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Dewas
India

Final Report

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BILL & MELINDA GATES foundation

SFD Report Dewas, India, 2016

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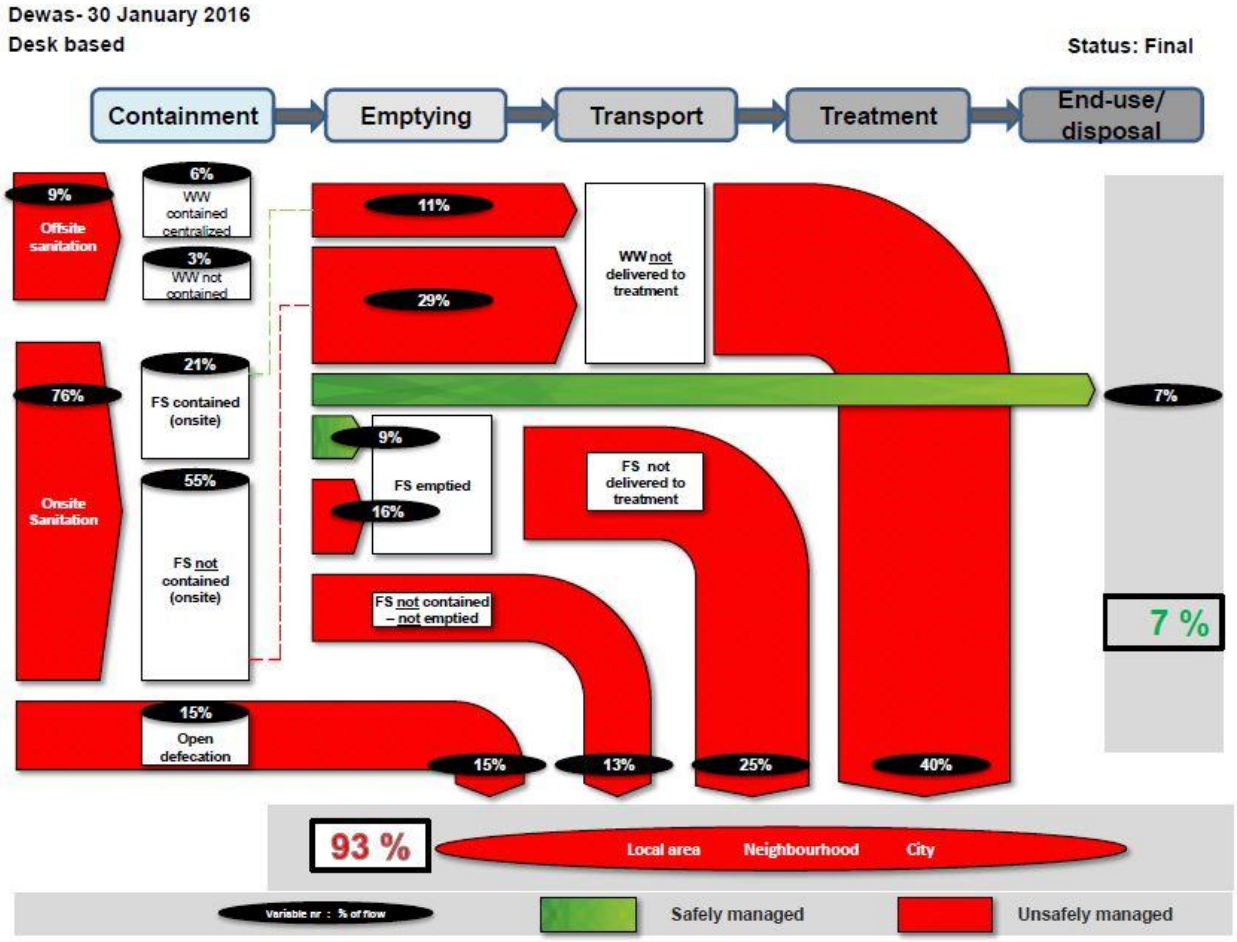
1. The Diagram



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3. General city information

Dewas city is located on the Malwa plateau of the central Indian state of Madhya Pradesh. It is headquarters of the Dewas district. The city is well connected with the state capital Bhopal by NH 86 and the commercial capital Indore by SH 18 (MoUD, 2015).

The population of city as per the 2011 Census is 289,438. The density of city is 2,889 persons per sq.km which is very high when compared to state average of 236 persons per sq.km. Total slum population is 92,770 which is 32% of the total population (Census of India, 2011). The floating population is around 25,000 (MoUD, 2015).

Municipal boundary has been chosen for the current study. It comprises of an area of 100.2 sq.km (MoUD, 2015).

4. Service delivery context

In 2008, the Ministry of Urban Development (MoUD) issued the National Urban Sanitation Policy (NUSP). The policy aims to: raise awareness, promote behaviour change; achieve open defecation free cities; develop citywide sanitation plans; and provide 100% safe confinement, transport, treatment and disposal of human excreta and liquid wastes. The NUSP mandates states to develop state urban sanitation strategies and work with cities to develop City Sanitation Plans (CSPs). Furthermore, it explicitly states that cities and states must issue policies and technical solutions that address onsite sanitation, including the safe confinement of faecal sludge (USAID, 2010).

The objectives of NUSP are to be realized through CSPs and state sanitation strategies. As of now there are very few cities which have finalized their CSPs, and those plans are also not implemented. This remains a major drawback in implementation of NUSP.

The advisory note on septage management in urban India, issued by MoUD in 2013, recommends supplementing CSPs with Septage Management Sub-Plan (SMP). Still septage management in India is not prominent due to lack of knowledge, consideration of septage management as an interim solution, lack of sufficient funding and many other socio-political issues.

There are no specific legal provisions relating to septage management, but there are a number of provisions relating to sanitation services and environmental regulations, which majorly stems from, The Environment (Protection) Act, 1986 and the Water (Prevention and Control of Pollution) Acts. Municipal acts and regulations usually refer to management of solid and liquid wastes but may not provide detailed rules for septage management (MoUD, 2013).

5. Service outcomes

Overview on technologies and methods used for different sanitation systems through the sanitation service chain is as follows:

Containment: According to the survey and KII conducted in 2015, only 9% of the city population is dependent on offsite sanitation system. Nearly 76 % is dependent on onsite sanitation systems. Rest 15% of the population practices open defecation. Fully lined tanks are the primary onsite sanitation technology used by the middle to high income group. Generally, these tanks are constructed under the toilets with an opening covered with a stone slab. The fully lined tanks are commonly known as septic tanks. In Dewas, two type of pits are prevalent. Lined pit with semi permeable walls and open bottom with no outlet or overflow and unlined pit with no outlet or overflow. The average dimension of lined pit is 4*4*6 cubic feet.

Emptying: DMC (Municipal Corporation of Dewas) owns two vacuum tankers with capacity of 3500 litres and 3000 litres. Vacuum tanks are mounted on a tractor. Sulabh International Social Service Organisation (SISSO) has one vacuum tanker with a capacity of 12,000 litres in Madhya Pradesh (DMC, 2015). Citizens have to submit an application letter requesting to DMC for emptying septage from the OSS. Emptying fees charged is INR 500 (7 USD) per trip (DMC, 2015).

Figure 1: Emptying from chambers

(Source: Rahul/CSE, 2015)

Figure 2: Disposal of septage into agricultural farms (Source: Rahul/CSE, 2015)

Transport: The sewage generated from Dewas Development Authority (DDA) developed colonies is conveyed through sewer. Due to inadequate/incomplete sewerage network the chambers/manholes start serving as collection tank and sewage is emptied from these chambers using vacuum tankers and is discharged into trunk sewer. Emptied septage is generally discharged in open drain or trunk sewer.

Treatment: Sewage treatment plant (STP) and septage treatment facilities are not available in the city.

End-use/Disposal: The sewage generated in the city is disposed into Kshipra river and Kali Sindh river. DMC and SISSO tankers dispose septage into surface drains/nullahs, low lying areas and agriculture fields (DMC, 2015). Rarely, DMC vacuum tankers dispose septage into dump yard (DMC, 2015). During visit to the city it was observed that farmers' households prefer to dispose the emptied septage from OSS to their agricultural field. Septage is applied in soybean and wheat cultivation field.

According to Census of India 2011, around 22% of the city is dependent on offsite systems, population connected to sewerage network is 20% and user interface directly discharging in open drain or open ground is only 2%. But according to the survey and key informant interviews (KIIs) conducted in 2015 and taking floating population into consideration, it is estimated that 9% of the population is dependent on offsite systems. Population connected to sewerage network is estimated to be 6% and user interface directly discharging in open drain or open ground is only 3%.

According to Census 2011, around 65% of the city is dependent on onsite sanitation systems (OSS), out of which around 63% is dependent on septic tanks and 2% on pits. But according to the survey and KIIs conducted in 2015 and taking floating population into consideration, it is estimated that around 55% of the city is dependent on lined tanks connected to open drain and 21% on pits and lined tanks connected sewerage network. The public latrines are connected to lined tanks and hence are incorporated in onsite systems. The tanks connected to open drain are not contained but pits are contained as the groundwater level is more than 10 mbgl. Tanks connected to sewerage network are also contained.

There is no clear differentiation between the volume of effluent and septage generated from tanks, hence to reduce the maximum error it is assumed to be 50% each. Therefore, 26% of FS is effluent that goes into open drains, 5% of effluent goes into sewerage network and the rest is emptied from tanks whenever full. Some FS is always left in the tanks and is assumed to be 13% in the case of tanks connected to open drains. Whereas FS from pits and tanks connected to sewerage network is considered contained and is calculated as 7%, which includes infiltration of water as well.

According to Census 2011, 13% of the population still practices, open defecation, but based on field research it was estimated to be 15%.

6. Overview of stakeholders

The 74th Constitutional Amendment Act of 1992 reformed the sector by transferring responsibility for domestic, industrial, and commercial water supply and sewerage (WSS) from state agencies, such as Departments of Public Health Engineering and State Water Boards, to Urban Local Bodies (ULBs). This transfer has resulted in a variety of implementation models, as well as lack of clarity in allocation of roles and responsibilities between state and local agencies, which sometimes results in implementation (USAID, 2010).

