SFD Report

Lucknow
India

Final Report

This SFD Report – Initial Level - was prepared by
Population Services International (PSI)

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SFD Report Lucknow, India, 2020

Produced by:

Ajeet Singh, Population Services International (PSI)

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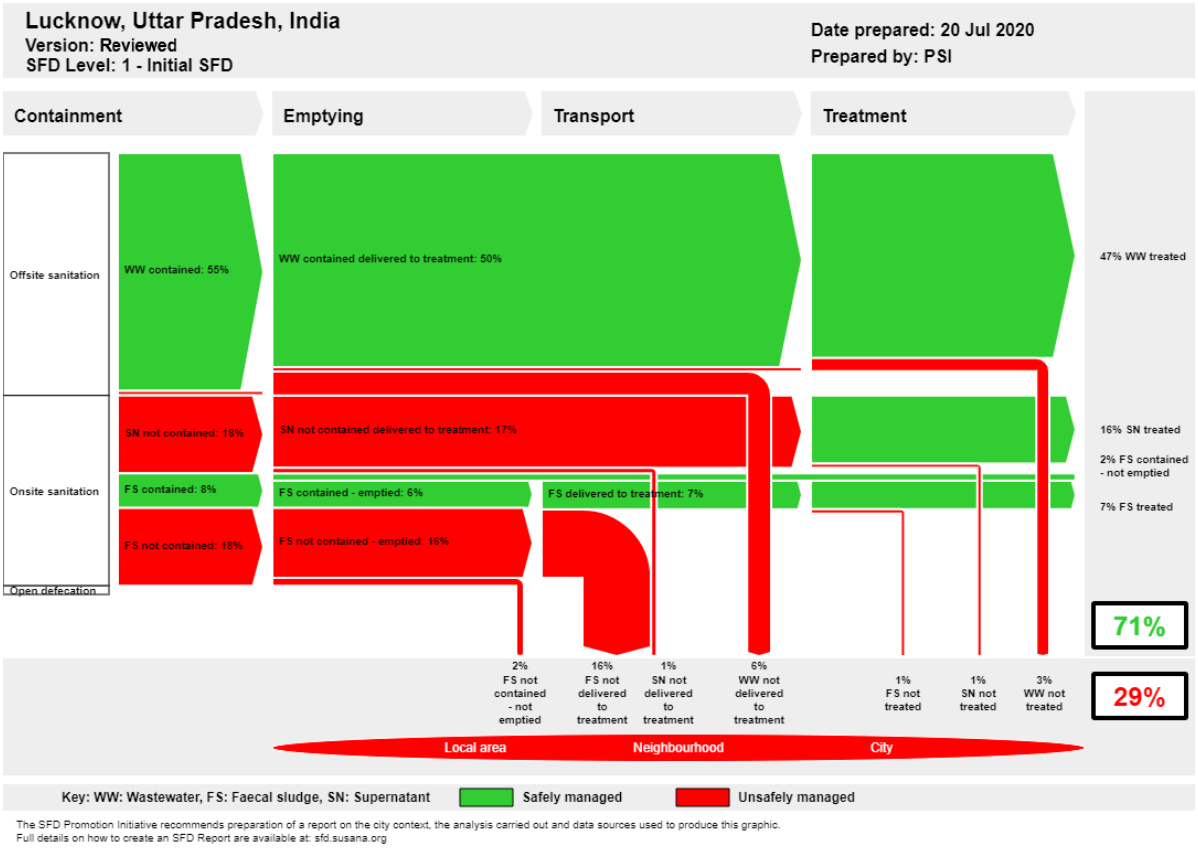
1. The SFD Graphic



The SFD Promotion Initiative recommends preparation of a report on the city context, the analysis carried out and data sources used to produce this graphic.
Full details on how to create an SFD Report are available at: sfd.susana.org

2. Diagram information

SFD Level:

This is a level 1- Initial SFD report.

Produced by:

Ajeet Singh , Population Services International.

Status:

Final SFD report.

Date of production: 30/09/2020

3. General city information

Lucknow is the capital city of the Indian state of Uttar Pradesh. Lucknow is also the *tehsil* and the district headquarters of the Lucknow district (TCPD, 2018). The urban local body governing the city is Lucknow Municipal Corporation (LMC)/Lucknow Nagar Nigam (LNN). Lucknow is a part of the Atal Mission for Rejuvenation and Urban Transformation (AMRUT) and the Smart city Mission of the Government of India (GoI).

The jurisdiction of LNN spans over an area of 349 km^2. The city is divided into 8 administrative zones and 110 wards. The total population of the city as per census 2011 is 2,817,105, while as per LNN the current population is 3,391,208 with 1,765,632 males and 1,625,576 females (LNN, 2019). Total number of households in the city are 557,130 and the average household size is 6.09 (LNN, 2019).

The city is situated at the latitude 26^o 30' N and longitude 81^o 13' E. The city is located at an elevation of 123 metres above sea level. The average rainfall in Lucknow city is 269.9 mm (Singh et al., 2012). Temperature in winters i.e. November to February are between 3^o C – 16^o C, while in summers i.e. March to August the temperature varies in the range of 28^o C – 41^{o}C. The city is situated in the upper Gangetic region. The chief geographical feature of the city is River Gomti which divides the city in Trans-Gomti and Cis- Gomti region (LNN, 2016). Lucknow is located in the Agro- climatic zone V, and features on the central plain region.

The region receives on an average 979 mm of rainfall; the climate ranges from dry sub-humid to semi-arid and the soil is alluvium calcareous sandy loam (GOI, 2015).

4. Service outcomes

Containment

According to Census of India, approximately 54.4% of households were connected to sewerage network. In 2011, the total households in the city were 512,519, while in 2020 the households have increased to 557,130. Post interventions under various projects since 2011 such as Jawaharlal Nehru National Urban Renewal Mission (JNNURM), AMRUT Mission and Smart Cities Mission, the coverage has increased, but so has the number of households. The number of households connected are 55%. But the number of connections since 2011 has increased from 278,835 to 307,863.

According to census, 32.44% of households were connected to septic tanks, 1.47% of households were dependent on other systems, 0.66% was dependent on pit latrines, 0.82% of households were disposing night soil directly into drain, 2.36% was dependent on public toilets and 7.48% practised open defecation. However, from the new set of data available from LNN, 35% of households are dependent on septic tanks connected to open drains, 4% of households are dependent on twin pit systems, 4% of households are dependent on fully lined tanks connected to open drains, 1% is dependent on pit systems and 1% is dependent on toilets discharging night soil directly to drain.

Sizes of the containment systems/Onsite Sanitation Systems (OSS) such as septic tanks and fully lined tanks vary across the city. The size of the containments is usually decided on the basis of space availability and affordability of the households. Due to no standardization being followed while constructing the containment system, few households have constructed their containments large in capacity irrespective of household size. As per Key Informant Interview (KII) with Private Tank Operators (PTOs), it was noted that the size of the tanks vary between 2,400 litres – 12,500 litres.

Lucknow was declared Open Defecation free on 21st September, 2018 by Ministry of Housing and Urban Affairs, Government of India.

Emptying

Emptying frequency differs across the city. Emptying frequency is dependent on the size of the septic tank and the willingness of the owner. As per KII with PTO's it was noted that in the central city, which is densely populated, the emptying frequency ranges from 2 months to 6 months. While the size of the containment system, in areas not served by sewerage network, increases as one would go further from the centre of the city.

Transport, Treatment and disposal

LNN owns 10 vacuum tankers and 6 truck jetting and sucking machine of which tractor-mounted have a faecal sludge carrying capacity of 3,000 litres capacity. The vehicles owned by LNN are used for cleaning of drains too. The emptying fee per trip charged by the LNN for a containment system with a capacity of 3,000 litres capacity is INR 1,500 (US$ 20).

As per KII with PTOs, there are 50 desludging tanker-mounted trucks in the city. The capacity of these vehicles is either 4,000 litres, 5,000 litres or 6,000 litres. These trucks operate across the city. Some of the main functioning areas for the PTOs are Rajnikhand, Neelmatha, Puia, Aligang shetia, Old Lucknow chowk, Imambara, Nawabgang and Logpur khatra. The trucks charge a base fees of INR 1,500 (US$ 20) for a distance of 1.5-2 km (from assembly point)/desludging. Increase in distance is negotiated with extra charge.

