removal of solid waste to assigned dumpsite, street sweeping and cleaning, septage removal from filled-up septic tanks and attending to public nuisance complaints. The Hoshangabad Municipality has one cesspool machine of 3,000 L capacity. On citizen requests/complaints this machine manned by 4 workers carries out the task of emptying the septic tank, transport of septage and dumping at the assigned dump site. The Municipality charges Rs. 500 per trip and reportedly does about ten toilets per month. Some private operators are also reportedly catering to requests. However one is not sure of the dumping protocol/safety and there is no monitoring at present.

Inclusion in City Governance: Discussions with the Community Organiser (working with the CDS project managed by DUDA) indicate that nearly 5,000 persons are members of various Self-Help Groups in the urban jurisdiction. However, not all the groups are active. It is reported that 46 active groups (with about 900 members and distributed in the urban area) exist under the District Urban Development Authority (DUDA)-assisted Community Development Society (CDS). Of this, 10 groups have received grants from the Community Development Society, while 3 groups have availed of loans from the Banks. Considering that the membership in SHGs under the CDS is targeted at the urban poor, this pool of civil resources could be highly useful for

[17] Mandated provisions for Commercial establishments, Hotel, including lodges, Educational institutions, Healthcare facilities, Health workers quarters, Offices, Places where people assemble – public/workers, Sabha Bhavan - Art galleries, library – restaurants, Factories, Stations, Bus stops etc. are detailed in the Act, which should find necessary description in the Development Control Regulations.

household mobilization. The Municipality has already carried out some pilot exercises in 2 wards using SHG women members to enumerate the sanitation provisions in houses and also to cross check available data in the other 31 wards. Since the CDS comes under the administrative jurisdiction of the District Urban Development Authority (DUDA) and thus the District Collector, the ULB could coordinate with the District Collector's office to finalise a comprehensive work-plan to work with the identified groups. The envisaged (not in place at the moment) City Sanitation cell will also need to provide for representation from the DUDA/CDS to make the involvement of SHGs transparent and cohesive with other activities planned by DUDA. The DfID-assisted MPUSP being implemented in the 14 identified[18] ULBs might provide pointers to this, even though the DFID-assisted project is being implemented in larger cities.

The GoMP has published the necessary legislation and rules for formation of ward committees (sub-ULB) and Mohalla committees (Sub-ward) to effectively take forward the idea of decentralized planning within ULBs (Notification No. 214, June 8, 2009). Feedback on this system has however not been without its problems with elected representatives feeling insecure about erosion of their authority, and the executive unsure too about the working of these committees. The participation of SHG members seem to vitiate this further since it signals another source of encroachment of authority and powers of ward members. The CSP planning process will need to take the council's confidence on mobilizing the ward committees to mitigate risks arising from the above political and personal issues.

Who will Manage the City Sanitation Plan (CSP)?

IUSP Guidelines: The Integrated Urban Sanitation Program (IUSP) guidelines (UADD, 2009) have suggested the activation of committees[19] at state, district and city levels to enable effective facilitation and advocacy. These are to be supported by Urban Sanitation Cells[20] at the state and City to implement and coordinate the program on a daily basis.

Under the IUSP guidelines, the City level Sanitation Committee shall directly support and facilitate preparation and implementation of the City Sanitation Plan. A review of Hoshangabad's sanitation work so far and discussions with staff indicate the formation of the City Sanitation Committee and Cell, but also point to the requirement of considerable support for its work to becoming effective.

Given current staffing and work pattern, perceived increases in work-loads are managed by increasing the number of daily-wage workers. In the absence of the Health Officer, dedicated work on preparing and implementing the CSP cannot be expected to a necessary degree from this department. The planning of the CSP, ward/*mohalla*/neighbourhood-level mobilization and subsequent activity-planning and implementation would require significant number of planning and revisions, and operational management of problems. While the ward and Mohalla committees provide suitable platforms or interfaces, communication and behaviour change initiatives will need to be carried out on a planned basis, iteratively in campaign mode and within a decided time frame. This will require preparatory/support work to be put in by a set of dedicated personnel (focussed on city human excreta and liquid waste management), who will use the offices of the City Sanitation cell and power derived from the member positions (under the direction of the CMO) to task the activities with active support of the Municipal administration. Thus, the City Sanitation Cell will need to have the support of a **dedicated sanitation support unit**[21], during the course of CSP implementation. Post implementation, if adequate monitoring systems have been institutionalised, *staffing will need to be reviewed.*