The following stakeholders are responsible for sanitation service delivery in Dewas:

Table 1: Key stakeholders (Source: compiled by CSE, 2015)

Key stakeholders	Institutions / organizations
Public institutions	Municipal Corporation of Dewas (DMC), Dewas Development Authority (DDA), Madhya Pradesh Pollution Control Board (MPPCB), Urban Development and Environment Department (UD&ED)
Private sector	NA
NGOs	Sulabh International Social Service Organisation (SISSO)

DMC is responsible for planning, designing, construction of sewerage system and maintenance of sewerage network. Public health, sanitation, conservancy, and solid waste management services are delivered by Health and Sanitation Department of DMC. Septage management is also the responsibility of the same department.
DDA is responsible for implementation of city master plan, development of commercial buildings and residential colonies/townships.

MPPCB is responsible for monitoring and evaluation of STPs.

SISSO is responsible for operation and maintenance of public toilets.

7. Credibility of data

Three key sources of data are used; Census of India 2011, City Development Plan 2015 and Slum Free City Plan of Action. Most of the data

is then updated by Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs). Overall, 5 KIIs and 5 FGDs were conducted with different stakeholders.

There were three major challenges to develop the SFD. Census and published/unpublished reports were not able to provide (i) up-to-date data on containment (ii) detailed typology of containment and (iii) actual information about FSM services provided to households. For this reason, field based studies were conducted to validate the data provided by secondary sources.

The Census and published/ unpublished reports mostly differentiate between different types of user interfaces or between septic tanks and pit latrines but not about the design of the actual containment systems on ground level. Therefore, a sample household survey was conducted in each ward of the city to identify and cross check the data collected from the Census, 2011.

The objective of the survey conducted was to obtain a more accurate measure of how excreta is managed through stages of sanitation service chain (from containment to end-use or disposal).

8. Process of SFD development

Data is collected through secondary sources. The city is visited to conduct the surveys, FGDs and KIIs with relevant stakeholders, to fill in the data gap and to crosscheck the data collected.

To start with, a relationship between sanitation technologies defined in Census of India and that defined in the project is established. The survey data is quantified and crosschecked with FGDs and KIIs.

The data is fed into the calculation tool to calculate the excreta flow in terms of percentage of the population.

Overall, 7% of excreta is safely managed in the city and rest 93% is unsafely discharged into the environment.

9. List of data sources

Below is the list of data sources used for the development of SFD.

- Published reports and books:
  - Census of India 2011, House listing and housing data, Government of India
  - Service levels in water and sanitation sector, MoUD, 2012
- KIIs with representatives from
  - Government agencies: DMC
  - Service providers: SISSO
  - Others: social activist, railway station manager, temple staff
- FGDs
  - DMC staff
  - Local masons
  - Council members
  - Association of industries
  - Educational institutions

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Abbreviations

AMRUT	Atal Mission for Rejuvenation and Urban Transformation
BIS	Bureau of Indian Standards
BJP	Bharatyia Janata Party
BMGF	Bill and Melinda Gates Foundation
BSUP	Basic Services for Urban Poor
BOD	Biological Oxygen Demand
^{0}C	Celsius
CDP	City Development Plan
CPHEEO	Central Public Health and Environmental Engineering Organisation
CSP	City Sanitation Plan
CSE	Centre for Science and Environment
E	East
FS	Faecal Sludge
GoI	Government of India
GoMP	Government of Madhya Pradesh
DMC	Dewas Municipal Corporation
IHSDP	Integrated Housing and Slum Development Programme
INR	Indian Rupee
IS	Indian Standards
Km	Kilometer
LBD	Length, Breadth and Depth
mm	Millimeter
mbgl	Metre below ground level
MoUD	Ministry of Urban Development
MPMA	Madhya Pradesh Municipality Act
MPPCB	Madhya Pradesh Pollution Control Board
MSME	Micro, Small and Medium Enterprise
MSL	Mean Sea Level
N	North
NH	National Highway
NIUA	National Institute of Urban Affairs
NUSP	National Urban Sanitation Policy
OD	Open Defecation
OSS	On-site Sanitation Systems
O & M	Operation and Maintenance

PHED	Pubic Health and Engineering Department
PS	Public Sector
SBM	Swachh Bharat Mission (Clean India Mission)
SFCPoA	Slum Free City Plan of Action
SFD	Shit Flow Diagram
SH	State Highway
Sq.km	Square Kilometer
SMP	Septage Management sub-Plan
SLB	Service Level Benchmark
SLIP	Service Level Improvement Plan
SPS	Sewage Pumping Station
STP	Sewage Treatment Plant
SWM	Solid Waste Management
TDS	Total Dissolved Solids
UD & ED	Urban Development and Environment Department
UIDSSMT	Urban Infrastructure Development for Small and Medium Towns
ULBs	Urban Local Bodies
USAID	United States Agency for International Development
USD	United States Dollar
WSS	Water Supply and Sewerage
WW	Waste Water

1 City context

Dewas city is located on the Malwa plateau of the central Indian state of Madhya Pradesh. It is the headquarters of the Dewas district. The city is well connected with the state capital city, Bhopal by NH 86 and the commercial capital city, Indore by SH 18.

The population of the city, as per the Census of India, 2011 is 289,438. The population density of the city is 2,889 persons per sq.km, which is significantly higher as compared to the state's population density of 236 persons per sq.km. The total number of households is 57,297. The average household size in Dewas is 5.04. The slum population is 92,770, which is 32% of the total population. The floating population is around 25,000. The population growth rate of the city is given in the Table 1. The area under Municipal Corporation of Dewas jurisdiction is 100.2 sq.km. Municipal boundary has been chosen for the current study. The Municipal Corporation of Dewas is divided into 8 administrative zones and 45 wards (MoUD, 2015).

Table 1: Population growth rate

Census Year	Population	Growth rate (%)
1971	51,866	-
1981	83,465	61
1991	1,64,364	97
2001	231,670	41
2011	2,89,438	25

(Source: Census of India, 2011)

Dewas is located at a distance of 35 kms from Indore. People prefer to stay in Indore and commute to Dewas for work. During the 1970s and 1980s, the city experienced rapid industrialization and economic development. As the population of the city increased, the city was upgraded from a Nagar Palika to a Municipal Corporation in the year 1982 (MoUD, 2015).

The city lies between 22° 58' North latitude and 78° 06' East longitude and is located at a height of 535 m above the mean sea level (MSL) (MoUD, 2015). The city lies in the foothills of the Chamunda hill which is situated along the northern slope of the plateau of the Vindhya ranges. Except for the plateau region, the entire city is situated on a plain. The city has a semi-arid climate with hot and dry summers stretching from March to mid-June, and the wet monsoon season stretching from mid-June to September, and winters from November to February. The city receives 1065 mm of rainfall on an average. During summer, the temperature averages around 40 ^{0}C with the maximum temperature rising up to 45 ^{0}C. In the months of winter, the temperature averages up to 10 ^{0}C (MoUD, 2015).

The river Kshipra is situated 19 km from the city of Dewas and forms the western boundary between the districts of Dewas and Indore. Kshipra river along with groundwater is the source of water supply for Dewas (MoUD, 2015).

In February 2014, river Narmada was interlinked with river Kshipra. This development has transformed Kshipra into a perennial water source for Dewas. Amongst the inland water bodies, Meetha Talab, Manduk Pushkar and Rajanal Talab are major ponds located in and around the city. Meetha Talab is the only pond located within the municipal limits. Rajanal Talab is also used as source of drinking water. The quality of water in the other ponds is not suitable for potable uses (MoUD, 2015).

