SFD Promotion Initiative

Solapur
India

Final Report

This SFD Report was created through desk-based research by Centre for Science and Environment (CSE) as part of the SFD Promotion Initiative.

Date of production: 1/08/2015

Last update: 7/01/2016

SFD Promotion Initiative

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On behalf of Federal Ministry for Economic Cooperation and Development

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SFD Report Solapur, India, 2015

Produced by:

Suresh Kumar Rohilla, CSE
Bhitush Luthra, CSE
Rahul Sanka Varma, CSE
Shantanu Kumar Padhi, CSE

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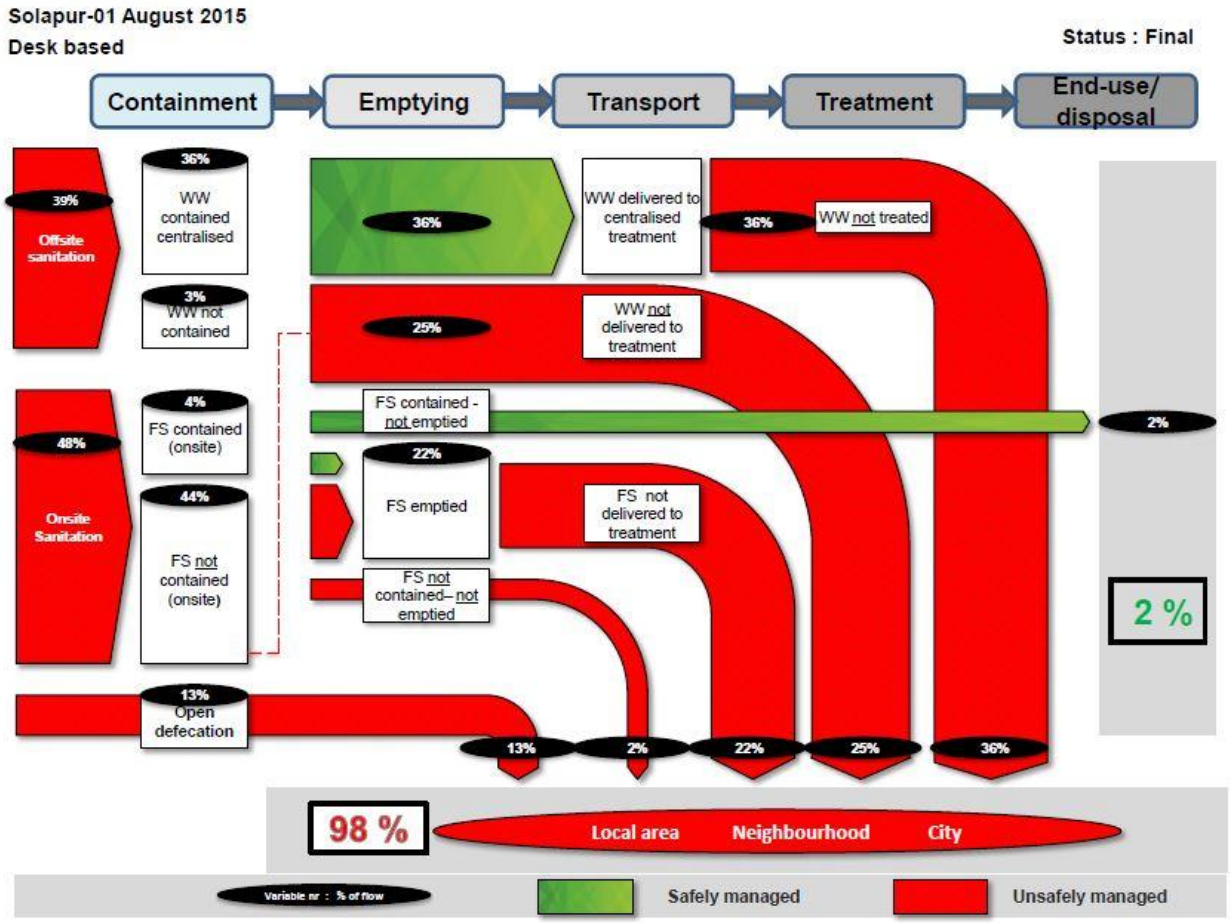
1. The Diagram



2. Diagram information

Desk or field based:

This is a desk based SFD

Produced by:

Centre for Science and Environment (CSE), New Delhi.

Status:

This is a final SFD

Date of production:

01/ 08/2015

3. General city information

Solapur is situated on the south-eastern border of Maharashtra state adjoining Karnataka. It is 550 km away from Mumbai and 300 km away from Hyderabad. It is known for textile production such as bed sheets, blankets, towels, etc (WSSD, 2011).

The population of city, as per Census 2011 is 951,118 persons. The density of city is 5,326 persons per sq.km which is very high when compared to state average of 365 persons per sq.km. Slum population is 218,757 persons which constitutes 23% of the total population (MoUD, 2013).

Municipal boundary has been chosen for the current study. It comprises an area of 178.57 sq. km (MoUD, 2013).

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 (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 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). Despite of no specific provisions for septage management, Solapur Municipal Corporation (SMC) provides emptying services at affordable prices, though they are disposing septage in solid waste dump yard.

5. Service outcomes

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

Containment: There is sewerage network which covers less than half of the population. Rest of the city is majorly dependent on septic tanks which are generally not adhering to design prescribed by Bureau of Indian Standards (BIS). The effluent from the septic tank flows into open drains. Some households are directly connected to pits. Around one-fifth of city's population depends on public toilets. The size of septic tank depends upon the availability of space at the time of construction, there is no standard size.