[18] Expanded from original 4 cities (Indore Bhopal, Jabalpur, Gwalior) to 14 cities in 2009, including Burhanpur, Ujjain, Khandwa, Dewas, Sagar, Katni, Satna, Rewa, Singrauli and Ratlam

[19] Responsibilities of the Cell and composition are detailed in Annexure B

[20] Responsibilities of the Cell and composition are detailed in Annexure B

[21] Current indications are that the person heading engineering is over loaded with line responsibilities and such additional responsibilities that arise owing to his prior experience in Hoshangabad. Similarly, the CMO+One staff member model runs the danger of action being initiated only for deadlines and mobilization being piece-meal.

Norms for Provision: Norms for sanitation provision in non-residential buildings and spaces where public congregate or functions are organised, will need to be specified in the Development Control Rules (DCR) or through byelaws approved by the ULB.

Septage Management: Provisions and Guidelines for septage management need to be issued at the city level by the HNPP. The current operations of the cesspool machine needs to be examined along with creation of household-level databases to ensure a more optimal use, and to inform further investments in equipment and personnel. The HNPP staff is contemplating a one-time cleaning of all the septic tanks within the municipal limits at a reduced fee. While helping to create a database, this would possibly prevent any kind of institutionalisation of the process as the septic tanks would take another two years to demand services. Additionally, norms for service fee (depending on sanitation option – connecting to sewer, on-site sanitation, etc) will need to be prepared, and approved by the council.

Technical Options and Implications on Institutional Options: The technical options proposed in the city sanitation plan document (WSP, 2010), each have an associated set of activities related to behaviour change, conveyance, safe disposal, treatment and reuse that vary in intensity with the option chosen. The fully on-site and fully off-site (simplified sewerage) options are two ends of the spectrum, in terms of effort and human capacity requirements. The former suggests a more decentralised mode of operation – mobilisation, monitoring, regulation – while the latter could possibly be effected through a more centralised approach. The mixed option (where all technology options exist at city level) is the one which would demand the maximum effort from the enabling institutional framework. This variety in management approaches and intensity of engagement (with households) means that adequate systems and capacities need to be built into the institutional framework that implements the chosen option set. Considering overall economy (for HNPP), it would make sense to manage some core functions in-house, while bringing in contractors or private partnerships for repetitive and specialised functions respectively. Some of the following options would be illustrative:

- The City Sanitation Cell assisted by the SSU becomes responsible more for design, planning and supervision making use of interface institutions (e.g. committees) and contract out implementation to contractors (mostly technical tasks). This would entail greater technical, procurement and contract supervision capacities within HNPP, appropriately enabling this at the interface levels, and might also require to be facilitated by appropriate GoMP intervention. This option would require considerable technical design capacities in-house, as also petty contract management (capacity that already exists) that could be streamlined. This would also enable building up of necessary databases as the workplan progresses and setting up systems for post-implementation monitoring. Third party monitoring of contractual work or post-implementation indicators could be explored which would have its cost implications.
- The City Sanitation Cell assisted by the Sanitation Support Unit (SSU) becomes responsible more for defining an outcome-based goal, focuses on campaign components (e.g. social mobilisation) and

enabling interface institutions. The CSC brings in a private party as a significant partner in which they a) win build-operate-transfer contract after x years (esp. Wastewater treatment, sewerage systems, etc.) – refer to the Alandur model; or award separate contracts for Construction and another one for O&M management. This would entail increased supervisory capacities within HNPP, but at discrete time periods, and so something that could be facilitated by GoMP resource person. Here, Contract Management capacities will need to be considerably enhanced at HNPP, whereas technical design capacities in-house may not be required at the ULB level. But post-commissioning, there will need to be a core capacity in the ULB to measure and monitor contract indicators and make payments (e.g. fees) based on such measurement. Some of the specialised measurements can again be given out to third parties (though this service will come at a cost) and general contract supervision retained within the HNPP.