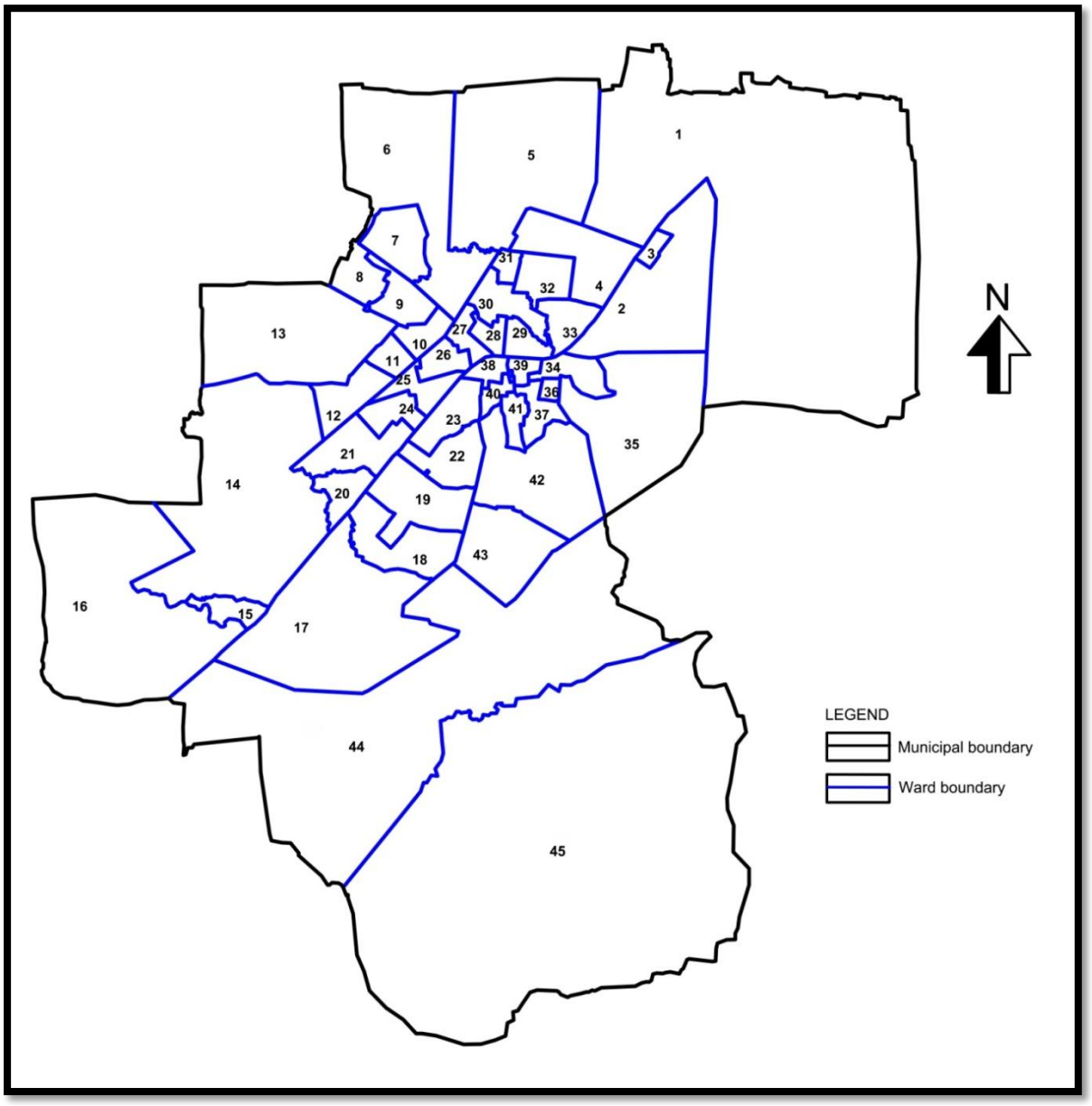

Figure 1: Ward map of Dewas city

2 Service delivery context description/analysis

2.1 Policy, legislation and regulation

2.1.1 Policies, legislations and regulations at national level

In 2008, the Ministry of Urban Development (MoUD) issued the National Urban Sanitation Policy (NUSP). The policy aims to: raise awareness, promote behavior change; achieve open defecation free cities; develop citywide sanitation plans; and provide 100% safe confinement, transport, treatment and disposal of human excreta and liquid wastes. The NUSP mandates states to develop state urban sanitation strategies and work with cities to develop City Sanitation Plans (CSPs). NUSP specifically highlights the importance of safe and hygienic facilities with proper disposal and treatment of sludge from on-site installations (septic tanks, pit latrines, etc.) and proper operation and maintenance (O&M) of all sanitary facilities. Furthermore, it explicitly states that cities and states must issue policies and technical solutions that address on-site sanitation, including the safe confinement of faecal sludge (FS) (USAID, 2010). The objectives of NUSP are to be realized through CSPs and state sanitation strategies. As of now there are very few cities that, have finalized their CSPs, and those plans are also not implemented. This remains a major drawback in the implementation of NUSP.

The advisory note on septage management in urban India, issued by MoUD in 2013, recommends supplementing CSPs with a Septage Management Sub-Plan (SMP) prepared and implemented by cities. Septage refers here broadly to not only FS removed from septic tanks, but also that removed from pit latrines and similar on-site toilets. This advisory provides references to the Central Public Health & Environmental Engineering Organization (CPHEEO) guidelines, Bureau of Indian Standard (BIS) standards, and other resources that users of this advisory may refer for details while preparing their SMP (MoUD, 2013). It clearly discusses on techno- managerial and socio- economic aspects of septage management in India and provides guidelines for Urban Local Bodies (ULBs) to plan and implement septage management plans.

There are no specific legal provisions relating to septage management, but there are a number of provisions relating to sanitation services and environmental regulations, which majorly stems from, The Environment (Protection) Act, 1986 and the Water (Prevention and Control of Pollution) Act, 1974. It also applies to households and cities with regard to disposing wastes into the environment. ULBs/ utilities also have to comply with discharge norms for effluent released from sewage treatment plants and to pay water cess under the Water Cess Act, 1977. The ULB is responsible for ensuring the safe handling and disposal of septage generated within its boundaries, for complying with the Water Act for meeting all state permit requirements and regulations (CSE, 2010). Municipal Acts and regulations usually refer to the management of solid and liquid wastes, but may not provide detailed rules for septage management (MoUD, 2013).

The Prohibition of Employment as Manual Scavengers and their Rehabilitation Act was enacted in 2013. This act prohibits employment of manual scavengers and installation of insanitary latrines. It has laid strong emphasis on rehabilitation of manual scavengers. This act has become instrumental in eradicating manual scavenging from India.

2.1.2 Policies, legislations and regulations at state level and ULB level

According to the Constitution of India, water and sanitation are state subjects. Statutory powers are conferred to the state for making laws on water and sanitation. As part of NUSP implementation, the Government of Madhya Pradesh has initiated the Integrated Urban Sanitation Programme (IUSP) for the state. The focus of programme is to develop citywide sanitation plans and implement them by integrating all aspects of sanitation in an effective way.

According to the *Madhya Pradesh Municipal Corporation Act, 1976*, public health, sanitation, conservancy, and solid waste management are mandatory functions of the municipal corporation. The act provides ULBs with powers (by notification) to ensure safe sanitation provisions in each building or land parcel within the city and also has some penal provisions for non-compliance. The ULB is empowered to raise revenue through taxes on property, water supply, tax on private latrines, tax on drainage provision and a cess on all buildings to pay for public facilities and city cleaning arrangements.

The Urban Development Department, GoMP has issued specific policy directives related to involvement of various stakeholders in urban sanitation, including ward committees, Mohalla Samitis (Madhya Pradesh Mohalla Samiti Niyam 2008 dated 13 October 2008), Safai Kamgars (Instruction No. 1849/2008/183 dated October 3, 2008) and Ragpickers (Ardha Shasakiya Patrak, PMU191 dated May 24, 2010).

2.1.3 Institutional roles

The MoUD is the nodal ministry for policy formulation and guidance for the urban water supply and sewerage sector. The ministry's responsibilities include broad policy formulation, institutional and legal frameworks, setting standards and norms, monitoring, promotion of new strategies, coordination and support to State Programmes through institutional expertise and finance. The ministry is also responsible for managing international sources of finance. The Central Public Health and Environmental Engineering Organisation (CPHEEO), created in 1953, is the technical wing of the MoUD, which advises the ministry in all technical matters and collaborates with the state agencies about water supply and sanitation activities. CPHEEO plays a critical role in externally funded and special programmes. CPHEEO also plays a central role in setting design standards and norms for urban water supply and sanitation (Planning Commission, 2002).

The 74th Constitutional Amendment Act of 1992 reformed the sector by transferring responsibility for domestic, industrial, and commercial water supply and sewerage (WSS) from state agencies, such as Departments of Public Health Engineering and State Water Boards, to Urban Local Bodies (ULBs). This transfer has resulted in a variety of implementation models, as well as lack of clarity in allocation of roles and responsibilities between state and local agencies, which sometimes result in gaps in implementation (USAID, 2010).

Management and delivery of urban basic services in Madhya Pradesh is governed by various institutions. The following are the institutions responsible for policy making, service provision and regulation of urban services.

The following table provides roles and responsibilities of various institutions.

Table 2: Roles and responsibilities

Institution	Roles and responsibilities
Urban Development and Environment Department (UD&ED)	Policy formulation, preparation of municipal laws, monitoring and evaluation of programmes, supervision of municipal administration, coordination with related state government departments, liaison with the central government and external funding agencies etc.
Madhya Pradesh Pollution Control Board (MPPCB)	Regulatory measures for domestic and industrial, licensing for environmental check etc. Monitor the compliance of the standards regarding ground water, ambient air, leachate quality and the compost quality including incineration standards as specified under Schedule II, III & IV of 'The Water (Prevention and Control of Pollution) Act 1974.
Dewas Development Authority (DDA)	Implementation of city master plan. Development of commercial buildings and residential colonies/townships.
Municipal Corporation of Dewas (DMC)	Delivery of municipal services in the city, including water supply, public sanitation, solid waste management, street lighting. Also responsible for planning, designing and construction and maintenance of sewerage system.

The DMC functions under the elected wing and executive wing. The elected wing is a council system headed by a Mayor. The executive wing is headed by the Municipal Commissioner (USAID, 2011).

2.1.4 Service provision

Institutional arrangements for water supply and sanitation in Indian cities vary greatly. Typically, a state-level agency is in charge of planning and investment, while the local government (ULB) is in charge of operation and maintenance (NIUA, 2005). Some of the larger cities have developed municipal water and sanitation utilities that are legally and financially separated from the local government. However, these utilities remain weak in terms of financial capacity. In spite of decentralization, ULBs remain dependent on capital subsidies from state governments. Tariffs are also set by state governments, which often subsidize operating costs (Planning Commission, 2002a).

In the absence of a separate utility, there is no separation of accounts for different activities within a municipality. Some states and cities have non-typical institutional arrangements. For example, in Rajasthan the sector is more centralized and the state government is also in charge of operation and maintenance, while in Mumbai the sector is more decentralized and local government is also in charge of planning and investment (NIUA, 2005).

In Dewas, public health, sanitation, conservancy, and solid waste management services are delivered by Health and Sanitation Department of DMC. Septage management is also the responsibility of the same department, headed by the health officer. Health and sanitary inspectors are appointed under the health officer, who looks after the day-to-day functioning of the department. This department has 196 permanent posts of sanitation workers, including 45 ward supervisors and four special supervisors (USAID, 2011).

The Public Works Department of DMC is responsible for provision of water supply and sanitation infrastructure and is headed by an executive engineer/City Engineer (USAID, 2011).

2.1.5 Service standards

1. Service Level Benchmarks (SLB), 2008: Issued by the Ministry of Urban Development in 2008, which seeks to:-
    i. Identify a minimum set of standard performance parameters for the water and sanitation sector that are commonly understood and used by all stakeholders across the country
    ii. Define a common minimum framework for monitoring and reporting on these indicators
    iii. Set out guidelines on how to operationalize this framework in a phased manner. SLB refers to improving service through better provision and delivery. It evaluates the performance of ULBs in providing urban services

2. General Standards for Discharge of Environmental Pollutants Part-A: Effluents-The Environment (Protection) Rules, 1986 (Schedule VI): Issued by Central Pollution Control Board (CPCB), a statutory organisation constituted in September, 1974 under the Water (Prevention and Control of Pollution) Act, 1974.