Figure 1: Emptying process of septage from community toilet (Source: Rahul/CSE, 2015)

Figure 2: Vacuum tanker emptying septage from community toilet (Source: Rahul/CSE, 2015)

Figure 3: Disposal of septage in solid waste dump yard (Source: Rahul/CSE, 2015)

Emptying: SMC is responsible for septage management. SMC owns four vacuum tankers with capacity of 3000 litres each. Citizens are required to submit an application form and pay INR 800 (12 USD) as emptying fees to avail the service. Septic tanks of community toilets are being emptied twice a week. On an average, vacuum tanker empties 32 – 40 septic tanks per day. Income from septage emptying is approximately INR 3,00,000 to 4,00,000 (4489

to 5985 USD) annually. Apart from SMC there are two private emptiers providing services in the city with two vacuum tankers of 3000 litres capacity each. They charge INR 1200 to 1500 (18 to 23 USD) as emptying fees.

Transport: Septage is transported by truck mounted vacuum tankers to disposal sites. The disposal site is 10 kms away from the city.

Treatment: Sewage treatment plant (STP) is not operational, hence sewage is disposed in open channels/ drains. No treatment facility for septage.

End-use/Disposal: Sewage is used for irrigation extensively. Septage collected by SMC is disposed into solid waste dump yard, whereas that collected by private emptiers is dumped in open drains.

According to Census, 38% of Solapur is dependent on offsite sanitation, population connected to sewerage is 36% and user interface discharging directly to open drain is only 2%. For 6 years the sewage treatment plant has not been functional, hence no treatment of wastewater.

Rest of the 49% of city is dependent on onsite sanitation systems, out of which 45% is dependent on septic tanks and 4% on pits. The public latrines are connected to septic tanks and hence are incorporated in onsite systems. FS is not contained as the septic tanks are connected to open drains and pits may be polluting the groundwater.

It is difficult to determine the percentage of effluent and septage generated from tanks, hence to reduce the maximum error; it's assumed to be 50% each. Therefore, 23% of FS is effluent, that goes into open drain and rest is emptied from tanks whenever full. Some FS is always left in the tanks and is assumed to be 2%.Since there is no treatment of wastewater and septage, excreta of 98% of city is not safely managed, which includes 13% of city which defecates in open.

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 large gaps in implementation (USAID, 2010).

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

Key Stakeholders	Institutions / Organizations
Public Institutions	Solapur Municipal Corporation(SMC), Maharashtra Jeevan Pradhikaran (MJP),State Pollution Control Board (SPCB)
Private Sector	Private emptiers

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

SMC is responsible for planning, designing, construction, operation and maintenance of sewerage network. A public health engineer is deputed from the state parastatal agency, Maharashtra Jeevan Pradhikaran (MJP), due to lack of qualified staff at the corporation level (MoUD, 2013).

Public health and sanitation is delivered by SMC through the health department of the corporation which is headed by the health officer. Septage management is also the responsibility of the same department of SMC.

SPCB is responsible for performance monitoring of STPs.

Private emptiers are also responsible for septage management. They are providing services within and around the city.

7. Credibility of data

Two key sources of data are used; Census of India, 2011 and draft CSP, 2011. The data is crosschecked and updated by Key Informant Interviews (KIIs). Six KIIs have been conducted with different stakeholders.

Data on containment is available in Census. Data on emptying and transport is collected by KII's. However most of the data is qualitative.

Some of the issues and challenges are listed below:

- Data insufficiency and non availability: No data available on how many septic tanks are connected to open drains
- Accuracy: Discrepancy observed between Census data and actual ground situation
- Data available at different time lines
- Limited data available on reuse (formal / informal)

Assumptions followed for preparing SFDs:

- Data provided by Census, 2011 is correct
- Septic tanks and sewer connections on ground are as per septic tanks and sewer connections defined in Census
- Volume of waste water generated is 80 % of water supplied
- 90% of the people get their tanks emptied when full

8. Process of SFD development

Data is collected through secondary sources. City is visited to conduct KIIs with relevant stakeholders, to fill in the gaps in data and to crosscheck the data collected.

To start with, a relationship between sanitation technologies defined in Census of India and the ones defined in project is established.

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

Excreta of 98% of the city is not managed safely, as there is no treatment of septage and waste water, only 2% of excreta that is contained in pits is only managed safely.

Limitations of SFD:
It's dependent on secondary data and true picture of the city may differ.

The data available is at different timelines, for example data on containment is from Census of India, 2011, and data on emptying and transportation is collected through KIIs conducted in 2015.

Excreta is safely managed or not is dependent on the containment of the system, and not on whether the waste is safely handled or not.

9. List of data sources

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

- Published reports and books:
  - Census of India 2011, House listing and Housing data, Government of India
  - CSP of Solapur, SMC, 2011
  - Service levels in water and sanitation sector, MoUD, 2012
- KIIs with representatives from
  - Government agencies: SMC
  - Service providers:
    Private emptiers

Solapur, India, 2015

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Abbreviations

BIS	Bureau of Indian Standard
CSP	City Sanitation Plan
CPHEEO	Central Public Health & Environmental Engineering Organization
CSE	Centre for Science and Environment
CGWB	Central Ground Water Board
CPCB	Central Pollution Control Board
FS	Faecal Sludge
GoM	Government of Maharashtra
MJP	Maharashtra Jeevan Pradhikaran
MPCB	Maharashtra Pollution Control Board
MTPVD	Maharashtra Town Planning and Valuation Department
MHADA	Maharashtra Housing and Area Development Authority
SMC	Solapur Municipal Corporation
MOUD	Ministry of Urban Development
NIUA	National Institute of Urban Affairs
PHED	Public Health and Engineering Department
SLB	Service Level Benchmarks
SMP	Septage Management Plan
SWM	Solid Waste Management
USAID	United States Agency for International Department
UDD	Urban Development Department
WSSD	Water Supply and Sanitation Department

1 City context

Solapur is situated on the south-eastern border of Maharashtra State, between 170' 10" N Latitude and 760' 15" E Longitude, adjoining Karnataka. It is 550 km away from Mumbai & 300 km away from Hyderabad. It is well known for textile production such as bed sheets, blankets, towels, etc. Famous temple of Lord Shiva (Shidheshwar mandir) is located in the city. Tulja Bhavani temple at Tuljapur and Akkalkot, the city of Shri Swami Sarmarth are located at 45 and 37 km distance from Solapur respectively (WSSD, 2011).