- The two illustrative options above indicate different levels of capacity building that are required within HNPP. Considering that some of these capacities are required only for a short term (3-5 years), It would possibly make economic sense to streamline existing capacities, while bringing in the additional capacities through GoMP-supported specialised teams that impart training to HNPP or explore partnerships that bring these in on a contractual basis. In the case of the latter, adequate safeguards to protect HNPP interests need to be built in through a partial capacity building component.

Monitoring & Regulation: The HNPP will need to prepare for compilation of robust baseline data and set up systems to track changes as anticipated by the workplan and the standards/norms issued. This will include:

- MIS systems at HNPP will need to incorporate monitoring of access to adequate and improved sanitation - households, institutions, floating population. The CSP process will need to set up systems for a one-time enumeration of these provisions, build up a data base, call upon the premises' owners to provide necessary facilities, and set up systems for subsequent monitoring and ensuring compliance.
- Septage management practices for each of the above segments' installations will also need to be tracked and corrected, as needed.
- Indicators for Public Health (e.g. Diarrhoea) and environment quality (e.g. water quality) will need to be tracked on a continuous basis. It would be good to compile a baseline for these from available data with the concerned agencies (Urban Health Centre or Hospital, MPSPCB, etc.).
- The HNPP will need to regulate all municipal properties to comply with standards/norms set forth in the byelaws.

OPTIONS FOR DEDICATED SANITATION SUPORT UNIT (SSU)

The Dedicated Sanitation Support Unit will be responsible for the following functions:

- Initiating community mobilisation through multiple channels – SHGs and federations, area sabhas (Mohalla), employment/trade associations, etc. The SSU members will be familiar with social mobilisation and shall be capable of learning participatory methods.
- Develop and launch the communication campaign (devised at the state) and build capacities in natural leaders who emerge during the city process to facilitate using them as spearheads for taking forward the campaign.
- Compile and disseminate the pros and cons of each of the technology options
- Train motivators and citizens in the operational guidelines of schemes (for urban poor)

The options for staffing of the SSU with the attendant financial and management pros and cons, are outlined below:

a. **SSU comprising staff from State Government Cadre**: This option involves deputing staff to form the SSU that will report to the CMO on a daily basis and will be responsible for reporting to the City level Sanitation Cell (Committee). The SSU will help the CMO coordinate with and report to the District and State Committees.

The proposed unit will have three officers - one with social mobilisation experience (communication, community development, etc.), one with engineering experience (preferably in Water and sanitation engineering) and one with experience in training and capacity building.

The SSU will also need the services of an accountant (familiar with Municipal/State program accounting) to manage the accounting for engineering works under the sanitation program. This position can be full-time or x days per quarter/month depending on volume of work in the phase of CSP. Administrative support will also be required for data entry, to manage correspondence, paperwork and to assist in compilation of data and preparation of reports.

i. **Advantages:**
   1. Financial expenditure on SSU personnel is low, as officers are on deputation (even if a deputation allowance is paid).
   2. Familiarity with government/ULB administrative work culture and possibility of working well with the rest of the ULB staff.
   3. May bring relevant experience if selected from other urban projects.

ii. Disadvantages
   1. May not bring new competencies or newer ways of thinking

b. **SSU Led by State Government Cadre with additional competencies from Market:** This option involves deputing staff (one officer, preferably with social mobilisation experience) to head the SSU and partnered by personnel selected from the open market. The SSU will report to the CMO on a daily basis and will be responsible for reporting to the City level Sanitation Cell (Committee). The SSU will help the CMO coordinate with and report to the District and State Committees.

The proposed unit will have additionally two personnel - one engineering knowledge and experience (in Watsan), and one with experience in training and capacity building. They would be recruited from the open market by GoMP on a contractual basis (annual, extendable yup to 2 years) at competitive rates.

The SSU will also need the services of an accountant (familiar with Municipal/State program accounting) to manage the accounting for engineering works under the sanitation program. This position can be full-time or x days per quarter/month depending on volume of work in the phase of CSP. Administrative support will also be required for data entry, to manage correspondence, paperwork and to assist in compilation of data and preparation of reports.

i. **Advantages:**
   1. Mixed team would bring in familiarity with government/ULB administrative work culture and possibility of working well with the rest of the ULB staff
   2. May bring relevant work experience if selected from other urban projects
   3. Additional competencies from market could benefit work culture.

ii. **Disadvantages:**
   1. Higher expenditure for personnel from the open market

c. **SSU Led by State Government Cadre with Support Organisation:** This option involves deputing staff (one officer, preferably with social mobilisation experience) to head the SSU and partnered by Non-government agency that fulfils other competencies required. The SSU will report to the CMO on a daily basis and will be responsible for reporting to the City level Sanitation Cell (Committee). The SSU will help the CMO coordinate with and report to the District and State Committees.