5. Service delivery context

In 2008, the Ministry of Housing and Urban Affairs (MoHUA), formerly known as 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. NUSP identifies the constitution of the multi-stakeholder task force as one of the principal activities to be taken up to start the city sanitation planning process. As per the requirement of CSP, a major role is to be played by the members of institutions, organizations, individuals, NGOs, academics, media

representatives, local councillors, industry owners, consultants, representatives of private sector, etc. Constitution of Swachh Bharat City Level Task Force (SBCLTF) formerly known as City Sanitation Task Force (CSTF) is facilitated by drawing members from these groups in consensus with citizens who will be constantly supporting the CSP preparation by analysing the strengths and competencies required to overcome the current situation and to improve sanitation facilities (MoUD, 2014). In Lucknow, Population Services International (PSI), an international development agency, is working with Lucknow Nagar Nigam. The partnership has established a Faecal Sludge and septage management task force and helped the private tank operators register at a subsidised rate in LNN.

A CSP for Lucknow was prepared under Jawahar Lal Nehru Urban Renewal Mission. Japan International Cooperation Agency (JICA), an independent international agency, which acted as a development partner to the Ministry of Urban Development in this endeavour during 2011, had appointed CRISIL Risk & Infrastructure Solutions Limited (CRIS), to prepare the CSP for the city of Lucknow (CRISIL, 2011).

The Environment (Protection) Act, 1986 and the Water (Prevention and Control of Pollution) Act, 1974 have provisions relating to sanitation services and environmental regulations. It applies to households and cities with regard to disposing wastes into the environment. Urban Local Bodies (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 Prohibition of Employment as Manual Scavengers and their Rehabilitation Act is enacted in 2013. This act prohibits employment of manual scavengers and insanitary latrines - Laying strong emphasis on rehabilitation of manual scavengers. The broad objectives of the act are to eliminate insanitary latrines, prohibit the employment of manual scavengers and the hazardous manual cleaning of sewer and septic tanks, and to maintain a survey of manual scavengers and their rehabilitation (MoSJE, 2014).

In February 2017, MoHUA issued the National Policy on Faecal Sludge and Septage Management (FSSM). The policy aims to set the context, priorities, and direction for, and to facilitate, nationwide implementation of FSSM services in all ULBs such that safe and sustainable sanitation becomes a reality for all in each and every household, street, town and city in India (MoUD, 2017).

The Fourteenth Finance Commission (FC-XIV) was constituted by the President of India under Article 280 of the Constitution on 2nd January 2013 to make recommendations for the period 2015-20. Its assignments include distribution of revenue between union and state; devising formula for grant; suggesting method to augment resources for local bodies; and taking care of any matter referred to it (NIUA, 2014).

Model Municipal Building Bye-laws 2016 was prepared by Town and Country Planning Organization (TCPO). Building Bye-laws 2016 is used to regulate coverage, height, building bulk, and architectural design and construction aspects of buildings so as to achieve orderly development of an area. They are mandatory in nature and serve to protect buildings against fire, earthquake, noise, structural failures and other hazards. It includes chapters on green buildings and sustainability provisions, rainwater harvesting, Wastewater (WW) reuse and recycle, installation of solar roof top photo voltaic norms, revised norms for adequate toilet facilities for women, public conveniences in public buildings and mandatory provisions for segregated toilet facilities for visitors in public buildings (TCPO, 2016).

6. Overview of stakeholders

An overview of the stakeholders is provided in Table 1.

Table 1: Key Stakeholders.

Key Stakeholders	Institutions / Organizations /
Public Institutions	Lucknow Municipal Corporation, Uttar Pradesh Jal Nigam, Uttar Pradesh Awas Vikas Parishad, RCUES
Non-governmental Organizations	Population Services International

7. Process of SFD development

Data are collected through secondary sources. City was visited to conduct KIIs with relevant stakeholders to fill in the gaps in data and cross-check 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 data were fed into the calculation tool to calculate the excreta flow in terms of percentage of population. Overall 74% of excreta is safely managed in the city and the rest 26% is discharged untreated to the environment, which also includes 1% of city

defecating in open, hence shown unsafe in the SFD graphic.

Limitations of the SFD graphic:

The SFD graphic is dependent on secondary data and true picture of the city may differ. The data were available at different time lines. For example, data on containment were extracted from census 2011 while emptying and transportation data were collected through KIIs conducted in 2020.

10. Credibility of data

Two key sources of data are used: Census of India, 2011 and published documents of relevant departments. Most of the data are then updated by KIIs. Overall, 3 KIIs have been conducted with different stakeholders. There were three major challenges to develop the SFD graphic. 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.

The Census and published/unpublished reports mostly differentiate between systems connected to the user interface, if any, but does not give information about the design of actual containment systems on ground level or about the disposal of septage and wastewater generated.

11. List of data sources

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

- Published reports and books:
- Census of India 2011, House listing and housing data, Government of India.
- KIIs with representatives from Lucknow Municipal Corporation, Jal Kal Vibhag, Jal Nigam and Urban development authority.
- TCPD, U., 2018. Town and Country Planning Department, UP. [Online] Available at: http://uptownplanning.gov.in/post/en/introduction-of-development-area-lucknow
- Singh, O., gupta, J. & Warsi, A., 2012. Climate of Lucknow, Lucknow: Indian Meteorological Centre, Ministry of Earth Sciences.
- CRISIL, 2011. Final City Sanitation Plan for Lucknow, Lucknow: Japan International Cooperation Agency (JICA)
- MoUD, 2017. National Policy on Faecal Sludge and Septage Management., Delhi: Ministry of Urban Development, Government of India
- MoSJE, 2014. The Prohibition of Employment as Manual Scavengers and their Rehabilitation, Delhi: Ministry of Social Justice and Empowerment, Government of India.
- NIUA, 2014. Fourteenth Finance Commission (2015-2020) - Report, Delhi: National Institute of Urban Affairs

SFD Lucknow, Uttar Pradesh, India, 2020

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Table of Content

List of tables

List of figures

Abbreviations

AMRUT	Atal Mission for Rejuvenation and Urban Transformation
BIS	Bureau of Indian Standard
CGWB	Central Ground Water Board
CPCB	Central Pollution Control Board
CPHEEO	Central Public Health & Engineering Organization
CSE	Centre for Science and Environment
CSP	City Sanitation Plan
CSTF	City Sanitation Task Force
CT	Community Toilet
DUDA	District Urban Development Authority
EWS	Economically Weaker Sections
FAB	Fluidized Aerobic Bioreactor
FC	Finance commission
FGD	Focus Group Discussion
FS	Faecal Sludge
FSM	Faecal Sludge Management
FSSM	Faecal Sludge and Septage Management
GoI	Government of India
GoUP	Government of Uttar Pradesh
INR	Indian National Rupee
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
KII	Key Informant Interview
LDA	Lucknow Development Authority
LMC	Lucknow Municipal Corporation
LNN	Lucknow Nagar Nigam
MLD	Million Litres per Day
MoHUA	Ministry of Housing and Urban Affairs
MoUD	Ministry of Urban Development
MPS	Main Pumping station
NIUA	National Institute of Urban Affairs
NMCG	National Ganga Clean Mission
NUHM	National Urban Health Mission
OD	Open Defecation
ODF	Open Defecation Free
OSS	Onsite Sanitation System
PMAY	Pradhan Mantri Awas Yojna
PT	Public Toilet
SBCLTF	Swachh Bharat City Level Task Force
SBM	Swachh Bharat Mission
SBM (U)	Swachh Bharat Mission (Urban)
SFD	Shit Flow Diagram
SFD-PI	Shit Flow Diagram Promotion Initiative
SLB	Service Level Benchmarks
SM	Septage Management
SN	Supernatant
SPS	Sewage Pumping Station
STP	Sewage Treatment Plant
TCPD	Town and Country Planning Department
TCPO	Town and Country Planning Organisation

UASB	Upflow Anaerobic Sludge Blanket
UDD	Urban Development Department
ULB	Urban Local Body
UP	Uttar Pradesh
UPAVP	Uttar Pradesh Awas Vikas Parishad
UPJN	Uttar Pradesh Jal Nigam
USAID	United States Agency for International Development
USD	United State Dollars (1 USD = 73 INR)
WSS	Water Supply and Sewerage
WW	Wastewater
ZPS	Zonal Pumping station

1 City context

Lucknow is the capital city of the Indian state of Uttar Pradesh, Lucknow is also the tehsil and the district headquarters of the Lucknow district (TCPD, 2018). The urban local body governing the city is Lucknow Municipal Corporation (LMC)/Lucknow Nagar Nigam (LNN). Lucknow is a part of the Atal Mission for Rejuvenation and Urban Transformation (AMRUT) and the Smart city Mission of the Government of India (GoI). The jurisdiction of LNN spans over an area of 349 km^2. The city is divided into 8 administrative zones and 110 wards (Figure 1).