3. Code of Practice for Installation of Septic Tanks, 1985: Issued by Bureau of Indian Standards. It is a national standards setting body of India. The code specifies standards and design consideration for installation of septic tanks.

4. Manual on Sewerage & Sewage Treatment, Second Edition, 2013: This manual has been developed by Central Public Health and Environmental Engineering Organization (CPHEEO). It provides detailed design and guidelines for various technologies of wastewater management.

2.2 Planning

2.2.1 Service targets

The City Development Plan (CDP) of Dewas, 2015, aims to provide a sewerage system to 80% of the population by 2020. An underground drainage project has been proposed for improving and strengthening the sewerage system in Dewas. The project will enable DMC to collect, treat, and safely dispose sewage (MoUD, 2015). According to the SLBs, the benchmark for coverage of sewerage system is 100%. The Swachh Bharat Mission (SBM) aims to eliminate open defecation by 2019. The provision of individual toilets to households is the main component of the mission. Table 3 gives an overview of service targets to be achieved in each stage of service chain.

Table 3: Service delivery targets in accordance with CDP and SLBs

Sanitation service chain	Parameter	National benchmark	Target for 2015 - 2016	Timeframe to achieve benchmark
Containment	Coverage of toilets	100%	80%	2019
Transport	Coverage of sewer network services	100%	10%	2020
	Collection efficiency of the sewerage network	100%	10%	2020
Treatment	Adequacy of sewerage treatment capacity	100%	0	2020
	Quality of sewerage treatment	100%	0	2020
End-use/disposal	Reuse and recycling	20%	0	2020
Other	Cost recovery	100%	100%	2020
	Efficiency of collection of charges	100%	10%	2020
	Redressal of Customer Complaints	80%	30%	2020

(Source: Adapted from MoUD, 2015 and MoUD, 2012)

2.2.2 Investments

In the first CDP, 2011, an investment of INR 1600 million was proposed for the sewerage and sanitation improvement. No project for the implementation of the sewerage system has been taken up by DMC. The revised CDP proposes INR 2460 million for underground drainage system including land acquisition cost (MoUD, 2015). The state annual action plan (SAAP) of Madhya Pradesh proposed an investment of INR 970 million to improve service level of sewerage and septage management. This will be funded under Atal Mission for Rejuvenation and Urban Transformation (AMRUT), a central government flagship programme on urban development. This programme recognizes septage management as one of the major thrust areas. SBM plans to build 3000 individual toilets by 2017 (DMC, 2015). The state government of Madhya Pradesh sanctioned 2,873 individual toilets (DMC, 2015).

Table 4: Phasing of investments in sewerage sector

Sector/Component		Implementing agency	Total (in millions)	2017-18	2018-19	2019-20	2020-21	2021-22
A	Construction of underground sewerage network for 2041 for Dewas	**DMC**	1750	350	350	530	530	0
B	Construction of sewage treatment plant	**DMC**	580	0	290	290	0	0
C	Construction of public toilets	**DMC**	30	10	10	10	0	0
D	Land Acquisition for STP	**DMC**	100	5	30	20	0	0
Total			**2460**	**410**	**680**	**850**	**530**	**0**

(Source: MoUD, 2015)

2.3 Reducing inequity

2.3.1 Current choice of services for the urban poor

There are 89 slum settlements within the DMC limits. According to Census of India, 2011, the slum population is 92,770 which is 32% of the total population. The slum survey conducted under Rajiv Awas Yojana (RAY) showed that 51% of the households have individual toilets, and 93% of them are connected to septic tanks. Open defecation is around 44%. About 50% of the households use open fields for defecation, while 20% defecate outside the settlement, next to streets, or near railway tracks. About 12% of the households use community toilets (MoUD, 2015).

Figure 2: Slum area in Dewas (Source: Rahul/CSE, 2015)

DMC provides emptying services in slums as well. Most of the sanitary workers of DMC live in slums. A FGD has been conducted with sanitary workers to know their work related issues. It has been revealed that, most of them belong to a particular caste. Most of them are contract laborers. Sometimes sanitary workers have to get into the OSS to clean the sludge. No safety measures are taken while emptying. Diseases are very common among sanitary workers (DMC, 2015).

Figure 3: Sanitary workers working without safety gears (Source: Anil/CSE, 2015)

2.3.2 Plans and measures to reduce inequity

The Slum Free City Plan of Action (SFCPoA) of Dewas proposed different strategies to improve the service levels. These include in-situ up-gradation of 8 slums, in-situ redevelopment of 65 slums and relocation of 12 slums. The investments needed for these projects would be INR 7.78 billion (UD&ED, 2014). The CDP proposed an investment of INR 4.04 billion for development of affordable housing and infrastructure (MoUD, 2015).

2.4 Outputs

2.4.1 Capacity to meet service needs, demands and targets

ULBs have insufficient financial resources. Municipal expenditures in India account for 1.1% of the country's GDP, compared to 6.9% in South Africa and 9.7% in Switzerland. ULBs therefore rely mainly on national or state grants (AFD, 2014). In the context of Dewas, the major source of income (both revenue and capital) is through grants and contributions, which constitute about 78%[1] of the total income in the financial year (2015-2016). The remaining 22%[2] is generated through taxes and user charges.

The majority of funds for capital works of infrastructure come from different central and state government's schemes like Urban Infrastructure Development for Small and Medium Towns (UIDSSMT), Integrated Housing and Slum Development Programme (IHSDP), Basic Services for Urban Poor (BSUP), SBM etc.

[1] Calculated from 2015-2016 municipal budget of DMC.
[2] Same as above

2.4.2 Monitoring and reporting access to services

The SLBs have to be revised yearly. Data on service levels should be collected, documented and reported to MoUD according to the format prescribed by SLB framework. Service level improvement plans (SLIPs) are prepared with yearly targets. It has to be reviewed each year and progress has to be monitored. The planning documents like CDP and CSP have to be reviewed once in 5 years. This gives an opportunity to monitor the progress on service level improvement.

DMC has computerized the billing of emptying services. The data on number of tanks emptied is available on weekly or monthly basis. This data can be used to quantify septage emptied. At present, the corporation is not using the available data for monitoring the emptying services. The officials of DMC occasionally carry out site inspections to check the quality of emptying services. Sanitary inspectors have to inspect the design of septic tanks and their adherence to standards at the time of construction. But, this is not done most of the time.

DMC has earned INR 0.4 million (5878 USD) revenue from emptying service and had expenditure of INR 2.2 million (32331 USD) from the year 2012 to 2015, which is a huge loss in emptying service. The mere reasons for the loss are due to the free emptying service to the government offices and emptying from sewer holes once in two weeks (DMC, 2015).

2.5 Expansion

2.5.1 Stimulating demand for services

The following activities may stimulate demand for services.

- Awareness generation on septic tank construction, regular desludging of septic tanks through awareness campaigns.
- Capacity building of ULB staff on septage management
- Skill development for local masons
- Monitoring and regulation of private emptiers

In view of the proposed sewer system for entire city, in CDP, the DMC officials were not keen to expand or regularize the septage management services.

2.5.2 Strengthening service provider roles

DMC is the only service provider for the emptying services. Sulabh International Social Service Organisation (SISSO) is responsible for operation and maintenance of public toilets. Community toilets in the slums can also be built and maintained in the same model. Partnership with SISSO in providing emptying service can improve efficiency of services.

Funding is available for septage management initiatives under AMRUT programme. These funds can be used to buy vacuum tankers, building treatment facility etc., DMC has to make use of these funds to strengthen the services. At present, there are no detailed plans for strengthening service delivery.

3 Service outcomes

3.1 Overview

Two key secondary sources of data are; Census of India, 2011, and City Development Plan (CDP), 2015. The secondary data is crosschecked and updated by key informant interviews (KIIs) and focus group discussions (FGDs). This section presents the range of infrastructure/ technologies, methods and services designed to support the management of faecal sludge and/or WW through sanitation service chain in Dewas. To prepare the SFD data on containment, emptying and transport is collected through FGD's and KIIs.

To start with, a relationship between sanitation technologies defined in Census of India and the ones defined in the project is established. Then the population dependent on those systems is represented in terms of percentage of population, as shown in Table 5.

Table 5: Sanitation technologies and contribution of excreta in terms of percentage of population

S. No.	Sanitation technologies and systems as defined by:		SFD reference variable	Percentage of population
	Census of India	SFD promotion initiative		
1	Piped sewer system	User interface discharges directly to centralized separate sewer	T1A1C2	19.7
2	Septic tank	Septic tank connected to open drain or storm sewer	T1A2C6	62.4
3	Other systems	User interface discharges directly to open ground	T1A1C8	1
4	Pit latrine with slab	Lined pit with semi-permeable walls and open bottom, no outlet or overflow, general situation	T1A5C10	0.9
5	Pit latrine without slab	Unlined pit no outlet or overflow, general situation	T1A6C10	0.4
6	Night soil disposed into open drain	User interface discharges directly to open drain or storm drain	T1A1C6	1
7	Service latrine	User interface discharges directly to 'don't know where'	T1A1C9	0.3
8	Public latrine	Septic tank connected to open drain or storm sewer	T1A2C6	1
9	Open defecation	Open Defecation	T1B11C7 TO C9	13.4

3.1.1 Sanitation facilities

This section presents on existing sanitation facilities: community/public toilets, institution, industries and commercial establishments.

Community/public toilets

DMC is responsible for construction of public/ community toilets. DMC has constructed 12 pay-and-use toilets and 8 community toilets. The pay-and-use public toilets are currently operated and maintained by an NGO, SISSO (MoUD, 2015). The user fee is same for all the Sulabh complexes, i.e. for lavatory use it is INR 5 (0.07 USD) per individual, for bathroom INR 5 (0.07 USD) per individual and using urinals is exempted from any charge, both for male and female. Urinals are constructed outside the Sulabh complex premises. Each Sulabh complex has its own groundwater supply to fulfill the water demand. Approximately 12,000 litres of water per day is required at Dewas bus stand Sulabh complex, while the other complexes require only 3000 to 4000 litres a day. All toilets and bathrooms in Sulabh complex have separate tap water supply except the one at Dewas bus stand. Sulabh complexes are functional from 5 am to 10 pm every day (SISSO, 2015).