The proposed SSU would be staffed with personnel from NGO or private sector Support organisation, selected by GoMP (with substantial experience in Hoshangabad district and preferably prior experience in sanitation (including rural sanitation)) to bring in supplementary competencies to the SSU through a contractual agreement that entails placement of competent personnel, clear roles and responsibilities and graded outcomes. Care would be taken to ensure that all requisite competencies – engineering, capacity building, social mobilisation - are covered by this arrangement.

The SSU will also need the services of an accountant (familiar with Municipal/State program accounting) to manage the accounting for engineering works under the sanitation program. This position can be full-time or x days per quarter/month depending on volume of work in the phase of CSP. Administrative support will also be required for data entry, to manage correspondence, paperwork and to assist in compilation of data and preparation of reports.

i. **Advantages:**
    1. NGO expertise supplements the authority and reach of the govt/ULB, and can lead to success especially if competent NGOs are available

ii. **Disadvantages:**
    1. Feeling of competition and erosion of authority on part of the Govt./ULB staff leading to conflicts
    2. Different work-culture and compensation may lead to difficulties in operations

Recommendations

1. SSU: The second option of a government officer-led SSU supported by competent personnel recruited from market, appears to be low-risk option while it also has the potential for successful partnership between the ULB/govt. and the private sector. If competent NGOs are available and interested in working in Hoshangabad, that option may be explored before selecting the above option 2.

2. Other Imperative Actions include:
    a. Filling up the position of the Health officer will be critical in ensuring the success of any of the above institutional options
    b. Byelaws will need to be immediately made or modified as necessary for sanitation provisions to non-residential buildings, sites, public spaces, etc.

CHAPTER 5: THE WAY FORWARD

As discussed in the beginning of the report (Chapter 1), a number of steps have been completed since initiation of the City-wide Sanitation process in Hoshangabad town. These are reiterated here so that the next steps are easily understood.

1. *Baseline Sanitation Survey (2008)*
2. *Initial reconnaissance visit and discussions with the Mayor and Chief Municipal Officer and council members*
3. *Preparation of Situational Analysis Report on Urban Sanitation in Hoshangabad (January 2009)*
4. *Presentation of Situational Analysis Report and consultations with Council Members (January 2009)*
5. *Discussion on implications of proposed centralised sewerage and sewage treatment scheme on sustainable operation maintenance and extension of sanitation services to households.*
6. *Discussions on possible sanitation options (Centralised Versus Decentralised Wastewater Treatment) for Hoshangabad town. June 2009*
7. *Presentation on Decentralised Wastewater Treatment Systems for municipal wastewater. July 2009*
8. *Community mobilisation piloting: committees formed in two municipals wards. The women members from these committees later assisted in validation of 'Baseline Sanitation Survey' and identified 2,625 households that lack individual sanitation facilities.*
9. *Submitted proposal to Government of India for financing construction of 2,625 individual household latrines under Integrated Low Cost Sanitation Scheme (ILCS).*
10. *Draft 2 of this reported shared with the entire council. Technical options and their financial implications were discussed in detail.*

This report forms tenth milestone on the way to achieving the goal of city-wide sanitation for Hoshangabad. The way forward or next steps from here are listed below:

11. *Further revision of the report 'Towards City-wide Sanitation' (incorporating preliminary suggestions, making consistent the household distribution across various options, further financial analysis to present implications for households and detailing of institutional options)- Draft 3 of the report submitted in April 2010.*
12. Constitution of City Sanitation Committee and District Sanitation Committee
13. Training Workshop for Council members to detail out the CSP planning and implementation process
14. Constitution of City Sanitation Cell
15. Series of Meetings to be organized in different wards with ward sabha, SHGs and institutional associations
16. Final selection of city-wide sanitation option
17. Identification of gaps in rules/ legislation, drafting appropriate rules and approval of the same
18. Defining and operationalising institutional set-up to ensure sustainable sanitation service delivery
19. Finalisation of enumerated dataset on sanitation provisions including establishments, public space requirements, etc.
20. Action Plan at ward level with commitments from ward members and mohalla committee representatives
21. Dove-tailing household/establishment level action plan with fund flow and wastewater treatment works plan
22. Design of M& E System
23. Implementation (including slum sanitation- management of community toilets or individual toilet construction)