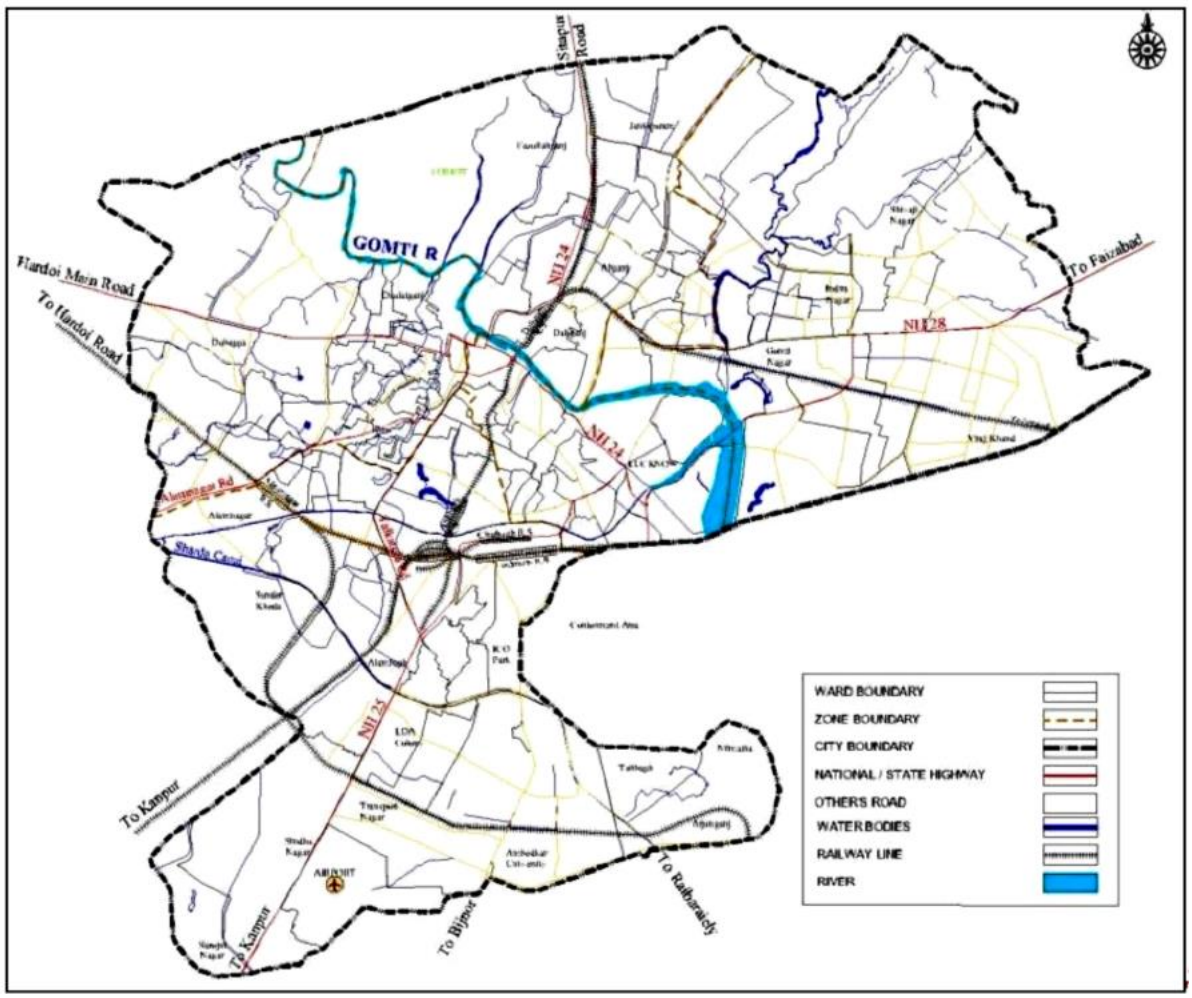

Figure 1: Lucknow base map. Source: Lucknow Nagar Nigam, 2020.

The total population of the city as per census 2011 is 2,817,105, while as per LNN the current population is 3,391,208 with 1,765,632 males and 1,625,576 females (LNN, 2019). Total number of households in the city are 557,130 and the average household size is 6.09 (LNN, 2019). Table 1: Population Increase up to 2019.

Table 1: Population Increase.

Census year	Population
1971	774,644
1981	947,990
1991	1,619,115
2001	2,185,927
2011	2,817,105
2019*	3,391,208
**Non-census year, data procured from smart city data unit- Lucknow municipal corporation*	

Source: (Census of India, 2011), (LNN, 2019)

The city is situated at the latitude 26° 30' N and longitude 81° 13' E. The city is located at an elevation of 123 metres above sea level. The average rainfall in Lucknow city is 269.9 mm (Singh, et al., 2012). Temperatures in winters i.e. November to February are between 3° C – 16° C, while in summers i.e. March to August the temperature varies in the range of 28° C – 41°C. The city is situated in the upper Gangetic region. The chief geographical feature of the city is River Gomti which divides the city in Trans- Gomti and Cis- Gomti region (LNN, 2016). Lucknow is located in the Agro- climatic zone V, and features on the central plain region. The region receives on an average 979 mm of rainfall; the climate ranges from dry sub-humid to semi-arid and the soil is alluvium calcareous sandy loam (GOI, 2015).

2 Service Outcomes

The analysis is based on data available from Census of India, 2011, published reports of government, non-profit organizations and reconnaissance household survey. Data collected from secondary sources are triangulated. Data on the containment are available in Census 2011. Data have been cross-checked and updated by Key Informant Interviews (KIIs). Data on emptying, transport, treatment and disposal of faecal sludge are collected through existing reports and KIIs with private emptiers and parastatal bodies. However, most of the data are qualitative.

2.1 Overview

To start with, a relationship between sanitation technologies defined in Census of India and the variables 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 2.

Table 2: 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 a centralized foul/separate sewer.	T1A1C2	54.4
2	Septic tank	Septic tank connected to open drain or storm sewer	T1A2C6	32.44
3	Other Systems	User interface discharges directly to open ground	T1A2C8	1.47
4	Pit latrine with slab	Lined pit with semi-permeable walls and open bottom, no outlet or overflow, general situation	T1A5C10	0.48
5	Pit latrine without slab	Unlined pit no outlet or overflow, general situation	T1A6C10	0.18
6	Night soil disposed into open drain	User interface discharges directly to open drain or storm drain	T1A1C6	0.82
7	Public latrine	Septic tank connected to open drain or storm sewer	T1A2C6	2.36
8	Open defecation	Open defecation	T1B11C7 TO C9	7.48
7	Service latrine	User interface discharges directly to ‘don’t know where”	T1A1C9	0.37

Source: (Census of India, 2011)

2.1.1 Sanitation facilities

This section presents on existing sanitation facilities in institutions, commercial establishments, slums and facilities for tourists.

Community and public toilets: There are 308 public toilets in the city, of which 265 have been constructed under Swachh Bharat Mission. There are 106 community toilets in the city. Therefore, there are a total of 414 community and public toilets in the city.

Education and healthcare facilities: There are 82 graduation colleges and 14 hospitals/dispensaries.

Parks, community halls and other recreational facilities: Lucknow has 1,684 parks and gardens and 10 community halls with a cumulative capacity of 11,600 people.

Industrial areas: Lucknow has major textiles industries, however further details on sanitation facilities are not available.

Due to the lack of data on excreta generated from schools, industries, education and healthcare facilities, this data are not taken into consideration for the production of the SFD graphic.

2.1.2 Containment

According to Census of India, approximately 54.4% of households were connected to sewerage network. In 2011, the total households in the city were 512,519, while in 2020 the households have increased to 557,130. Post interventions under various projects since 2011 such as Jawaharlal Nehru National Urban Renewal Mission (JNNURM), AMRUT Mission and Smart Cities Mission, the coverage has increased, but so has the number of households. The number of households connected are 55% (system T1A1C2) in 2020. But the number of connections since 2011 has increased from 278,835 to 307,863.

According to census, 32.44% of households were connected to septic tanks, 1.47% of households were dependent on other systems, 0.66% was dependent on pit latrines, 0.82% of households were disposing night soil directly into drain, 2.36% was dependent on public toilets and 7.48% practised open defecation. However, from the new set of data available from LNN, 35% of households are dependent on septic tanks connected to open drains (system T1A2C6), 7% of households are dependent on twin pit systems (system T1A3C10, as these systems are cylindrical shaped with semi-spherical bottom. They are completely lined with slight perforations for liquid portion to seep out. The faecal sludge in these systems remains completely contained and are/can be eventually used as manure), 1% of households are dependent on fully lined tanks connected to open drains (system T1A1C6), 1% is dependent on pit systems (system T1A4C10, as they are more similar to tanks rather than to pits) and 1% is dependent on toilets discharging night soil directly to drain (system T1A1C6).