Since the British era, Solapur has developed as a textile hub. The economy of Solapur is primarily based on textile industries, mostly, handlooms and power looms. Also, due to the Ujjani dam and other irrigation projects, the agriculture sector is also another major sector contributing to the Solapur's economy. Apart from this, the co-operative sugar factories, the beedi industry, and the service class population working in the government sector are also contributing to it. Textile units, based in the area under the Maharashtra Industrial Development Corporation (MIDC) in Solapur along the Akkalkot road, have contributed to Solapur's economy in a major way. The majority of the industrial units are textile-based, followed by chemical industries (MoUD, 2013).

Table 1: Population growth rate

Census Year	Population	Growth rate (%)
1971	3,98,361	
1981	5,14,660	29.9
1991	7,09,317	37.82
2001	8,72,424	23.00
2011	9,51,118	09.02

(source: MoUD, 2013)

The population of Solapur, as per the Census of India, 2011 is 951,118 which has increased by 0.87% compound annual growth rate from the previous Census (872,424 in 2001 Census) (MoUD,2013). The floating population is around 19450 per day (WSSD, 2011).

Solapur Municipal Corporation (SMC) was established on 1st May 1964. SMC's territorial jurisdiction has increased from 33.23 to 178.57 sq km in 1992. The population density is 5,326 persons per sq km. There are 158 notified and 62 non-notified slums in the Solapur city with an estimated population of 218,283. This reflects that around 25% of the total population of the city lives in slums (WSSD, 2011).

The climate is tropical and in summer the maximum temperature is 42°C and minimum is 28°C. In winter the maximum temperature is 27°C and minimum is 13°C. The average rainfall for the city is 760 mm with an average of 45 rainy days (WSSD, 2011).

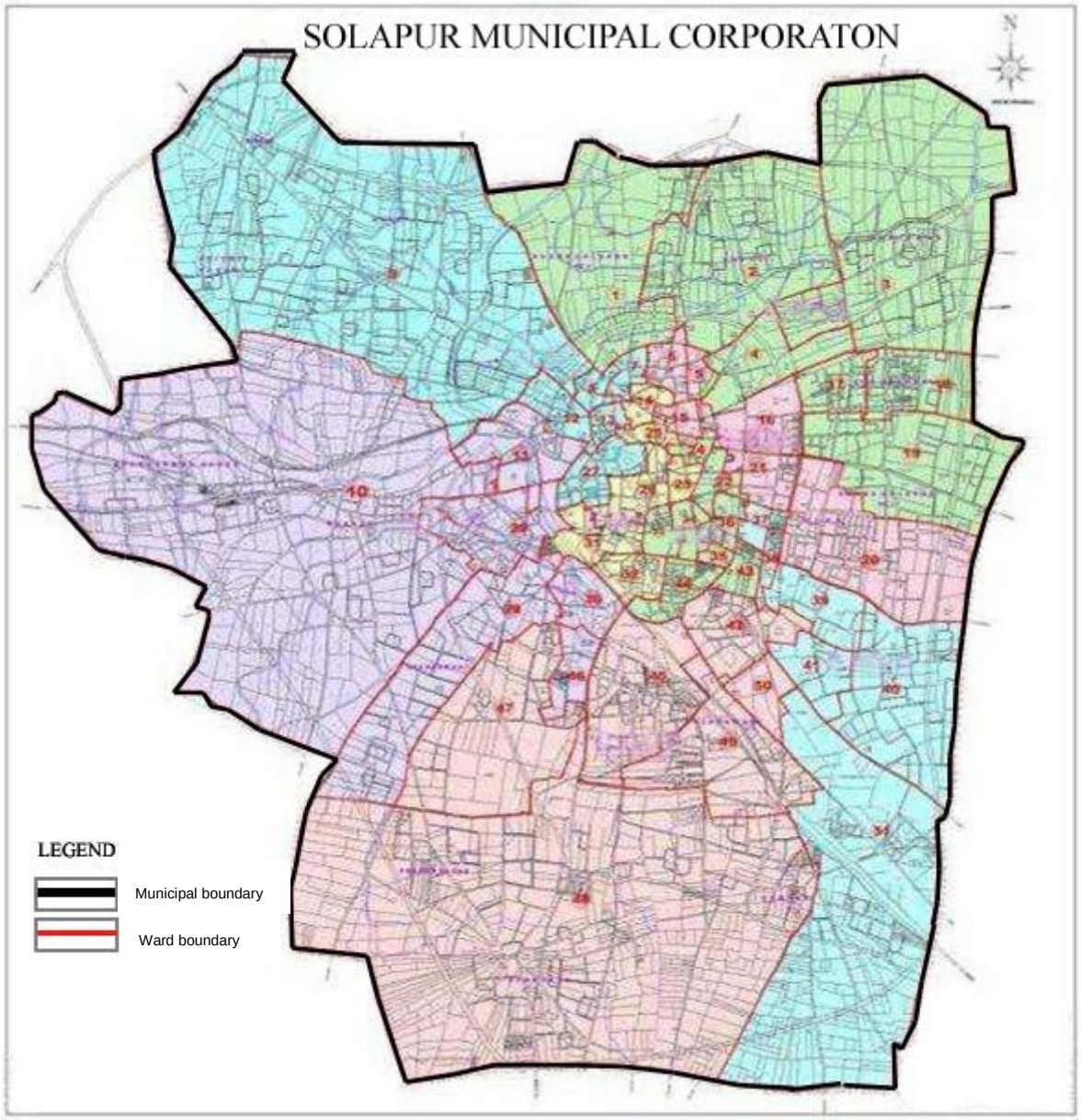

Figure 1: Ward map of Solapur

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 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). 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 onsite 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, 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) as a part of the CSP, being prepared and implemented by cities. Septage here broadly refers 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 Central Public Health & Environmental Engineering Organisation (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, 2013a). 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 SMP.