ANNEXURE A: LEGAL PROVISIONS IMPACTING SANITATION MANAGEMENT

The council can ask owner/occupier to provide for privies, cesspools or water closets in any building. Where water closet systems have been introduced, these should compulsorily replace service latrines [Sec. 208 (1)]. Failure to comply will lead to cancellation of license for building and any penalty liable under this Act [Sec. 261]

The Council can by written notice require any person or persons, employing workmen or labourers exceeding twenty in number, or owning any place of public resort (theatre, school, markets, etc.) to provide such latrines and urinals at such sites as it may direct, and to cause the same to be kept in proper order, and to be daily cleaned [Sec. 208 (2)].

Enclosure of urinal/latrine with walls or necessary alteration can be effected by council notice, if the same is considered a nuisance [Sec. 208(3)]

Failure to comply with Council notice within period specified can beget punishment with a fine upto one thousand rupees, failure to pay can beget imprisonment upto 3 months [Sec 208(5)]. The council can also get the work done and recover cost from owner/occupier [Sec. 208]

In any building where any method hygienic disposal of night soil is not feasible, the owner can provide service privy of type approved by council [Sec. 216]

Common latrines can be constructed for group of houses as prescribed by byelaws [Sec. 217]

No latrines can be constructed within fifty feet of any source of water supply, except with permission of council [Sec. 218]

If an owner of any building allows filth to kept on premises for more than 24 hours, or neglects to employ proper means of disposal, the council can fine upto fifty rupees, with compounding of rupees five for each additional day.

Excreta conveyance (night soil in law) should not wilfully or due to negligence cause nuisance (stench of offensive) and whoever is guilty can be fined up to twenty-five rupees.

The council may make suitable byelaws for construction, maintenance and control of drains, sewers, latrines, urinals, prescribe distance limitations from water source for latrine/urinal, regulate and prevent discharge into municipal drains, control the duties of sweepers. [Sec. 358(5)]; prescribe the sanitary provisions and disposal safeguards in markets, slaughter houses, lodging houses, eating houses theatres and other places of public resort [Sec. 358(7)].

The Madhya Pradesh Municipalities Act (MPMA) also enjoins the ULB to impose these taxes, subject to any general order by GoMP:

- Property tax payable by owners of building or lands situated within ULB area;
- Water tax, for lands and buildings which are connected by means of pipe to municipal water works
- General sanitary cess for construction of public facilities and for cleaning the city;
- Latrine tax payable by owner/occupier upon private latrines cleaned by Municipal agency
- Drainage tax, where system of drainage has been introduced.

For buildings exempt from property tax, the water tax would be as specified by the council. For others, it would be at a percentage of the property tax charged additionally. The sanitary cess would also be levied at a consolidated rate on the property tax. The council can prescribe, subject to any order of GOMP the amount for the latrine and drainage tax.

Annexure B: Ward wise number of households lacking access to individual household sanitation facility (validated information)

Ward No	Ward Name	Total Households Surveyed	Households lacking access to individual household sanitation facility
1	Shashri Ward	347	20
2	Shanichara Ward	224	5
3	Jagdishpura Ward	401	27
4	Mangalwara Ward	237	9
5	Narayanganj Ward	200	20
6	Ramganj Ward	330	105
7	Azad Ward	249	75
8	Subhashganj Ward	162	52
9	Balaganj Ward	212	30
10	Ganeshganj Ward	128	01
11	Janakpuri	293	
12	Sadar Bazar	371	
13	Kothi Bazar Ward	692	60
14	Tilak Ward	510	07
15	Malakhedi Ward (North)	762	294
16	Malakhedi Ward (South)	895	366
17	Civil Line Ward	609	43
18	Housing Board Ward	1,531	163
19	Anand Nagar Ward	1,418	253
20	Adamgarh Ward	276	197
21	Phephartaal Ward	284	52
22	SPM Ward (East)	112	
23	SPM Ward (West)	277	30
24	Rasooliya Ward	398	204
25	Rajendra Ward	1,221	13
26	Rewaganj Ward	349	60
27	Bheelpura Ward	358	80
28	Krishnapuri Ward	233	40
29	Gokulpuri Ward	503	42
30	Gwaltoli Ward	371	30
31	Govindpura Ward	262	110
32	Gandhi Ward	622	38
33	Tagore Ward	768	199
Total			**2,625**