Sizes of the containment systems/Onsite Sanitation Systems (OSS) such as septic tanks and fully lined tanks vary across the city. The size of the containments is usually decided on the basis of space availability and affordability of the households. Due to no standardization being followed while constructing the containment system, few households have constructed their containments large in capacity irrespective of household size. As per KII with Private Tank

Operators (PTOs) it was noted that the size of the tanks vary between 2,400 litres – 12,500 litres.

Lucknow was declared Open Defecation free on 21st September, 2018 by Ministry of Housing and Urban Affairs, Government of India. Figure 2 shows the SFD selection grid.

List A: Where does the toilet discharge to? (i.e. what type of containment technology, if any?)	List B: What is the containment technology connected to? (i.e. where does the outlet or overflow discharge to, if anything?)									
	to centralised combined sewer	to centralised foul/separate sewer	to decentralised combined sewer	to decentralised foul/separate sewer	to soakpit	to open drain or storm sewer	to water body	to open ground	to 'don't know where'	no outlet or overflow
No onsite container. Toilet discharges directly to destination given in List B		T1A1C2			Significant risk of GW pollution Low risk of GW pollution	T1A1C6				Not Applicable
Septic tank					Significant risk of GW pollution Low risk of GW pollution	T1A2C6				
Fully lined tank (sealed)					Significant risk of GW pollution Low risk of GW pollution	T1A3C6				T1A3C10
Lined tank with impermeable walls and open bottom	Significant risk of GW pollution Low risk of GW pollution	Significant risk of GW pollution Low risk of GW pollution	Significant risk of GW pollution Low risk of GW pollution	Significant risk of GW pollution Low risk of GW pollution	Significant risk of GW pollution Low risk of GW pollution					Significant risk of GW pollution T1A4C10
Lined pit with semi-permeable walls and open bottom	Not Applicable									Significant risk of GW pollution Low risk of GW pollution
Unlined pit										Significant risk of GW pollution Low risk of GW pollution
Pit (all types), never emptied but abandoned when full and covered with soil										Significant risk of GW pollution Low risk of GW pollution
Pit (all types), never emptied, abandoned when full but NOT adequately covered with soil										
Toilet failed, damaged, collapsed or flooded										
Containment (septic tank or tank or pit latrine) failed, damaged, collapsed or flooded										
No toilet. Open defecation	Not Applicable									Not Applicable

Figure 2: SFD selection grid.

2.1.3 Emptying

Emptying frequency differs across the city. Emptying frequency is dependent on the size of the septic tank and the willingness of the owner to get it emptied. As per KII with PTO's it was noted that in the central city, which is densely populated, the emptying frequency ranges from 2 months to 6 months. While the size of the containment system, in areas not served by sewerage network, increases as one would go further from the centre of the city.

LNN owns 10 vacuum tankers and 6 truck jetting and sucking machine, of which tractor-mounted ones have a faecal sludge carrying capacity of 3,000 litres capacity. The vehicles owned by LNN are used for cleaning of drains, too. The emptying fee per trip charged by the LNN for a containment system with a capacity of 3,000 litres capacity is INR 1,500 (US$ 20).

As per KII with PTO's there are 50 desludging tanker-mounted trucks in the city (Figure 3). The capacity of these vehicles is either 4,000 litres, 5,000 litres or 6,000 litres. These trucks operate across the city. Some of the main functioning areas for the PTOs are Rajnikhand, Neelmatha, Puia, Aligang shetia, Old Lucknow chowk, Imambara, Nawabgang and Logpur khatra. The

trucks charge a base fees of INR 1,500 (US$ 20) for a distance of 1.5-2 km (from assembly point)/desludging. Increase in distance is negotiated with extra charge.

Figure 3: LNN tanker-mounted tractor (Source: Ajeet/PSI).

2.1.4 Transport

Sewage is transported to Sewage Treatment Plants (STPs) through the sewerage network and pumped through Sewage Pumping Stations (SPSs). For effective planning, implementation and maintenance, the Uttar Pradesh Jal Nigam (UPJN) has divided the whole city into four sewage districts. Cumulatively, the sewerage network comprises of 1,176 km of existed sewer lines laid by UPJN and 774 km of existed sewer lines were laid by LDA and UP Awas Vikas Parishad, making a total of 1,950 km of sewer lines laid in the city and 16 SPSs, with a transportation efficiency of 90% (LNN, 2015). Out of the 29 drains, 26 drains have been intercepted (diverted towards the sewerage treatment plants) till 2019 under the Atal Mission for Rural and Urban Transformation (AMRUT) and Namami Gange (UPJN, 2019). A total of 643.29 million litres per Day (MLD) is carried by these drains of which 599.58 MLD (93%) is tapped.

FS is transported using tractor-mounted tankers operated by PTOs and LNN. New tanker-mounted trucks cost anywhere between INR 7.5 Lacs- INR 9 Lacs (US$ 10,214 - US$ 12,257), this is exclusive of extension pipes which cost INR 7,000 (US$ 95) for a 30 ft. (9 m) pipe and INR 12,000 (US$ 163) for a 100 ft. (30 m) pipe. PTO's have to extend the length of these pipes by attaching multiple pipes, costing up to INR 40,000 (US$ 544). These vehicles are assembled at Rajni khand. The maintenance for a month of these vehicles is INR 5,000 (US$ 68) and upwards, while the driver is paid INR 10,000-INR 12,000/month (US$ 136-US$ 163/month) and the helper receives INR 7,000-INR 9,000/month (US$ 97-US$ 122/month). Many PTOs operating in LNN are farmers from outskirts of the city. They are a part to this business owing to availability of tractors and usage of collected faecal sludge (FS) as soil conditioner for the fields. The emptiers advertise their contact numbers using wall paintings and distribution of business cards (Sandeep, 2020) (Mukesh, 2020).

Faecal sludge collected from the city is discharged at designated sewage pumping stations (SPSs) (Figure 4). The registration was done to facilitate discharge at the SPSs located in ward 88 and 46 in the city. Population Services International (PSI), an international development agency, has helped facilitate open disposal near ward 7 and 8 due to the distance from SPSs. As of October, 2019 only 6 PTOs having 12 tankers were registered, only 19% of the faecal sludge can be assumed to be safely disposed while the remaining PTOs tend to discharge in various low lying areas of the city.

As on August, 2020 the total registered PTOs have increased to 18, however for the purpose of this report, data of October, 2019 are being taken into consideration. Population Services International (PSI), the nodal agency working and advocating faecal sludge and septage management in Lucknow, has brought together the PTOs and LNN in November, 2019. PSI helped in bringing down registration charges from INR 10,000 (US$ 136) to INR 2,000 (US$ 27).

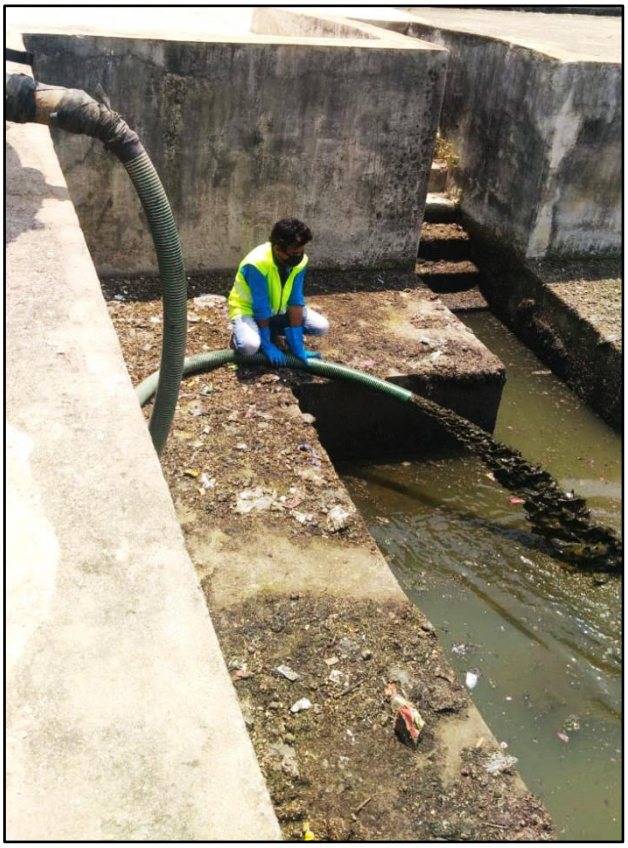

Figure 4: Disposal in a sewage pumping stations (Source: Ajeet/PSI).

Overall, four sewerage systems consists of four separate Sewerage Districts, further divided into zones, each with its own pumping station or trunk sewer. Zones are further divided into several sewer sub-catchment areas (Figure 5).