Figure 4: Community/public toilet in Bhopal chouraha, Dewas (Source: Rahul/CSE, 2015)

Institutions and commercial establishments

There are 268 educational institutions, 1 government hospital, 2 private hospitals and 10 nursing homes in Dewas. No data is available on number of other institutions and commercial establishments, which includes offices, police quarters, hotels, restaurants, cinema halls and markets etc. The septic tanks are installed in industries to handle the black water and the effluent from these tanks is disposed in nearby drains (AI, 2015).

Industrial

Dewas has 500 small scale and few large scale industries (MoUD, 2015). The industrial area is located on the periphery of the city.

During field based research, a Focus Group discussion (FGD) was conducted with Association of Industries (AI) related to sanitation facilities. It is reported that the Ranbaxy pharmaceutical industry has an activated sludge plant for treatment of domestic wastewater generated at the industry. Some of the byproducts like manure and treated wastewater are used for horticulture (MoUD, 2010). (Please refer to table 14 in the appendix for sanitation system in industries and other establishments).

Due to the lack of data on excreta generated from institutions and industrial areas. These establishments have not been taken into consideration for production of SFD.

Though most of the market areas are dependent on public toilets and all big industries have their own treatment plant. The excreta generated from public toilets, residential as well as hotels to cater floating population is considered for this study.

3.1.2 Containment

According to the survey and KII conducted in 2015, only 9% of the city population is dependent on offsite sanitation system. Nearly 76 % is dependent on onsite sanitation systems. Rest 15% of the population practices open defecation.

The sewer network covers DDA developed colonies (MoUD, 2010). Households in DDA colonies are connected to chamber/sewer-hole right next to their house. All these chambers are interconnected through underground pipes (shallow sewer). The branch sewer with several chambers is connected to community septic tanks or trunk sewer or open drains. It was observed during the survey that, in some of the residential areas the chamber/sewer-hole started serving as containment because either the sewerage network is totally choked or the branch sewers connecting to trunk sewer are missing. The trunk sewer is uncovered and is laid right in the middle of the road (refer figure 5). All the Sulabh complexes have septic tanks with the effluent flowing into open drains. Generally the size followed is 20*10*10 cubic feet (SISSO, 2015).

Fully lined tanks are the primary onsite sanitation technology used by the middle to high income group. Generally, these tanks are constructed under the toilets with an opening covered with a stone slab. The fully lined tanks are commonly known as septic tanks. During field based research, it was observed that the containment is poorly designed and/or constructed and/ or emptying period is above 3 years. Due to these deficiencies OSSs are not performing as septic tanks instead they are acting as sealed vaults. The size, location, and design of on-site systems is discretion of local masons and majorly dependent on space available.

In Dewas, two types of pits are prevalent. Lined pit with semi permeable walls and open bottom with no outlet or overflow, and unlined pit with no outlet or overflow. The average dimensions of lined pit is 4*4*6 ft (LBD). The pits are not emptied for more than 10 years.

During the field based research it was observed that some households discharge sewage directly to open drain or storm water drain because the containment is collapsed or damaged. This type of containment system is prevalent in slum areas where the households could not afford to construct a septic tank (Figure 6: clockwise from top; 1. Chamber, 2. Fully lined tanks, 3. Community septic tank).

Figure 5: Trunk sewer and containment system (Source: Shantanu/CSE, 2015)

Figure 6: Containment systems in Dewas (Source: Shantanu/CSE, 2015)

3.1.3 Emptying services

In Dewas, emptying services are managed and regulated by the DMC. SISSO has a vacuum tanker for emptying septage generated from septic tank of community/public toilets. Frequent emptying of septic tanks of public toilet is part of SISSO's operation and maintenance. DMC hires SISSO's vacuum tanker for emptying community septic tanks from DDA developed colonies (DMC, 2015).

DMC owns two vacuum tankers with a capacity of 3500 litres and 3000 litres. Vacuum tanks are mounted on a tractor. The 3500 litres capacity vacuum tanker runs with 35 HP tractor's engine shaft for blow and suction process. The 3000 litres capacity vacuum tanker runs with a generator machine of 5 HP for suction. SISSO has one vacuum truck with a capacity of 12000 litres in Madhya Pradesh (DMC, 2015 SISSO, 2015).

DMC had procured 3500 litres capacity vacuum tanker in the year 2013 at a cost of INR 1.1 million (16,151 USD) and 3000 litres capacity vacuum tanker in the year 2004 for INR 600,000 (8809 USD). Generally, the OSSs of the households are oversized as compared to DMC vacuum tanker capacity, one trip for emptying is not sufficient (DMC, 2015).

Citizens have to submit an application letter requesting to DMC for emptying septage from their OSS. Emptying fees to avail the service is INR 500 (7 USD) per trip (DMC, 2015). Each vacuum tanker has one driver and two sanitary workers. Emptying service is carried out under the supervision of sanitary supervisor. The sanitary workers do not use gloves, boots, or masks or any other safety gear (DMC, 2015).

DMC also empties chambers/sewer-holes of DDA developed colonies. DMC empties the sewer-holes once in 15 days or a month. Emptying period of community septic tanks and community/ public toilet's septic tanks is twice a year. DMC pay INR 13,000 per day (176 USD) to SISSO for emptying DDA's community septic tanks. Emptying period of households connected to fully lined tanks with outlet or overflow varies from 3–15 years. Emptying period of pits is around 10 years (DMC, 2015) (Figure 7: Clockwise from top 1. Sanitary worker emptying sewage from choked sewer-hole 2. 3. and 4. Emptying service from lined tanks)

Figure 7: Emptying service by DMC (Source: Rahul/CSE, 2015)

3.1.4 Transportation

The sewage generated from DDA developed colonies is conveyed through sewer. Some colonies do not have branch sewer connecting to the trunk sewer. The sewage emptied from sewer-holes using vacuum tankers is discharged into trunk sewer. The sewage carried by trunk sewer is discharged into open drains.

The fully lined tanks and septic tanks are connected to open drain. The storm water drainage system in Dewas consists of lined and unlined drains with an approximate length of 157 km of open drains and 46 km of closed drains (MoUD, 2013a). Generally, the sewage generated from the city is conveyed in unlined open drain adjacent to SH-18.

Solid waste dump yard (landfill) is located 10 km away from the city. During the interview, it was reported that dump yard is also used as one of the disposal sites for collected septage.

Figure 8: DMC vacuum tankers used for emptying septic tanks/pits (Source: Anil/CSE, 2015)

3.1.5 Treatment and end use/disposal

Sewage treatment plant (STP) and septage treatment facilities are not available in the city. Around 80% of the wastewater (WW) is conveyed to Kshipra River via two main drains flowing across the city, the rest of it is discharged to Kali Sindh River. The dumping yard is spread over 10 hectares in the outskirts of the city called as trenching ground. Rarely, DMC and SISSO vacuum tankers dispose septage into dumping yard (MoUD, 2015). These tankers generally discharge septage into surface drains/nullahs, low lying areas and agriculture fields (DMC, 2015).

During visit to the city it was observed that farmers' households prefer to dispose the emptied septage to nearby agricultural field. Septage is applied in soybean and wheat cultivation field. A few years back septage disposal on agricultural land was commonly practiced by farmers, gradually the trend is declining (DMC, 2015).

In few municipal wards the household do not have lined open drains, the sewage is directly disposed into any empty plot available next to the household. (Figure 9: Clockwise from top; Sewage discharge 1. into trunk sewer, 2. into open ground, 3. open drain) (Figure 10: Clockwise from top; Disposal of sewage into Kshipra river, dumping yard, agricultural field)

Figure 9: Sewage discharge in local area (Source: Bhitush/CSE, 2015)

Figure 10: Disposal sites of sewage and septage (Source: Bhitush/CSE, 2015)

3.2 SFD matrix

The final SFD for the Dewas is presented in appendix 7.3.

3.2.1 SFD matrix explanation

According to Census of India 2011, around 22% of the city is dependent on offsite systems, population connected to sewerage network is 20% and user interface directly discharging in open drain or open ground is only 2%. But according to the survey and key informant interviews (KIIs) conducted in 2015 and taking floating population into consideration, it is estimated that 9% of the population is dependent on offsite systems. Population connected to sewerage network is estimated to be 6% and user interface directly discharging in open drain or open ground is only 3%.

According to Census 2011, around 65% of the city is dependent on onsite sanitation systems (OSS), out of which around 63% is dependent on septic tanks and 2% on pits. But according to the survey and KIIs conducted in 2015 and taking floating population into consideration, it is estimated that around 55% of the city is dependent on lined tanks connected to open drain and 21% on pits and lined tanks connected sewerage network. The public latrines are connected to lined tanks and hence are incorporated in onsite systems. The tanks connected to open drain are not contained but pits are contained as the groundwater table is more than 10 mbgl. Tanks connected to sewerage network are also contained.

There is no clear differentiation between the volume of effluent and septage generated from tanks, hence to reduce the maximum error it is assumed to be 50% each. Therefore, 26% of FS is effluent that goes into open drains, 5% of effluent goes into sewerage network and the rest is emptied from tanks whenever full. Some FS is always left in the tanks and is assumed to be 13% in the case of tanks connected to open drains. Whereas FS from pits and tanks connected to sewerage network is considered contained and is calculated as 7%, which includes infiltration of water as well.

According to Census 2011, 13% of the population still practices, open defecation, but based on field research it was estimated to be 15%. Definition and estimation of different variables used to make SFD are explained below.

Containment system:

Field based research revealed that there are around 16 types of containment systems prevalent in Dewas city. The septic tanks prevalent in the city are not adhering to the design prescribed by Bureau of Indian Standards (BIS). The floating population is assumed to be dependent on lined tanks with open drain (most popular containment system in the city). All the 16 types of systems are listed below.