ANNEXURE C: EXCRETA DISPOSAL FOR HOUSEHOLD LATRINES PROPOSED UNDER INTEGRATED LOW COST SANITATION SCHEME FOR HOSHANGABAD

The baseline sanitation survey (2008) findings were re-validated in 2009, which identified a total of 2,625 households lacking access to individual sanitation facility.

The Hoshangabad Nagar Palika Parishad, through the Government of Madhya Pradesh, has submitted a proposal to the Government of India with a request to finance construction of latrines, for these households, under 'Integrated low Cost Sanitation Scheme'. A successful implementation of this scheme will achieve 100 percent coverage for resident population of Hoshangabad.

As per the ILCS guidelines, 'twin soak pits' is the suggested excreta disposal option. However, the guidelines do not restrict the ULBs to construct only soakage pits. The ULBs are free to choose any suitable disposal option based on site specific considerations.

In Hoshangabad, depending upon final selection of wastewater treatment alternative[22], five possible excreta disposal options can be considered for latrines proposed under ILCS. These alternatives are presented in Table (B.1) below.

TABLE (C.1): POSSIBLE EXCRETA DISPOSAL OPTIONS FOR LATRINES PROPOSED UNDER ILCS, HOSHANGABAD

Option	Disposal arrangement	Remark
Option 1	Latrine connected to soakage (seepage) pit	1. *On-plot disposal for all households located in areas that will not be covered under proposed NRCP / UIDSSMT sewerage scheme or pilot DEWATS* 2. either single or twin pit, depending on space, preference or other constraints; 3. ideal for areas with adequate permeability (but not hard rock areas or areas with low permeability. In such cases, **Option 4** – ECOSAN (compost) toilet should be adopted)
Option 2	Latrine connected to septic tank followed by seepage pit *Note: after commissioning sewerage network, these households should be connected to sewerage network*	1. *On-plot disposal for isolated households located in areas that are proposed for coverage under NRCP/ UIDSSMT sewerage scheme or pilot DEWATS* 2. Septic tank should be designed to treat entire domestic wastewater. A seepage pit shall be constructed to disperse septic tank effluent.
Option 3	Latrine connected to community septic tank followed by seepage pit *Note: after commissioning sewerage network, the simplified sewerage network should be connected to sewerage network*	1. *On-plot disposal for a cluster of households located in areas that are proposed for coverage under NRCP/ UIDSSMT sewerage scheme or pilot DEWATS* 2. The option would be especially suitable for households, where space is a constraint (such as slum pockets, dense housing colonies). The households can be connected through simplified sewerage network to a common septic tank. 3. Entire domestic wastewater discharge (from all the households) should be disposed into the community septic tank. The septic tank should be designed accordingly.

[22] Possible options include: septage management, centralised wastewater treatment or de-centralised wastewater treatment.

TABLE (C.1): POSSIBLE EXCRETA DISPOSAL OPTIONS FOR LATRINES PROPOSED UNDER ILCS, HOSHANGABAD		
Option	**Disposal arrangement**	**Remark**
Option 4	ECOSAN (compost toilet)	1. *On-plot treatment and disposal for households located in areas that will not be covered under proposed NRCP / UIDSSMT sewerage scheme or pilot DEWATS* 2. *Should be preferable option for areas having low soil permeability or hard rock areas. The option should be preferred over pit latrines.*
Option 5	Household latrine and grey water discharge connected to simplified sewerage. Wastewater treatment in DEWATS facility.	1. This option is most suitable for isolated group of households beyond already proposed schemes (NRCP/ UIDSSMT/ DEWATS); and if the local soil is not suitable for construction of seepage pits and entire domestic wastewater has to be treated. Construction of ECOSAN toilets suggested in Option 4 will not solve the problem of grey water treatment and disposal. 2. This option is most suitable for comprehensive solution for such areas. 3. This will be an expensive option and hence may not be possible within resources available under ILCS. Additional funds will have to be mobilised.