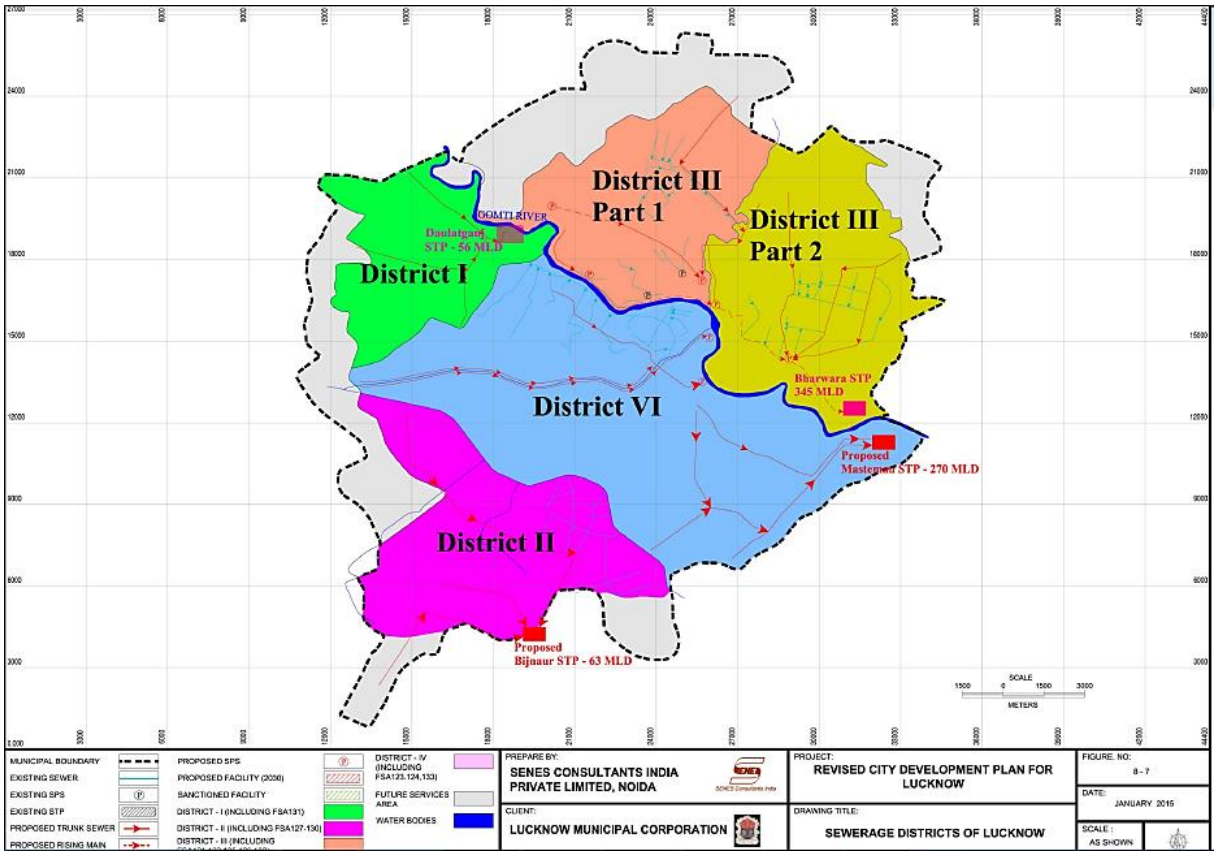

Figure 5: Sewerage Zones of Lucknow (Source: (LNN, 2015)).

There are three levels of sewerage pumping stations in Lucknow. First there are Zonal Pumping Sations (ZPS) where sewage from branch lines is collected and first level of screening is done. The sewage is then discharged in major drains where screening is done of solid waste and silt. Sewage from 4 drains is sent directly to Daulataganj STP, while WW from 22 drains are tapped in various SPS and sent to Main Pumping Station (MPS) located at Gawari. From MPS sewage is diverted to Bharwara STP. All SPS and MPS are maintained by Jal Kal (Table 3).

Table 3: Location and number of Zone Pumping Stations (ZPS).

Zone number	No. of ZPS	Location of ZPS
Zone 1	4	Laxman Mela, Butler Palace, Khayali ganj and Dali bagh
Zone 2	1	Gaughat
Zone 3	3	Jankipuram, Nishatganj, Mahanagar
Zone 4	1	Kukrail
Zone 5	4	Sector M, Sector N
Zone 6	1	Rajajipuram

Source: Jal Kal (LNN)

2.1.5 Treatment and disposal

Lucknow has four operational STPs which aggregate to 445 MLD of which only 416 MLD is operational (details in Table 4). As per City Development Plan 2015, there is a gap of 89 MLD, which is currently being facilitated with construction of new STPs (see section 3.2.2 Investments (LNN, 2015)).

Table 4: Details of Sewerage Treatment Plants in Lucknow.

Name of STP	Capacity existing (MLD)	Capacity proposed (MLD)	Capacity being utilized (MLD)
Bharwara	345		345
Daulatganj	56		56
Vrindavan pariyojna sec-10	37.5	120	9
Vrindavan 6B	6.5		6.5
Total	445		416.5
Treatment efficiency/ Portion of wastewater treated as received at STP			94%

Source: UPJN, 2020

Bharawara STP operates on Up flow Anaerobic Sludge Blanket (UASB) while Daulataganj STP operates on Fluidized Aerobic Bioreactor (FAB). The efficiency of both plants is 100% as per KII with Superintendent Engineer, Jal Kal. The by-product(s) of Daulataganj STP are sludge cakes and treated effluent, while that of Bharwara STP are sludge cakes, treated effluent and biogas. Sludge cakes from both the STPs are given away to farmers, treated effluent is not sold and is discharged to River Gomti, and lastly, the biogas is flared to the atmosphere.

Technological details of STPs at Vrindavan 6B and Vrindavan pariyojna sec- 10 are not known.

There is no co-treatment facility or Faecal Sludge Treatment Plants existing in the city, however as aforementioned, FS from registered PTOs is disposed at designated SPSs. It has been recorded in a study done at Alternate Hydro Energy Centre in 2013 which states that “Due to the inefficient sewerage network, highly diluted sewage is received at the Bharwara plant due to which there is insignificant biogas generation which could otherwise be used for power generation, hence better cost recovery” (Mansi Tripathi, 2013). Perhaps, improvement in the sewerage network and increase in disposal of FS by PTOs would increase the quality of biogas and would become worthy of sale.

2.2 SFD Matrix

The SFD matrix for Lucknow city is presented in Table 5.

Table 5: SFD Matrix.

Lucknow, Uttar Pradesh, India, 20 Jul 2020. SFD Level: 1 - Initial SFD
Population: 3391208
Proportion of tanks: septic tanks: 50%, fully lined tanks: 50%, lined, open bottom tanks: 50%

System label	Pop	W4a	W5a	W4c	W5c	F3	F4	F5	S4e	S5e
System description	Proportion of population using this type of system	Proportion of wastewater in sewer system, which is delivered to centralised treatment plants	Proportion of wastewater delivered to centralised treatment plants, which is treated	Proportion of wastewater in open sewer or storm drain system, which is delivered to treatment plants	Proportion of wastewater delivered to treatment plants, which is treated	Proportion of this type of system from which faecal sludge is emptied	Proportion of faecal sludge emptied, which is delivered to treatment plants	Proportion of faecal sludge delivered to treatment plants, which is treated	Proportion of supernatant in open drain or storm sewer system, which is delivered to treatment plants	Proportion of supernatant in open drain or storm sewer system that is delivered to treatment plants, which is treated
T1A1C2 User interface discharges directly to a centralised foul/separate sewer	55.0	90.0	94.0							
T1A1C6 User interface discharges directly to open drain or storm sewer	1.0			93.0	94.0					
T1A2C6 Septic tank connected to open drain or storm sewer	35.0					90.0	2.0	94.0	93.0	94.0
T1A3C6 Fully lined tank (sealed) connected to an open drain or storm sewer	1.0					90.0	2.0	94.0	93.0	94.0
T1A3C10 Fully lined tank (sealed), no outlet or overflow	7.0					90.0	100.0	100.0		
T1A4C10 Lined tank with impermeable walls and open bottom, no outlet or overflow	1.0					0.0	0.0	0.0		

Source: SFD-PI

2.2.1 SFD matrix explanation

Definition and estimation of different variables (used to make the SFD graphic) are explained below in Table 6.

Table 6: Description of variables used for defining containment systems.