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 management of solid and liquid wastes but may not provide detailed rules for septage management (MoUD, 2013a).

The Prohibition of Employment as Manual Scavengers and their Rehabilitation Act is enacted in 2013. This act prohibits employment of manual scavengers, 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 Constitution of India, water and sanitation is a state subject. Statutory powers are conferred to the state for making laws on water and sanitation.

There is no specific state sanitation policy for Maharashtra, but the state follows the approach advocated in the NUSP. Maharashtra adopted the guiding principles of NUSP in its, Sujal Nirmal Abhiyan (SNA), vision statement for the urban water supply and sanitation sector. SNA prescribes certain measures, mainly addressing community/public latrines, but falls short of addressing the entire FSM chain (PAS, 2013).

In May 2008, water supply and sanitation department (WSSD) of Maharashtra issued a Government Resolution (GR) which has guidelines for constructing toilets. The GR stated that every city should follow standards prescribed by the National Building Code, 2005.The Urban Development Department, GoM, issued a GR encouraging cities to develop plans to recycle and reuse at least 20 percent of waste water generated (PAS, 2013).

Each Municipal council is entitled to make its own by-laws for various aspects of city governance, and Building By-Laws is one of them. The state has provided Model Building By-Laws to guide ULBs to develop their own laws. Model By-Law describes septic tanks as the most common method of collecting faecal matter and also sullage (if no drains are available) and it has to be designed according to Indian Standards code. It also provides the details of septic tank design and construction (PAS, 2013).

Toilets, bathrooms and kitchens are part of a building and are governed by Building By-Laws. The regulatory guidelines and process is well laid out in the Municipal Acts. As per *Maharashtra Municipal Councils, Nagar Panchayats and Industrial Townships Act, 1965*, the Municipal Corporation/Council is responsible for issuing permits for construction of new buildings and/or repairs/renovation of old buildings (PAS, 2013).

According to the Act, a person intending to construct a building should submit a plan with information on drain pipes, privies, water closets, cesspools etc along with house plan. The chief officer, after due inspection grants permission for construction. The owner/occupier of a building can be fined if he causing nuisance by discharging any wastewater, cesspool water etc in to open drains/streets/open plots. The development control rules of many cities mandate that effluent from septic tanks should be properly treated before disposing into open drains or water body (GoM, 1965).

The chief officer is responsible for fixing the timings and planning routes for removal and transportation of septage. The emptier can be fined if improper vehicle is used for emptying, disposing septage in water body or anywhere which causes nuisance. However, the act lacks specifications for vehicles, approval mechanisms of licenses to emptiers (GoM, 1965).

In solapur, a council resolution was passed in year 2000 for undertaking emptying services by the municipal corporation. The corporation was to able buy vacuum trucks after this resolution.

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 leave large gaps in implementation (USAID, 2010).

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

1. Urban Development Department (UDD)
2. Water supply and sanitation Department (WSSD)
3. Maharashtra Jeevan Pradhikaran (MJP)
4. Maharashtra Pollution Control Board (MPCB)
5. Maharashtra Town Planning and Valuation Department (MTPVD)
6. Maharashtra Housing and Area Development Authority (MHADA)
7. Solapur Municipal Corporation (SMC)

The following table provides roles and responsibilities of various institutions:

Table 2: Institutional roles and responsibilities

Institution	Roles and responsibilities
Urban Development Department (UDD)	Allocation of budget, regular monitoring and functioning of ULBs. Approval of municipal budgets, funding of CSPs and other proposals.
Water supply and sanitation Department (WSSD)	Preparation of state urban sanitation strategies, policy, guidelines, schemes.
Maharshtra Jeevan Pradhikaran (MJP)	Key financing vehicle. Plans and constructs urban Infrastructure. However, it is not involved in management of onsite sanitation systems.
Maharashtra Pollution Control Board (MPCB)	Advises state on pollution related standards and policies. Monitoring of treatment plants. Key regulator for pollution related issues.
Maharashtra Town Planning and Valuation Department (MTPVD)	Development of regional and city development plans
Maharashtra Housing and Area Development Authority (MHADA)	Implements low cost housing projects, slum improvement projects
Solapur Municipal Corporation (SMC)	Planning, designing, implementation, operation and maintenance (O&M) of urban infrastructure. Development control. Overall management of the civic services in the city. Responsible for septage emptying, transportation and disposal.

Several institutions are involved in management of sanitation activities with varying roles. While most of the state level institutions are responsible for policy setting, oversight and monitoring, SMC is responsible for actual implementation. The Municipal Acts place most of the responsibilities in the area of sanitation to SMC. Three departments in SMC i.e., Town planning, Public Health Engineering and Sanitation are vested with powers of implementation of sanitation related schemes/projects.

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 (Urban Local Bodies) 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 subsidise operating costs (Planning Commission, 2002a).

Furthermore, when no separate utility exists, 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).