Table 6: Containment systems and corresponding percentage of population using these systems

S. no.	Containment	SFD reference variable	Percentage of population
1	User Interface discharges directly to a centralised foul/separate sewer	T1A1C2	6.0%
2	User Interface discharges directly to open drain or storm sewer	T1A1C6	2.9%
3	Septic tank connected to open drain or storm sewer	T1A2C6	4.0%
4	Septic tank connected to open ground	T1A2C8	2.6%
5	Fully lined tank (sealed) connected to an open drain or storm sewer	T1A3C6	37.8%
6	Fully lined tank (sealed) connected to an open ground	T1A3C8	1.7%
7	Septic tank connected to centralised foul/separate sewer	T1A2C2	6.3%
8	Fully lined tank (sealed) connected to a centralised foul/separate sewer	T1A3C2	4.3%
9	Fully lined tank (sealed), no outlet or overflow	T1A3C10	2.9%
10	Lined tank with impermeable walls and open bottom, no outlet or overflow, where there is a 'low risk' of groundwater pollution.	T1A4C10	2.9%
11	Lined pit with semi permeable walls and open bottom, no outlet or overflow, where there is a 'low risk' of groundwater polltion.	T1A5C10	3.2%
12	Lined tank with impermeable walls and open bottom, connected to an open drain or storm sewer.	T1A4C6	6.0%
13	Unlined pit, no outlet or overflow, where there is a low risk of groundwater pollution.	T1A6C10	1.7%
14	Containment (septic tanks, fully lined tanks, partially lined tanks and pits and unlined pits) failed, damaged, collapsed or flooded- connected to open ground	T1B10C8	1.4%
15	Containment (septic tanks, fully lined tanks, partially lined tanks and pits and unlined pits) failed, damaged, collapsed or flooded- with no outlet or overflow	T1B10C10	1.4%
16	Open defecation	T1B11C8	14.9%

The calculation tool can incorporate only ten containment systems for one SFD hence the similar systems were combined together to form 10 systems. The systems which were combined together are coded with same colors in the above table.

The new systems, their schematic reference and corresponding percentage of the population is listed in the table 7.

Table 7: Estimation for the SFD matrix calculations on containment

	SFD reference variable	Description of sanitation containment system	Containment systems schematics reference	Percentage of population
Offsite systems	**T1A1C6**	User Interface discharges directly to open drain or storm sewer	Reference L4	3%
	T1A1C2	User Interface discharges directly to a centralised foul/separate sewer	Reference L1	6%
Onsite systems	**T1A3C2**	Fully lined tank (sealed) connected to a centralised foul/separate sewer	Reference L6	10%
	T1A3C6	Fully lined tank (sealed) connected to an open drain or storm sewer	Reference L8	46%
	T1A3C10	Fully lined tank (sealed), no outlet or overflow	Reference L10	3%
	T1A4C10	Lined tank with impermeable walls and open bottom, no outlet or overflow, where there is a 'low risk' of groundwater pollution.	Reference L11	6%
	T1A4C6	Lined tank with impermeable walls and open bottom, connected to an open drain or storm sewer.	Reference L8	6%
	T1A6C10	Unlined pit, no outlet or overflow, where there is a low risk of groundwater pollution	Reference L11	2%
	T1B10C7 to C9	Containment (septic tanks, fully lined tanks, partially lined tanks and pits and unlined pits) failed, damaged, collapsed or flooded-connected to open ground	Reference L18	3%
Open Defecation	**T1B11C7 to C9**	Open defecation	Reference L20	15%

Table 8: Description and estimation of variables used in SFD for containment systems

Variable	Description	Estimated percentage of population
W2	WW contained centralized (offsite)	6%
W15	WW not contained (offsite)	3%
F2	FS contained (onsite)	21%
F10	FS not contained (onsite)	55%
OD9	Open defecation	15%

According to the field based research W2 is estimated to be around 6% and W15 is estimated to be 3%. T1A1C2 feeds into W2 and T1A1C6 feeds to W15. F2 is estimated to be around 21% which includes T1A3C2, T1A3C10, T1A4C10 and T1A6C10. F10 is estimated to be around 55% which constitutes of T1A3C6, T1A4C6 and T1B10C7toC9. Since there is no clear demarcation in the amount of solid FS generated and effluent/infiltration generated from an onsite system, it is assumed to be 50% each. The percentage of population using their systems with emptying is estimated based on the field based research. Percentage of population defecating in open, OD9, is estimated to be around 15%.

Table 9: Description and estimation of variables used in SFD for emptying and transportation

Variable	Description	Estimated percentage of population
W11a	WW not delivered to centralized treatment plant	11%
W11c	WW not contained not delivered to treatment plant	29%
W11	WW not delivered to treatment	40%
F3a	FS contained- emptied	9%
F3b	FS not contained- emptied	16%
F3	FS emptied	25%
F8	FS contained- not emptied	7%
F15	FS not contained- not emptied	13%
F11	FS not delivered to treatment	25%

Emptying and Transportation:

According to field based research W11a is estimated to be around 11% and W11c as 29%. The 6% of population is connected to sewerage network but sewage is not delivered to treatment plant, hence feeds to W11a. The effluent (5% FS) from septic tanks/tanks, connected to sewer line, is considered contained and is hence added to W11a. 29% of W11c consists of 3% from T1A1C6 and (26% FS) effluent from tanks/pits which are not contained. In total the WW not delivered to treatment plant i.e. W11 (=W11a+W11c) comes out to be 40%.

The FS emptied from contained systems (T1A3C2, T1A3C10, T1A4C10 and T1A6C10), i.e. F3a is estimated to be 9% and FS emptied from not-contained systems (T1A3C6, T1A4C6), i.e. F3b is estimated to be 16%. In total FS emptied i.e. F3 (=F3a+F3b) comes out to be 25%. There is some FS always left in tanks and pits and some FS infiltrates into the ground as water, for contained systems it is defined as F8 and estimated to be 7%. For not-contained systems it is defined as F15 and is estimated around 13%.

Treatment and disposal:

There is no sewage or faecal sludge treatment facility in Dewas. The emptied FS is not delivered to treatment plant, hence F11 is same as F3 i.e. 25%. All the FS and WW is discharged untreated in the local environment.

It can be concluded that excreta of 7% population is managed safely in Dewas city and 93% of excreta is discharged in environment untreated.

3.2.2 Risk of groundwater contamination

The SFD assessment includes the risk of groundwater pollution as an important factor in determining whether excreta is contained or not contained. If the risk of contamination to groundwater is low then FS is considered “contained”. The type of onsite sanitation technology in use also has an influence on infiltration of liquid into the groundwater and therefore on the potential risk of groundwater pollution.

Soil characteristics in Dewas; primary soil strata is of black cotton soil of depth 1-4 meters, secondary soil strata is of yellow soil and murum, tertiary strata is of basalt rock which is more than 10 meters in depth. The black cotton soil has the ability to absorb and retain large volume of water in the monsoon season. In the summer season, the moisture is evaporated from the soil and the soil contracts.

Based on the survey with households and KIIs in Dewas, it was decided to characterize all existing sanitation containment systems as having ‘low risk’ of groundwater pollution, as groundwater table is more than 30 mbgl. According to the Census, 52% of the population is dependent on piped water supply and 48 % on well, tube well and bore well. Sample survey revealed 73% of the respondents are dependent on piped water supply, which also includes public tap water and households’ dependent on community based piped water connections. 27 % of the respondents were depended on bore well and tube wells.

3.3 Discussion of certainty/uncertainty levels of associated data used for the SFD matrix

There were three major challenges to develop the SFD. Census and published/unpublished reports were not able to provide (i) up-to-date data on containment (ii) detailed typology of containment and (iii) actual information about FSM services provided to households. For this reason, field based studies were conducted to validate the data provided by secondary sources.

The Census and published/ unpublished reports mostly differentiate between different types of user interfaces or between septic tanks and pit latrines but not about the design of the actual containment systems on ground level. Therefore, a sample household survey was conducted in each ward of the city to identify and cross check the data collected from the Census, 2011.

There is uncertainty in the data collected through survey as well. The data was collected from 321 households, which is a very small sample to represent the whole city. Though it was made sure that 5-10 households from each ward is surveyed representing households from planned and unplanned areas and different socio economic backgrounds. No other agency was hired for survey, CSE's representative conducted the KIIs, FGDs and primary surveys.

Assumption regarding the amount of FS emptied as compared to FS generated has high impact on the overall SFD. Reliable method for estimating quantities of FS generated on a citywide scale do not yet exist, and it is complicated because the containment size and emptying period greatly varies. The amount of FS emptied is not clear because DMC empties sewage from sewer-holes, septage from government and private institutions and commercial establishment. However, based on survey, it is assumed that, respondents getting their OSS emptied within 10 years are using their systems with emptying and respondents getting their OSS emptied after 10 years are using their system without emptying.

The objective of the survey conducted was to obtain a more accurate measure of how excreta is managed through stages of sanitation service chain (from containment to end-use or disposal).

4 Stakeholder engagement

4.1 Key informant interviews

The key informant interviews were conducted with the stakeholders having a role or interest in sanitation and FSM services within the city. The relevant departments were contacted through e-mail, letter, call and fax prior to visit to the city. The purpose of the SFD study and depth of data required was conveyed through an introductory letter to respective departments. Overall, 4 KIIs were conducted with different stakeholders like government functionaries, emptiers, (see appendix 7.2). Apart from KIIs, other interviews conducted, include representatives from temple, NGOs, bus terminal and Dewas railway junction.

No/limited information was available prior to the field based research about the type of containment, emptying service, transportation and disposal of sewage generated by the city. The visit enabled in enhancing data collection through gathering progress details of SBM, published and unpublished reports like CDP, Slum Free City Plan of Actions (SFCPoA) etc., which were not available on the websites. The published/unpublished reports were shared and discussed during face-to-face meetings. Interview with the DMC and other stakeholders provided additional insight into the service delivery context.