S. No.	SFD Promotion initiative	SFD Reference variable	Percentage of households
1.	Toilet discharges directly to a centralized foul/separate sewer	T1A1C2	55
2.	Toilet discharges directly to open drain or storm sewer	T1A1C6	1
3.	Septic tank connected to open drain or storm sewer	T1A2C6	35
4.	Fully lined tank (sealed) connected to an open drain or storm sewer	T1A3C6	1
5.	Fully lined tank (sealed), no outlet or overflow	T1A3C10	7
6.	Lined tank with impermeable walls and open bottom, no outlet or overflow	T1A4C10	1

Offsite systems

Population connected to sewerage network (system T1A1C2) accounts to 55% and 1% of the population is dependent on user interface discharging directly to open drain/storm sewer (system T1A1C6).

Assumptions for offsite systems:

1. The efficiency of the sewer drain system is 90%. So, efficiency of the system T1A1C2 is taken as 90% (variable w4a set to 94%).
2. 93% of the wastewater is transported to the STP through diverted drains. So, the efficiency of the drain for system T1A1C6 is estimated at 93% (variable w4c set to 93%).

3. Wastewater treatment efficiency is estimated to be 94% as stated in Table 4 (so variables W5a and W5c are set to 94%).
4. The Graphic Generator uses rounding off decimal digits.

Onsite Systems

44% of the city is dependent on OSS, out of which 1% of the population is dependent on fully lined tanks (sealed) connected to open drain or storm sewer (system T1A3C6), 35% of the population is dependent on septic tanks connected to open drain or storm sewer (system T1A2C6), 7% of the population is dependent on fully lined tanks (sealed), no outlet or overflow (system T1A3C10) while 1% is dependent on lined tank with impermeable walls and open bottom, no outlet or overflow, (T1A4C10) where there is a 'low risk' of groundwater pollution.

Assumptions for onsite systems:

1. There is no clear differentiation between the volume of effluent and solid FS generated from septic tanks and fully lined tanks, hence to reduce the maximum error, it is assumed to be 50% each.
2. It is assumed that 90% of the population (dependent on onsite systems) gets their systems emptied when full. Thus, variable F3 for systems T1A2C6, T1A3C10 is set to 90%. System T1A4C10 has no emptying services, so variables F3, F4 and F5 are all set to 0%.These systems are open to ground with permeable walls, due to the nature of the containment it is often not emptied.
3. As mentioned above, 12 of 50 tankers are registered, and hence it is assumed for calculation purposes that the average size of tankers is 5,000 litres. Tankers plying to SPSs have an average trip size of 5.25 while tankers disposing into the open have an average trip size of 1. Therefore, it has been assumed that in a day, only 2% of the FS emptied from OSS reached the STP, while the remaining 98% is disposed into the open (Table 7).Therefore, variable F4 for systems T1A2C6 and T1A3C6 is set to 2%.

Table 7: Details of FS emptying and transport.

Details of FS Empting and Transport		
Average volume of tanker vehicles	5,000	litres
Private tanker vehicles	50	units
Tanker vehicle discharging in open	38	units
Average trips of tanks discharging waste in open	1	units
Estimated FS collected by tanker vehicles discharging in open	190,000	litres
Tanker vehicles tipping at SPSs	12	units
Estimated FS collected by tanker vehicle tipping at STP	3,267	litres
Total FS collected	193,267	litres
% FS reaching STP	2%	

Source: KII with PTO; PSI, 2019

4. FS reaching the STP is treated at an efficiency of 94% as stated in Table 4. Thus, variable F5 for systems T1A2C6 and T1A3C6 is set to 94%.

5. According to the groundwater risk assessment carried out, it was estimated that sanitation systems are located in areas of low risk of groundwater contamination (groundwater level is greater that 10 metres).
6. FS generated in twin pits or fully lined tanks with no outlet is considered to be treated at site in line with the technology type (variables F4 and F5 are set both to 100%). It is assumed that 90% of the system is emptied during the emptying process to let the degradation properties be maintained in the system. Upon emptying, they are emptied only 90% for decomposing bacteria to be present for the next batch (variable F3 set to 90%).

Open defecation

Lucknow has been declared as an Open Defecation Free (ODF) city. ODF city means that everyone in the city will have access to toilet, even if there is no toilet at house, the people would have an approachable PT (Public Toilet) and/or CT (Community Toilet). It also means that at any given time, no one would be seen defecating in the open. No open defecation was observed during the field visit.

2.3 SFD Graphic

Figure 6 shows the SFD graphic for the city where 71% of the excreta generated are safely managed while 29% of the excreta generated are unsafely managed.

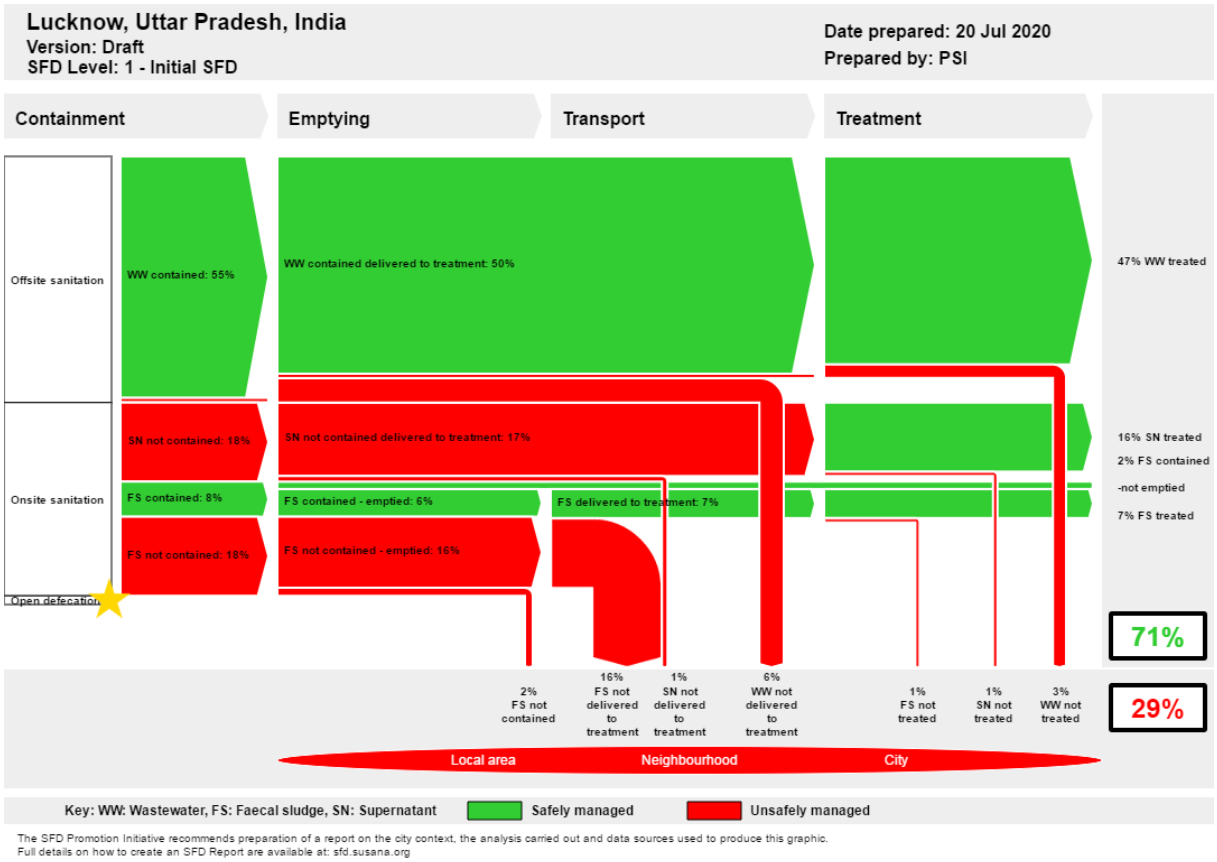

Figure 6: SFD Graphic (Source: SFD-PI).

From the 55% of wastewater (WW) contained, 50% is WW delivered to the treatment plant. In the end, 47% of the wastewater generated is treated while 3% of the WW remains untreated due to the efficiency of the treatment process.

The 18% of Supernatant (SN) not contained is attributed to 17% of SN from system T1A2C6 and 1% of SN from system T1A3C6 (refer to point 1 under “Assumption for OSS). the 17% of SN not contained delivered to the treatment plant is attributed to 16% of SN from system T1A2C6 and 1% SN from system T1A3C6 (Refer to point 5 under “Assumption for OSS”). the 1% of SN not delivered to treatment is attributed to systems T1A2C6 and T1A3C6. The 16% of SN treated is attributed to 15% of SN from system T1A2C6 and 1% of SN from system T1A3C6 (Refer to point 6 under “Assumption for OSS”). the 2% of SN not treated is attributed to 2% of SN from system T1A2C6 (Refer to point 6 under “Assumption for OSS”).