SMC has the dual role of service provision for public services and regulation of activities for households. SMC is responsible for planning, designing, construction, operation and maintenance of sewerage network. A public health engineer is deputed from the state parastatal agency, Maharashtra Jeevan Pradhikaran (MJP), due to lack of qualified staff at the corporation level (MOUD, 2013b). Public health and sanitation is delivered by SMC through the health department of the corporation. Septage management is also the responsibility of the same department of SMC. The department is headed by medical officer of health and is supported by supervisory staff consisting of Chief Conservancy Superintendent, six Chief Sanitary Inspectors and 54 Sanitary Inspectors and subordinate staff consisting of 37 drivers and 135 sanitary workers (MoUD, 2013b).

2.1.5 Service standards

1. Service Level Benchmarks (SLB), 2008: Issued by the Ministry of Urban Development in 2008, It 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 and (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. 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.

4. 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.

3 Service outcomes

Service outcome analysis is based on secondary sources. Two key sources of data are; Census of India, 2011, and draft CSP, 2011. The data is crosschecked and updated by key informant interviews (KIIs). Data on containment is available in the Census. Data on emptying, transport and treatment is collected by KIIs. However, most of the data is qualitative. The sewage treatment plant is not in working condition, and half of the city is dependent on onsite sanitation systems.

3.1 Overview

This section presents the range of sanitation technologies/infrastructure, methods and services designed to support the management of FS and Waste Water (WW) through sanitation service chain in Solapur. The details on quantitative estimations are presented in table below and following sections:

Table 3: 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	35.9%
2	Septic tank	Septic tank connected to open drain or storm sewer	T1A2C6	22.3%
3	Other systems	User interface discharges directly to open ground	T1A1C8	0.4%
4	Pit latrine with slab	Lined pit with semi-permeable walls and open bottom, no outlet or overflow, general situation	T1A5C10	3.2%
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	2.0%
7	Service latrine	User interface discharges directly to ‘don’t know where’	T1A1C9	0.5%
8	Public latrine	Septic tank connected to open drain or storm sewer	T1A2C6	22.2%
9	Open defecation	Open Defecation	T1B11C7 TO C9	13.3%

3.1.1 Sanitation facilities

This section presents existing sanitation facilities apart from household toilets.

Community toilets: In Solapur around 25 % of the population live in slum areas and most of them are dependent on community toilets. There are 53 community toilets in the city having equal number of seats for male and female. These toilets are majorly connected to septic tanks. (SMC, 2015).

Public toilets: To cater to a floating population, there are a total of 272 toilet seats at public places. Across the city there are 402 public urinals. These are mostly situated at bus stands, railway station and market areas. There are no urinal facilities for women at public places (WSSD, 2011).

Due to the lack of data on excreta generated from institutions, industrial areas, restaurants and hotels. These establishments have not been taken into consideration for production of SFD. Whereas excreta from public toilets, residential as well as commercial areas is considered for this study.

3.1.2 Containment

Only 30% of the city's population has access to sewerage system. Nearly 26 % is dependent on onsite sanitation systems. Another 22 % is dependent on Public/community latrines, most of them are connected to septic tanks (SMC,2015a).Containment prevalent in the city is septic tanks and pits latrines. Different types of septic tanks/pits have been observed here – Pits made of concrete rings placed one on another, fully plastered tanks, tanks with only brick work (not plastered). The effluent from the septic tank flows into open drains. It is observed that size, location, and design of on-site systems is prerogative of local masons and is majorly dependent on space available. The septic tanks constructed are generally not adhering to design prescribed by the BIS (SMC, 2015b).

3.1.3 Emptying

In Solapur, emptying services are managed and regulated by the municipal corporation. SMC owns four vacuum tankers with capacity of 3000 litres each. Citizens are required to submit an application form and pay INR 800 (12 USD) as emptying fees to avail the service. For emptying outside city limits, it will be charged INR 8 (0.12 USD) per kilometer. Emptying is done within three days of submitting the application. SMC also empties septic tanks of community toilets twice a week. On an average, 32 – 40 septic tanks are emptied in a day. Revenue from septage emptying is approximately INR 3,00,000 to 4,00,000 (4489 to 5985 USD) annually (SMC, 2015). Apart from SMC there are two private emptiers providing services in the city with two vacuum tankers of 3000 litres capacity each. They charge INR 1200 to 1500 (18 to 23 USD) as emptying fees (S Ganesh 2015, pers. comm., 11 June).

It is observed that no safety precautions are taken by persons who empty the septic tanks.

Figure 2: Emptying septic tank of community toilet (source: Rahul/CSE, 2015)

3.1.4 Transportation

Septage is transported by truck mounted vacuum tankers to disposal sites (SMC, 2015). The disposal site is 10 kms away from the city. The vacuum tankers are parked at a dedicated parking area along with solid waste collection trucks. Sewage is either conveyed through sewer lines or open drains.

3.1.5 Treatment and disposal

Sewage treatment plant (STP) is not operational; hence sewage is disposed in open channels/ drains. Sewage is used for irrigation extensively (SMC, 2015). There is no treatment facility for septage. SMC disposes septage into solid waste dump yard which is 8-

10 kms distance from the town. Septage that collected by private emptiers is dumped in open drains.

Figure 3: Discharge of septage in to solid waste dump yard (source: Rahul/CSE, 2015)

3.2 SFD Matrix

The final SFD for Solapur is presented in appendix 7.3

3.2.1 SFD Matrix Explanation

According to Census of India, 2011, 39% of Solapur is dependent on offsite sanitation, population connected to sewer line is around 36% and user interface discharging directly to open drain or open ground is only 3%. For 6 years the Sewage Treatment Plant (STP) has not been functional, hence no treatment of wastewater. 48% of city is dependent on onsite sanitation systems (OSS), out of which 44% is dependent on septic tanks and 4% on pits. The public latrines are connected to septic tanks and hence are incorporated in onsite

systems. FS is not contained as the septic tanks are connected to open drains and pits may be polluting the groundwater.