4.2 Field observations

In order to get a better picture of variety/typology of onsite sanitation system primary surveys were conducted. Sample was carefully chosen to get good spatial representation from each ward. At-least 5-10 households were surveyed in each of the 45 wards of Dewas. Since 30% of the population lives in slums, it was made sure that 30% of our respondents represented slums. The surveyor also recorded the field observations related to sanitation. Such surveys, observations and KIIs helped to produce a more credible and accurate SFD, as well as provides qualitative data and perhaps more precise quantitative data relating to the service delivery. Some of the observations are listed below.

It was observed that few economically weaker section (EWS) households have poorly constructed toilets. The toilet is generally constructed for females in the house, male members and kids practice open defecation. The containment system varies according to the economic section of the society. Due to such variation of containment system in the city, it was decided on the field to conduct survey with each ward of the municipal area. A field visit was undertaken to understand emptying process and identify disposal point of both sewage and septage. The visit also helped in sample selection as it gave a better understanding of the city context.

4.3 Focus group discussions

The Focus Group Discussions (FGDs) were conducted to complement, validate and challenge data collected during literature review and interviews. In total, four FGD sessions were conducted. FGDs were held with emptying service providers (DMC), community representatives (*Parishads*), local masons and Association of Industries. The questionnaires for FGDs were prepared in English, but the interviewer asked the questions, translating into the Hindi language.

The findings from the FGD sessions revealed information that increased the understanding of the sanitation and septage management in Dewas. FGDs were useful in data triangulation. Primary survey helped in validating secondary data and data provided by different stakeholders. It resulted in actual and true SFD of the city.

5 Acknowledgement

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7 Appendix

7.1 Stakeholder identification

Table 10: Stakeholder identification

No.	Stakeholder group	In Dewas context
1	City council / Municipal authority / Utility	Dewas Municipal Corporation
2	Ministry in charge of urban sanitation and sewerage	Urban Development & Environment Department, GoMP
3	Ministry in charge of urban solid waste	Urban Development & Environment Department, GoMP
4	Ministries in charge of urban planning finance and economic development.	Urban Development & Environment Department, GoMP
	Ministries in charge of environmental protection/	Forest and Environment Department, GoMP
	Ministries in charge of health	State Health Department, GoMP
5	Service provider for construction of onsite sanitation technologies	N/A
6	Service provider for emptying and transport of faecal sludge	Dewas Municipal Corporation and Sulabh International and Social Service Organisation
7	Service provider for operation and maintenance of treatment infrastructure	N/A
8	Market participants practicing end-use of faecal sludge end products	Farmers
9	Service provider for disposal of faecal sludge (sanitary landfill management)	Dewas Municipal Corporation
10	External agencies associated with FSM services: e.g. NGOs, academic institutions, donors,	Sulabh International and Social Service Organisation

7.2 Tracking of engagement (Tab 3: Stakeholder tracking tool)

Table 11: Tracking of engagement

S.No.	Name of Organization	Designation	Date of engagement	Purpose of engagement
1	DMC	Deputy Commissioner	28/8/2015	Introducing SFD project and permission to conduct FGDs in the offices and municipal wards
2	DMC	City Engineer/ Project Officer	29/8/2015	Collection of City Development Plan and Slum Free city plan of Action, KII
3	DMC	Sanitary Inspector	28/8/2015	FGD
4	DMC	Health Inspector		
5	DMC	Sanitary Worker		
6	DMC	Sanitary Worker		
7	DMC	Sanitary worker		
8	Private	Local Masons	30/8/2015	FGD
9	Private	Local Masons		
10	Private	Local Masons		
11	Private	Local Masons		
12	SISSO	Sulabh Toilet Complex, Dewas Incharge	3/9/2015	KII
13	BJP	Council	4/9/2015	FGD
14	BJP	Council		
15	BJP	Council		
16	BJP	Council		
17	BJP	Council		
18	Stesalit Pvt.Ltd	Project Manager	1/9/2015	Map collection
19	NGO	Social Activist, Abhivyakti Natya Kala Sansthan	1/9/2015	KII
20	Association of Industries	President	2/9/2015	FGD
21	Association of Industries	Secretary		
22	Mahakal foods private Limited	General manager		
23	Tata International limited	Factory manager		
24	Navin Flourine International Limited,	NA		
25	Aviratt Inn	Manager		
26	Dewas Railway Junction	Station Manger	30/8/2015	KII
27	KP College	Director	01/09/2015	FGD
28	Government B.Ed College	Adminsitrative Assistant		
29	Escort Junior college	CEO		
30	James Academy School	Principal		
31	Naidu Hostel	Manager		
32	Gurudwara	Temple staff	03/09/2015	KII