The 8% of FS contained is attributed to 7% of FS from system T1A3C10 and 1% of FS from system T1A4C10 (Refer to point 8 and 10 under “Assumption for OSS”). The 6% of FS contained and emptied is attributed to 6% of FS from system T1A3C10 (Refer to point 10 under “Assumption for OSS”). The 2% of FS contained and not emptied is attributed to 1% of FS from system T1A3C10 and 1% of FS from system T1A4C10 (Refer to point 8 and 10 under “Assumption for OSS”).

The 18% of FS not contained is attributed to 18% of FS from system T1A2C6 (Refer to point 1 under “Assumption for OSS). The 16% of FS not contained-emptied is attributed to 16% of FS from system T1A2C6 (Refer to point 2 and 3 under “Assumption for OSS). The 2% of FS not contained and not emptied is attributed to 2% of FS from system T1A2C6 (Refer to point 2 and 3 under “Assumption for OSS). The 16% of FS not delivered to the treatment plant is attributed to 16% of FS from system T1A2C6 (Refer to point 4 under “Assumption for OSS”).

The 7% of FS delivered to treatment plant and the 7% of FS treated is attributed to 1% of FS from system T1A2C6 and 6% from system T1A3C10 (Refer to point 4 and 10 under “Assumption for OSS. The tool also recognizes 1% of FS not treated which is attributed to system T1A2C6 (Refer to point 6 under “Assumption for OSS”) however given to rounding off does not reflect in the final FS treated portion.

2.4 Risk of groundwater contamination

Uttar Pradesh is covered with rich fertile soil and underlain by a large thickness of alluvium making it one of the richest groundwater repositories of the world (CGWB, 2014).For the purpose of this report, lined tanks with impermeable walls and open bottom (1%) were assumed to be located in areas of low risk of groundwater contamination.

The SFD graphic assessment includes the risk of groundwater pollution as an important factor in determining whether the sanitation systems are located in areas of low/high risk of groundwater pollution. If the risk of contamination to groundwater is low, then the FS is considered “contained”.

2.5 Discussion of certainty/uncertainty levels of associated data

There were three major challenges to develop the SFD graphic. 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 Faecal Sludge Management (FSM) services provided to households.

The assumption regarding the amount of FS emptied as compared to FS generated has high impact on the overall SFD graphic. A 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 vary. The amount of FS emptied is not clear because the private emptiers empty sewage from sewer-holes, septage from government, private institutions and commercial establishments. However, based on a random 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. In the matrix, it is assumed that 90% of the population get their containment systems emptied when full.

3 Service delivery context

3.1 Policy, legislation and regulation

3.1.1 Policy, legislation and regulation at national level

In 2008, the Ministry of Housing and Urban Affairs (MoHUA), formerly known as 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. NUSP identifies the constitution of the multi-stakeholder task force as one of the principal activities to be taken up to start the city sanitation planning process. As per the requirement of CSP, a major role is to be played by the members of institutions, organizations, individuals, NGOs, academics, media representatives, local councillors, industry owners, consultants, representatives of private sector, etc. Constitution of Swachh Bharat City Level Task Force (SBCLTF) formerly known as City Sanitation Task Force (CSTF) is facilitated by drawing members from these groups in consensus with citizens who will be constantly supporting the CSP preparation by analysing the strengths and competencies required to overcome the current situation and to improve sanitation facilities (MoUD, 2014). In Lucknow, Population Services International (PSI), an international development agency is working with Lucknow Nagar Nigam. The partnership has established a faecal sludge and septage management task force and helped the private tank operators register at a subsidised rate LNN.

A CSP for Lucknow was prepared under Jawahar Lal Nehru Urban Renewal Mission. Japan International Cooperation Agency (JICA), an independent international agency, which is acted as a development partner to the Ministry of Urban Development in this endeavour during 2011, had appointed CRISIL Risk & Infrastructure Solutions Limited (CRIS), to prepare the CSP for the city of Lucknow (CRISIL, 2011).

The advisory note on septage management in urban India, issued by MoHUA in 2013, recommends supplementing CSPs with a Septage Management Sub-Plan (SMP), 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 systems. This advisory provides a reference to CPHEEO guidelines, Bureau of Indian Standard (BIS), and other resources that users of this advisory may refer, for details while preparing their SMP (MoUD, 2013). The advisory clearly discusses the techno-managerial and socio-economic aspects of septage management in India and provides guidelines for Urban Local Bodies (ULBs) to plan and implement SMP.

The Environment (Protection) Act, 1986 and the Water (Prevention and Control of Pollution) Act, 1974 have provisions relating to sanitation services and environmental regulations. It 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 Prohibition of Employment as Manual Scavengers and their Rehabilitation Act is enacted in 2013. This act prohibits employment of manual scavengers and insanitary latrines - Laying strong emphasis on rehabilitation of manual scavengers. The broad objectives of the act are to eliminate insanitary latrines, prohibit the employment of manual scavengers and the hazardous manual cleaning of sewer and septic tanks, and to maintain a survey of manual scavengers and their rehabilitation (MoSJE, 2014).

In February 2017, MoHUA issued the National Policy on Faecal Sludge and Septage Management (FSSM). The policy aims to set the context, priorities, and direction for, and to facilitate, nationwide implementation of FSSM services in all ULBs such that safe and sustainable sanitation becomes a reality for all in each and every household, street, town and city in India (MoUD, 2017).

The Fourteenth Finance Commission (FC-XIV) was constituted by the President of India under Article 280 of the Constitution on 2 January 2013 to make recommendations for the period 2015-20. Its assignments include distribution of revenue between union and state; devising formula for grant; suggesting method to augment resources for local bodies; and taking care of any matter referred to it (NIUA, 2014).

Model Municipal Building Bye-laws 2016 prepared by Town and Country Planning Organization (TCPO). Building Bye-laws 2016 is used to regulate coverage, height, building bulk, and architectural design and construction aspects of buildings so as to achieve orderly development of an area. They are mandatory in nature and serve to protect buildings against fire, earthquake, noise, structural failures and other hazards. It includes chapters on green buildings and sustainability provisions, rainwater harvesting, Wastewater (WW) reuse and recycle, installation of solar roof top photo voltaic norms, revised norms for adequate toilet facilities for women and public conveniences in public buildings and mandatory provisions for segregated toilet facilities for visitors in public buildings (TCPO, 2016).

3.1.2 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. Some of the policies, laws and regulations are listed below:

The Uttar Pradesh Water Supply and Sewerage Act, 1975:

An act to facilitate the establishment of corporation, authorities and organizations for the development and regulation of water supply and sewerage services, related matters. According to this act, the corporation has powers to fine the owner of the improper/damaged septic tank.

The Uttar Pradesh Urban Sanitation Policy, 2010:

In 2010, the Director of Local Authorities, Uttar Pradesh issued the Uttar Pradesh Urban Sanitation Policy (UPUSP). The policy is inspired from the NUSP. The UPUSP mandates the cities to establish City Sanitation Task Force (CSTF) and to elevate the consciousness about sanitation in municipal agencies, government agencies and most importantly, amongst the people of the city. UPUSP 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. As of now, there are very few cities that have finalized their CSPs, and it remains a major drawback in the implementation of the UPUSP.

Uttar Pradesh Faecal Sludge and Septage Management (FSSM) Policy, 2019:

The goal of the Uttar Pradesh State Septage Management Policy (UPSSMP) is to improve water quality and protect public health in urban areas of the State by 2023. The objective is to enhance the ability of local implementers to build and operate septage treatment systems for urban centres and promote the behaviour change and supporting environment needed for systems to be effective and sustainable. The main strategy is to facilitate a bottom-up, demand-driven project development process by providing State Government support and incentives. As per estimation 9 lakh ($9x10^5$) Individual Household latrines (IHHLs) constructed under Swachh Bharat Mission- Urban (SBM) (U) over last 3 years also warrant immediate attention on Septage Management (SM). Sanitation coverage in 610 ULBs are completely dependent on septic tanks. There are 72 lakh ($72x10^5$) On-site Sanitation Systems (OSS) which generates approximately 5,000 MLD of sewerage. This highlights the magnitude of effort required for addressing environmental and public health safety on account of untreated sewerage/septage (UDD, UP, 2019).

Uttar Pradesh Municipal Building Bye-Laws, 2008: Issued by Housing Department, Government of Uttar Pradesh, the codes specify standards and design consideration for installation of toilets and septic tank.