It is difficult to determine the percentage of effluent and septage generated from tanks, hence to reduce the maximum error; it's assumed to be 50% each. Therefore, 22% of FS is effluent, that goes into open drain and rest is emptied from tanks whenever full. Some FS is always left in the tanks and is assumed to be 2%. Since there is no treatment of wastewater and septage, excreta of 98% of city is not safely managed, which includes 13% of city that defecates in open.

Table 4: Description of variables used in SFD

Variable	Description
W2	WW contained centralized (offsite)
W15	WW not contained (offsite)
W11	WW not delivered to treatment
W11c	WW not contained not delivered to centralized treatment plant
W4a	WW delivered to centralized treatment plant
W12	WW not treated
W12a	WW not treated at centralized treatment plant
F2	FS contained (onsite)
F10	FS not contained (onsite)
F3	FS emptied
F3a	FS contained- emptied
F3b	FS not contained- emptied
F8	FS contained- not emptied
F15	FS not contained- not emptied
F11	FS not delivered to treatment
OD9	Open Defecation

Assuming Census figures are correct; W2 was estimated to be around 36%. It is assumed that all the WW would reach STP hence W4a is estimated to be 36%. W15 is rounded off as 3%, as it includes WW discharged in open drains i.e. 2%, WW discharged on open ground (defined as other systems in Census) i.e. 0.4% and WW from service latrines i.e. 0.5%. Since WW is not treated at STP, W12a and W12 become 36%. 22% of FS, in the form of effluent from septic tanks is discharged into open drains, hence joins W15 to become 25% of WW i.e. not contained not delivered to treatment plant, therefore W11c=25%. Total WW not delivered to treatment plant, W11, is also equal to 25%.

F10 is estimated to be around 44% and F2 is estimated to be around 4% which constitutes of 3.2 % population dependent on lined pits with semi-permeable walls & open bottom and 0.4% are dependent on unlined pits. Since there is no clear demarcation in quantity of solid FS generated and effluent/infiltration generated from onsite systems, it is assumed to be 50% each. It is also assumed that 90% of population (dependent on onsite systems) gets their system emptied when full. Therefore out of 44% septic tank dependent population, FS of 20% population gets emptied. Similarly for lined pits and unlined pits FS emptied taken together, comes out to be 2% approximately, making total FS emptied, i.e. F3 equal to 22%. Where F3a is 2% and F3b is 20%. Whereas FS contained but not emptied, i.e. F8 comes out to be 2%. The emptied FS is discharged untreated in environment therefore F11 comes out to be 22%. Since there's some sludge always left in the tanks and pits F15 is estimated to be 2%. 13% of population practice open defecation and hence OD9 is computed to be 13%.

It can be concluded that excreta of 98% population is not being managed safely in Solapur city as F8 is only 2% rest all excreta is discharged in environment untreated.

Table 5 summarizes the percentage of the population using each sanitation technology and method along the service chain.

3.2.2 Risk of groundwater contamination

The level of ground water table is 2.2 to 9.79 mbgl. According to a study of Central Ground Water Board, the nitrate concentration in Solapur is as high as 125 mg/l. As per the BIS Standard for drinking water the maximum desirable limit of Nitrate concentration in ground water is 45 mg/l. Though nitrate is considered relatively non-toxic, a high nitrate concentration in drinking water is an environmental health concern (CGWB, 2011). From this it is evident that ground water in the city is contaminated. This might be due to wastewater seepage or seepage from septic tanks and pit latrines.

Table 5: Percentage of the population using each system technology and method

System type	Containment	Emptying	Transport	Treatment	End-use/ disposal
Offsite	T1A1C2 (Reference L1): 36% of the population is connected to centralised sewer, hence W2 is 36%. T1A1C6 (Reference L4): 2 % of the population is discharging their excreta directly to open drain. T1A1C8 & T1A1C9 (Reference L5): 0.4 % of the population is discharging their excreta directly to open ground and 0.5% discharging don't know where. Total WW not contained (offsite), i.e.W15, adds up to 3%.	No data available.	WW of 36%of the population served by centralised sewers, reaches treatment facilities, hence W4a is 36%. WW not contained, delivered to centralised treatment plant, i.e. W4c is 0%. Therefore WW not contained not delivered to centralised treatment plants, i.e. W11c, is 25% which includes W15=3%. Total WW not delivered to treatment plant, i.e. W11, is 25%.	Treatment facility available is dysfunctional, hence 0% of the population has their wastewater treated, and therefore W12a or W12 is 36%. 0% of the population has their WW treated, hence W5a is 0%.	WW of 36% of the population is disposed in local area/ river without treatment. WW is also used for irrigation sometimes. Total WW disposed untreated in local area comes out to be 25%
Onsite	48% of population is dependent on onsite sanitation systems, hence F10, FS not contained is 44% and F2, FS contained is 4% T1A2C6 (Reference L8): 44% of population is dependent on septic tanks connected to open drain T1A5C10 (Reference L11):3.2% of population is dependent on lined pit with semi permeable walls and open bottom T1A6C10 (Reference L11):0.4% of population is dependent on unlined pit	Since most of the population is getting their systems emptied, it is assumed 90% of population has their onsite technology emptied. Since there is no clear differentiation between % of septage and effluent, it is assumed to be 50% each. FS not contained- emptied, i.e. F3b comes out to be 20% and FS contained-emptied, i.e. F3a is 2%. FS contained- not emptied, i.e. F8, becomes 2 %.	No FS is transported to treatment plant therefore FS not delivered to treatment plant, i.e.F11, is 22%.	No treatment facility exists hence no FS is treated, therefore FS treated, i.e. F5, is 0%.	All the FS emptied ends up in local area without any treatment.
Open Defecation	13% of population practice open defecation and hence OD9 is computed to be 13%.				