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ANNEXURE D: INSTITUTIONAL FRAMEWORK SUGGESTED IN IUSP GUIDELINES

1. **Roles and Responsibilities**

a. State level Coordination and Monitoring Committee: This committee shall review, monitor and evaluate the programme from time to time. The committee shall also provide feedback and strategic direction to improve the quality of the program implementation. Principal Secretary, Urban Development Department as its head, the committee shall consist of Principal Secretaries of various departments as its members.

b. District level Urban Sanitation Committee: This committee shall be empowered to approve the City Sanitation Plans, review the progress of sanitation activities, provide guidance and issue necessary guidelines and instructions to meet the targets set under the program.

c. City level Sanitation Committee: The committee shall directly support and facilitate preparation and implementation of the City Sanitation Plan.

d. State level Urban Sanitation Cell: Providing technical support to the ULBs, facilitating interdepartmental coordination for preparing City Sanitation Plan and implementation of sanitation infrastructure, etc shall be the core responsibilities of the Cell. Officers from Project Uday and Project Utthan, as given in Annexure 4, shall be the members of the cell, who; in addition to performing their routine duties, also perform duties allotted under this cell. Support from experts and consultants, as required shall also be taken in programme implementation.

e. City level Urban Sanitation Cell: The cell shall be responsible for preparation and implementation of the city sanitation plan. Commissioner/ CMO shall be the head of the cell and may appoint suitable officer as the in-charge officer. Commissioner/CMO may also nominate other suitable officers as members of the Cell, in addition to the members proposed in this annexure.

2. **Composition of Committees**

a. State level Coordination and Monitoring Committee

1.	Principal Secretary, Urban Administration and Development Department	Chairperson
2.	Principal Secretary/ Secretary- Finance	Member
3.	Principal Secretary/ Secretary- Planning, Economics and Statistics	Member
4.	Principal Secretary/ Secretary- Education	Member
5.	Principal Secretary/ Secretary- Health	Member
6.	Principal Secretary/ Secretary- Women and Child welfare	Member
7.	Commissioner, Urban Development and Administration Department	Member
8.	State Programme Officer, Urban Sanitation Programme	Member
9.	Project Director (Project Uday)	Member Secretary

b. District level Urban Sanitation Committee

1.	Collector	Chairperson
2.	Commissioner/CMO of the ULBs	Member
3.	Mayor/ Presidents of the ULBs	Member
4.	NGO representatives	Member
5.	Representatives of Professional/ Business Associations	Member
6.	Project Officer, DUDA	Member Secretary

c. City level Sanitation Committee

1.	Mayor/President of the ULB	Chairperson
2.	Members of MIC/PIC	Member
3.	Women ward member nominated by Mayer/ President	Member
4.	Representative of Business Associations	Member
5.	Representative of sanitary workers associations	Member
6.	NGO representatives	Member
7.	Officers from various departments associated with sanitation	Member
8.	Subject Expert - with permission form the Chairperson	Member
9.	Commissioner/CMO of the ULB	Member Secretary

d. State level Urban Sanitation Cell

1.	Commissioner, Urban Development and Administration Department	Chief
2.	Project Director (Project Uday)	Controller
3.	Chief Engineer, Urban Development and Administration Department	Technical Advisor
4.	Assistant Project Officer (Project Uday)	Technical Officer
5.	Deputy Director (Nominated by Commissioner)	Planning and Development Officer
6.	Public Relation Officer	Public Relation Officer
7.	Urban Governance Officer (Project Uday)	Administrative assistant Controller
8.	Sanitation Expert from Project Uday and Project Utthan	Technical and Social Advisor

e. City level Urban Sanitation Cell

1.	Commissioner/CMO of the ULB	Chief
2.	Assistant Engineer/ Sub Engineer	Technical Officer
3.	Health Officer/ Sanitary Inspector	Technical Officer
4.	Sanitation worker	Social Organizer
5.	Chief of Sanitary Workers Associations	Social Expert