7.3 SFD matrix

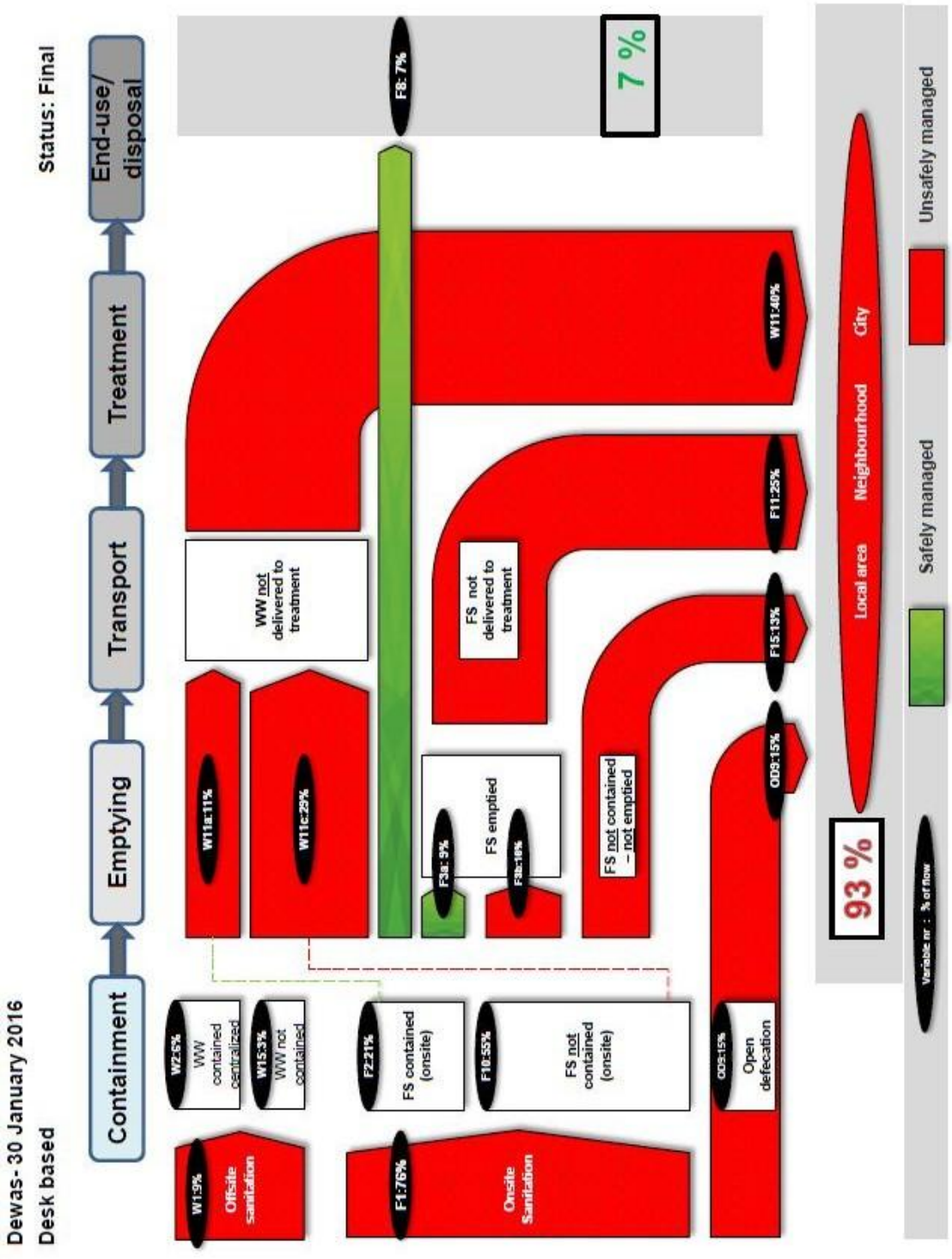

Figure 11: SFD matrix

7.4 Organogram of Dewas Municipal Corporation

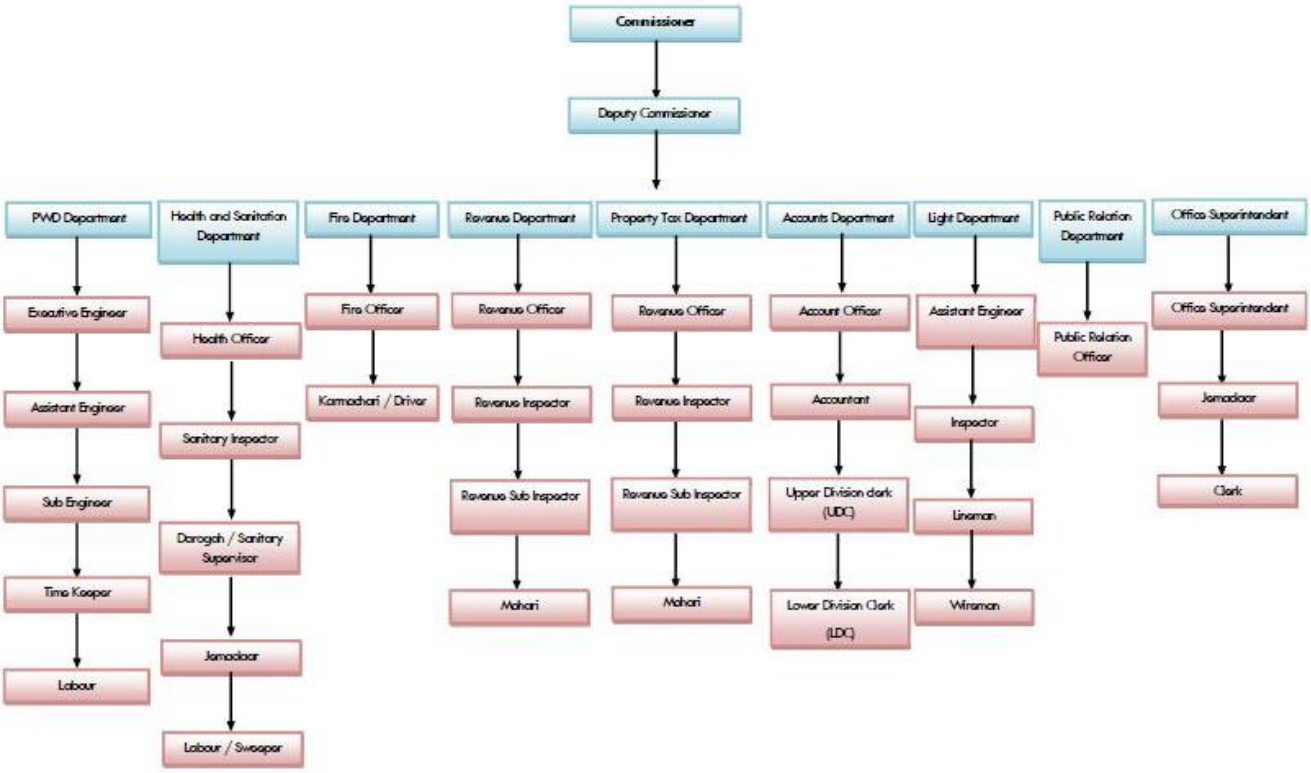

Figure 12: Organogram of Dewas Municipal Corporation

7.5 Organogram of health and sanitation department

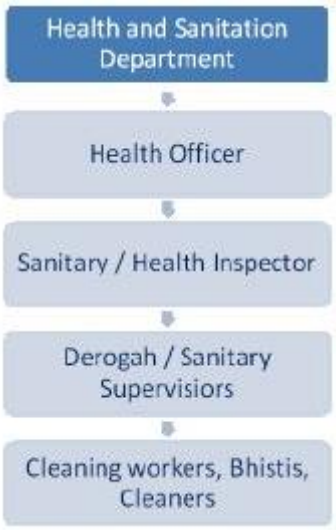

Figure 13: Organogram of Health and Sanitation Department

7.6 SFD calculation tool

Table 12: Sanitation containment system of Dewas as in the SFD calculation tool

Questions	Question A Where does the user interface discharge to? (i.e. what type of container, if any?).	Question B Where the user interface and /or container is abandoned, failed, damaged, collapsed, not working or open defecation is practiced, select which option applies	Question C What is the containment (or user interface if no containment) connected to? (i.e. where does the outlet or overflow discharge to?)	Question D What is the risk of pollution of groundwater ? Determine risk using ' Tab 3 – Question D'	Containment and emptying outcome	Tab 1 ref
Answers for system 1	No onsite container user interface discharge directly to destination given in question C	Not applicable – question A applies	to open drain or storm sewer	Low risk	Not contained, emptying not applicable	**T1A1C6**
Answers for system 2	No onsite container user interface discharge directly bto destination given in question C	Not applicable – question A applies	to centralised foul/separate sewer	Low risk	Contained, emptying not applicable	**T1A1C2**
Answers for system 3	Fully lined tank (sealed)	Not applicable – question A applies	to centralised foul/separate sewer	Low risk	Contained, emptying possible	**T1A3C2**
Answers for system 4	Fully lined tank (sealed)	Not applicable – question A applies	to open drain or storm sewer	Low risk	Not Contained, emptying possible	**T1A3C6**
Answers for system 5	Fully lined tank (sealed)	Not applicable – question A applies	no outlet or overflow	Low risk	Contained, emptying possible	**T1A3C10**
Answers for system 6	Lined tank with impermeable walls and open bottom	Not applicable – question A applies	no outlet or overflow	Low risk	Contained, emptying possible	**T1A4C10**
Answers for system 7	Lined tank with impermeable walls and open bottom	Not applicable – question A applies	to open drain or storm sewer	Low risk	Not contained, emptying possible	**T1A4C6**
Answers for system 8	Unlined Pit	Not applicable – question A applies	No outlet over flow	Low risk	Contained, emptying possible	**T1A6C10**
Answers for system 9	Not applicable – question B applies	Containment (septic tank or tank or pit latrine) failed. Damaged, collapsed or flooded	To open ground	Low risk	Not contained, emptying possible	**T1B10C7 to C9**
Answers for system 10	Not applicable – question B applies	Open defecation	To open ground	Low risk	Not contained, emptying not applicable	**T1B11C7 to C9**

7.7 Community/public toilets

Table 13: Details of community/public toilets

SISSO toilet complexes			
S.No.	**Location**	**Number of seats**	**Effluent connected to**
1	Bhopal Chouraha	15	Septic tank effluent connected to open drain
2	Dewas Bus Stand	16	
3	Chamunda devi temple Entry	11	
4	Chamunda devi temple over the hill	4	
5	Collectorate office	12	
6	Nahardarwaja	10	
7	MG Hospital (Inside Premises)	11	
8	District Court (Inside Premises)	8	
9	Station Road	22	
10	Madhu Milan	17	

7.8 Sanitation in industries

Table 14: Sanitation systems in industries and other establishments

Industries/Institutions/ commercial Establishments	Type	Occupancy	No. of toilets	Type of containment	Emptying period
Texpert international India Limited	Industrial	25	14	Septic Tank to open drain	Not Yet
Navin Flourine International Limited,	Industrial	100	10	Septic Tank to ETP	Not Yet
Mahakail foods private Limited	Industrial	120	8	Septic Tank to ETP	Twice a year
Gangotri Unit 2	Industrial	55	2	Septic Tank to open drain	NA
Tata International limited	Industrial			Septic Tank to ETP	NA
Cummins Turbo Technologies	Industrial	500	30	Septic Tank to STP	NA
Avirat Inn	Commercial	60%	32	Septic Tank to open drain	1 years 6 months not yet
Escort Junior college	Institutional	500 approx	30	Septic Tank to open drain	5 years not yet
Dewas railway station	PS	NA	14	Septic Tank to open drain	2 years
Gurudwara (Temple)		NA	8	Septic Tank to open drain	2 to 3 years
K.P College	Institutional	2625	10	Septic Tank to open drain and Sewerage network	Not yet

7.9 Photographs captured during field visit

Figure 14: User interface discharges directly to open ground (Source: Rahul/CSE, 2015)

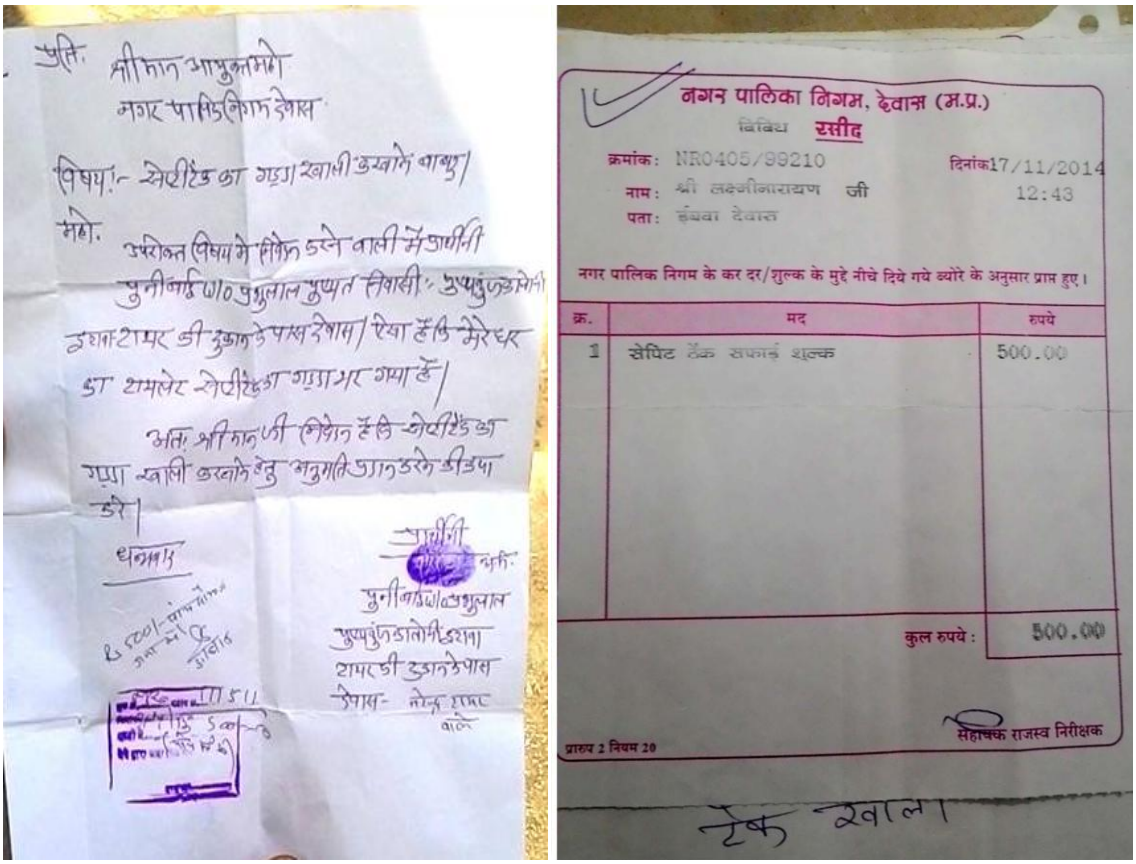

Figure 15: Emptying application letter by household (left) and receipt from DMC (right) (Source: Shantanu/CSE, 2015)

Figure 16: Survey in peri-urban area (Source: Rahul/CSE, 2015)

Figure 17: Survey in slums (Source: Rahul/CSE, 2015)

Figure 18: Focus group discussion with community representatives (Source: Rahul/CSE, 2015)