4 Stakeholder engagement

4.1 Key informant interviews

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 introductory letter to respective departments. Overall, 6 KIIs were conducted with different stakeholders like government functionaries, private emptiers, (see appendix 7.2). The GoM, operates through its UDD. UDD is supported by WSSD and MJP.

Limited documents were available on web hence the visit to city also helped in collecting data, including unpublished reports. The KIIs and data collected helped in understanding the existing situation and upcoming development plans in the sanitation sector. Due to limitation of desk-based study all the key stakeholders engaged in sanitation services could not be interviewed in person.

5 Acknowledgement

This report was compiled as part of the SFD promotion initiative project funded by the Bill and Melinda Gates foundation (BMGF). We would like to take this opportunity to thank Mr. Vijay Kalam, Commissioner, SMC, Dr. Jayanthi Adke, Chief Health Officer, SMC, Mr. G. M. Dulange, Deputy Engineer, SMC for their support during our visit to Solapur. We would like to specially mention Mr. Savanth, Conservancy Superintendent, SMC for facilitating a visit to solid waste dump yard. A special thanks to Dr. Suresh Kumar Rohilla, Programme Director, CSE for his supervision and guidance at every step of the assessment and report writing.

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7 Appendix

7.1 Stakeholder identification

Table 6: Stakeholder identification

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

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

Table 7: Tracking of engagement

Name of the organisation	Name of the contact person	Designation	Date of engagement	Purpose of engagement
Solapur Municipal Corporation	Mr R.N.Reddy	Deputy Engineer (water supply)	10.06.2015	Data collection
Solapur Municipal Corporation	Mr S. Kallappa Usturage	Deputy Engineer (water supply)	10.06.2015	KII
Solapur Municipal Corporation	Mr Vijay Lokhande	Junior Engineer (City Engineering)	10.06.2015	Data collection
Solapur Municipal Corporation	Mr R.D.Jadav	Assistant Engineer (Sewerage)	11.06.2015	KII
Solapur Municipal Corporation	Mr Savanth Raju	Conservancy Superintendent (Public Health Department)	11.06.2015	KII
Solapur Municipal Corporation	Dr Jayanthi Adke	Chief Health Officer (Public Health Department)	11.06.2015	KII
Solapur Municipal Corporation	Mr K. Arun	Sanitary worker	11.06.2015	KII
No name	Mr S. Ganesh	Private emptier	11.06.2015	KII
Solapur Municipal Corporation	Mr G.M.Dulange	Deputy Engineer (Sewerage)	12.06.2015	Data collection
Solapur Municipal Corporation	Mr A.M.Rathod	Deputy Engineer (City Engineering)	12.06.2015	Data collection

7.3 SFD matrix

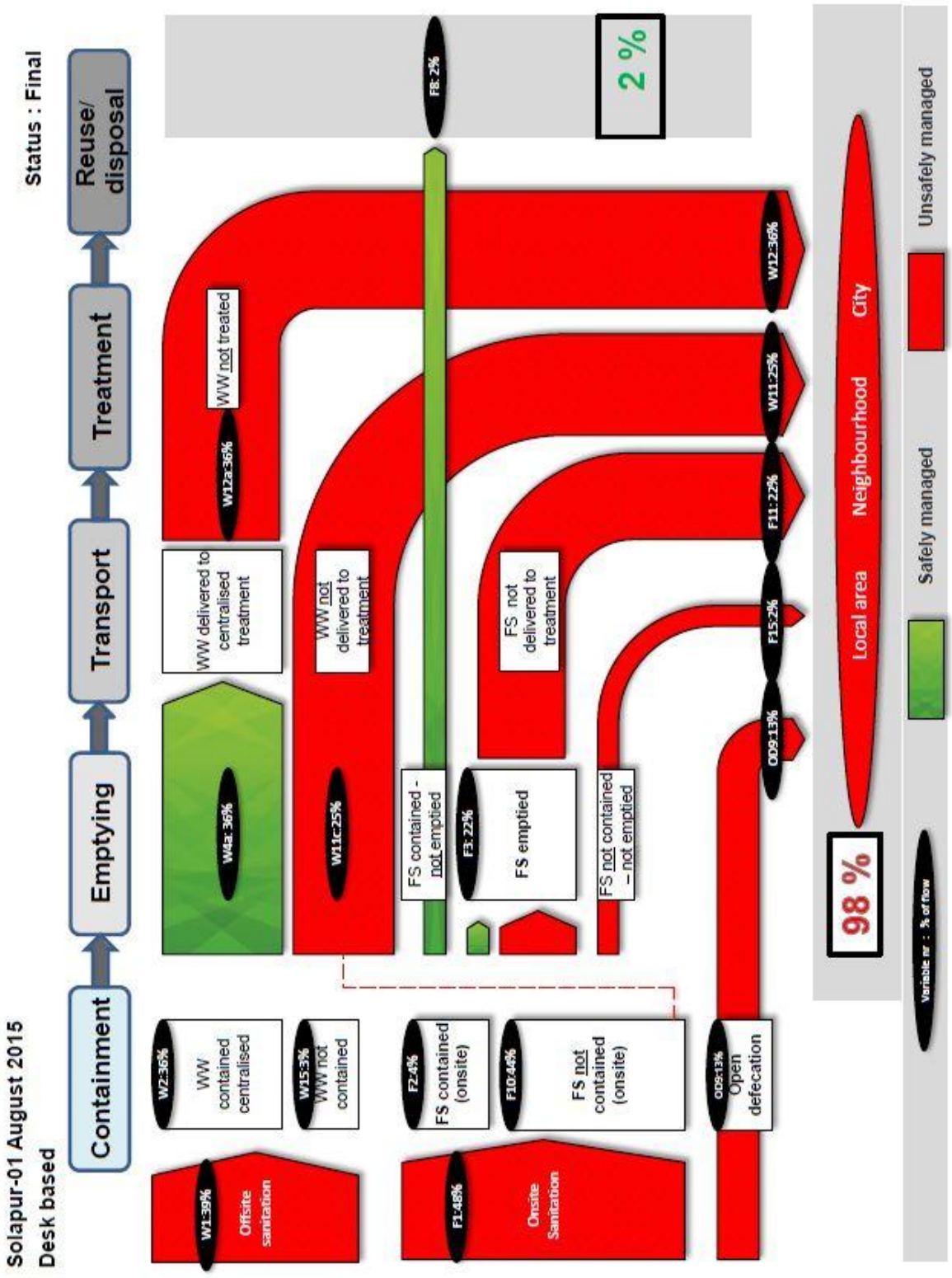

Figure 4: SFD matrix

7.4 Organogram of Solapur Municipal Corporation

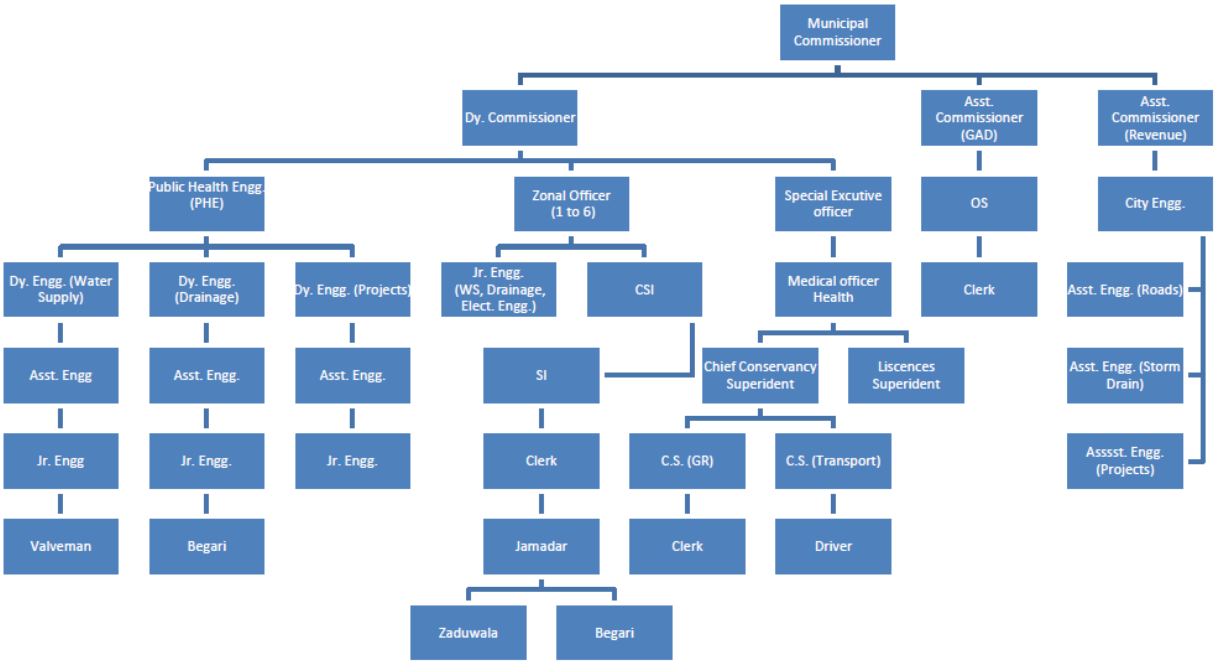

Figure 5: Organogram of Solapur Municipal Corporation

7.5 Application form for septage emptying services

दिनांक : / /२०

मा. आरोग्याधिकारी साहेब,
सोलापूर महानगरपालिका, सोलापूर
यांचेकडेस..

विषय : संडासचे सेप्टिक टँक साफ होऊन मिळणेबाबत

अर्जदार :

राहणार :

मोबाईल नं. :

महोदय,

वरील विषयानुसार
सदर ---------- जागेच्या संडासचा सेप्टिक टँक भरलेला आहे. तरी वरील हौद (टँक) खात्यामार्फत साफ होऊन मिळावा. त्याकरिता जी काही फी असेल ते आम्ही भरणेस तयार आहोत.

आपला विश्वासू

सूचना व अटी

१. प्रती खेप रुपये ८००/- प्रमाणे
२. गाडी घरापर्यंत येते कां ? : होय / नाही
३. सेप्टिक टँक साफ करुन किती वर्ष झाली आहेत : ---------- वर्षे
४. सदर टँकमधील मैला हा घट्ट आहे की पातळ आहे, याबाबत खात्री करुन घेऊनच टँक साफ करणेबाबत अर्ज करावा. सेप्टिक टँकमध्ये जर मैला घट्ट असेल तर सक्शन मशीनने टँक साफ करता येत नाही किंवा सक्शन मशिनने काढता येत नाही. याबाबत अर्जदारांनी नोंद घ्यावी.
५. सक्शन मशिनने अथवा अन्य काही करणास्तव सेप्टिक टँकमधील मैला साफ न केला गेल्यास मनपाकडे भरलेले पैसे परत मिळणार नाहीत.
६. पावती केल्यानंतर ४ ते ५ दिवसांनी अर्जदाराच्या घरी सेक्शन मशिनची गाडी येईल.
७. सदरचे शहर हद्दीत आहे किंवा शहर हद्दीबाहेर आहे? : हद्दीत / हद्दीबाहेर
८. शहर हद्दीबाहेर असलेल्या ठिकाणासाठी त्याचे चार्ज वेगळे पडेल (रुपये ८/- प्रति. कि.मी. प्रमाणे)

वरील सर्व अटी मला मान्य आहेत.

आपला विश्वासू

Figure 6: Application form for septage emptying services (in local language)