Uttar Pradesh Finance Commission: It is a committee pertaining to the state of Uttar Pradesh, established with a purpose of reviewing the financial implementations of the state. The main purpose of this committee is to formulate implementation of financial policies pertaining to the state of Uttar Pradesh. The Finance Commission is set up under the Article 243 Sec I of the Indian Constitution, which orders that the Governor of the state would, at the end of every fifth year establish, a Finance Commission for the purpose of reviewing, within the introduction of the 73rd Amendment of the Constitution Act, 1992 (BMoI, 2016).

3.1.3 Institutional roles

The MoHUA 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 MoHUA, which advises the ministry on 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 norm setting for urban water supply and sanitation (Planning Commision, 2002).

National Council for Rejuvenation, Protection and Management of River Ganga (referred as National Ganga Council) formerly known as National Ganga River Basin Authority (NGRBA), which was constituted under the provisions of the Environment (Protection) Act (EPA),1986. The Council aims at ensuring effective abatement of pollution and rejuvenation of the River Ganga by adopting a river basin approach to promote inter-sectoral co-ordination for comprehensive planning and management, maintenance of minimum ecological flows in the river Ganga with the aim of ensuring water quality and environmentally sustainable development (NMCG, 2017a).

State Mission for Clean Ganga-Uttar Pradesh (SMCG-UP) in an extended arm of National Mission for Clean Ganga (NMCG) for the state of Uttar Pradesh which is implementing the Namami Gange and other programmes through various executing agencies. At state level, it is an implementing arm of State Ganga Committee constituted vide S.O. 3187 E dated 7th October, 2016 under Environment protection act 1986 to implement River Basin Management Programme prepared and approved by the National Ganga River Basin Authority & SMCG-UP. The main objectives of SMCG are to monitor the executed programme of National Ganga River Basin Authority at State level and to evaluate and audit itself or to get it evaluated and audited and to implement the recycling and reuse of water, rain water harvesting, decentralized sewage treatment system, water conservation and conservation procedures (SMCG, 2016)

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 a lack of clarity in roles and responsibilities of state and local agencies, resulting in large gaps in implementation (USAID, 2010).

Management and delivery of urban basic services in Lucknow is governed by various institutions. In Table 8 are the institutions responsible for policy making, service provision and regulation of urban services.

Table 8: Institutional roles and responsibilities.

Institutions	Roles and responsibilities
Urban Development Department (UDD)	Policy formulation, preparation of municipal bye-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, administrative and financial management of municipalities and implementation of development programmes.
Nagar Nigam Lucknow (LNN)	Water supply and sewerage, public health, sanitation, conservancy and solid waste management, urban poverty alleviation by providing infrastructure, provision and maintenance of urban amenities and facilities such as parks, gardens, playgrounds, provision and maintenance of the lighting in the public streets, corporation markets, public buildings. Registration of births and deaths, O&M of burial grounds, cremation grounds, etc. The ULB has a vital role in design, develop, plan and implement ULB level FSSM strategy, set up and ensure operation of systems for 100% safe and sustainable collection, transport, treatment and disposal of faecal sludge & septage, monitor and evaluate FSSM strategy and implementation plan and Implement Municipal Bye-laws.

Jal Nigam-Lucknow (JKLMC, n.d.)	• Ensuring uninterrupted pure drinking water supply in the city. • Providing citizens sewer facility. • Creating awareness among citizens about water conservation. • Preventing infection in water supply. • Transparency in the work of Jal Sansthan and to provide better facilities to citizens.
Lucknow Development Authority	• Implementation of various housing schemes under the central and state government housing scheme in Lucknow city. • Preparation and implementation of Master Plan.
Uttar Pradesh Jal Nigam (UPJN)	Carry out the functions of – • Preparation, execution, and promotion of ULB and state level plans of water supply and sewerage schemes. • Establishment of standards for water supply and sewerage in the state.
Uttar Pradesh Awas Vikas Parishad (UPAVP)	Its functions are to: • Plan and develop affordable housing to the economically weaker section of the society. • To ensure prudent financial results with appropriate accounting principles. • To plan and develop centres of excellence at strategic locations across the state. • To maintain an effective public grievance redressal mechanism and set standards by adhering to time-frame and schedules.
State Urban Development Authority (SUDA) / District Urban Development Authority (DUDA)	Its functions are to– • Execute various government schemes for urban development and employment generation. • Create urban infrastructure, including water supply. • Undertake tasks related to urban infrastructure to generate local employment. Construct community toilets and link it to sewer lines etc. • Lay sewerage network according to plan made by Jal Nigam. • Regulate and help ULBs set up systems to ensure financial sustainability in provision of sanitation services.
Uttar Pradesh Pollution Control Board (UPPCB)	Regulation, 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 in Schedule II, III & IV of 'The Water (Prevention and Control of Pollution) Act 1974 '.

3.1.4 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 largest cities have created municipal water and sanitation utilities that are legally and financially separate 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 Commision, 2002).

Furthermore, when no separate utility exists, there is no separate allocation 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 Lucknow, public health, sanitation, conservancy, and solid waste management services are delivered by Health Department of LNN. Septage management is also the responsibility of the same department, headed by the Sanitary Officer. There are 6 zonal sanitary inspectors and 27 sanitary workers (LNN, 2020).

3.1.5 Service standards

1. Service Level Benchmarks (SLB), 2008: Issued by the Ministry of Urban Development in 2008, the SLB seek 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. The SLB refers to improving service through better provision and delivery. It evaluates the performance of urban services provided by different ULBs throughout the country.
2. General Standards for Discharge of Environmental Pollutants – 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. General standards are notified with respect to parameters for safe discharge of effluent to inland surface water/public sewers/land for irrigation/ marine coastal areas.
3. Manual on Sewerage & Sewage Treatment, Second Edition, 2013: This manual was developed by Central Public Health and Environmental Engineering Organization (CPHEEO). It provides detailed designs and guidelines for various technologies of wastewater management.
4. Code of Practice for Installation of Septic Tanks, 1985: Issued by, Bureau of Indian Standards. The code specifies standards and design consideration for installation of septic tanks.

3.2 Planning

3.2.1 Service targets

State governments must put in place targets for delivery of essential services provided by the local bodies viz. water supply, sewerage, solid waste management and storm water drains in line of handbook for SLB by MoHUA. State government must notify or cause all ULBs to notify by the end of a fiscal year the service standards and targets (PAS, 2009-16). The Swachh Bharat Mission (SBM), one of the flagship programmes of the government of India, was launched on October 2nd 2014 by MoHUA. SBM-Urban aims to eliminate open defecation, eradicate manual scavenging, augment the capacity of ULBs and generate awareness about sanitation and its linkage with public health during the mission period till 2019.

The SBM (urban) aims to ensure that no new insanitary toilets are constructed during the mission period and that pit latrines should be converted into sanitary latrines. The target group for construction of household units of toilets thus is (i) 80% of urban households engaging in open defecation, remaining 20% of households practising open defecation are assumed to be catered by community toilets due to constraints of space (ii) all households with insanitary latrines (iii) all households with single-pit latrines (MoUD, 2014). Table 9 provides an overview of service delivery targets and Table 10 outlines an overview of service delivery progress in accordance with SBM.

Table 9: Service delivery targets in accordance with SLBs.

Sanitation service chain	Parameter	National benchmark	Time-frame to achieve benchmark
Containment	Coverage of toilets	100%	2019
Transport	Coverage of sewer network services	100%	2031
	Collection efficiency of the sewerage network	100%	2031
Treatment	Adequacy of sewage treatment capacity	100%	2031
	Quality of sewage treatment	100%	2031
End-use/disposal	Reuse and recycling	20%	2031
Other	Cost recovery	100%	2031
	Efficiency of collection of charges	100%	2031
	Redressal of customer complaints	80%	2031

Source: Adapted from (MoUD, 2008), (MoUD, 2010)

Table 10: Service delivery progress in accordance with SBM.

SBM Head	Total toilets built
Individual Household Toilets (IHHT)	15,279
Community Toilets (CT)	106
Public toilets (PT)	265

Source: Geoportal for Urban Missions (http://geourbanmissions.gov.in/?)

3.2.2 Investments

Lucknow is a designated NMCG city, an AMRUT city and a Smart city. Under Both the missions of the central government, the city has been assigned funds under various infrastructure development initiatives. For the sanitation purposes, the details of funds allocated to the city for various projects is enlisted in Table 11.

Table 11: Sanitation related Infrastructure details.

Mission and Project Detail	Funds (INR Crores)	Funds (million USD)
NMCG		
Interception and Diversion of drains and Sewerage Treatment Plant	298.12	40.8
AMRUT		
Construction of House Connecting Chamber at Sewerage District I, Lucknow	58	7.9
Rehabilitation of rising Main from CGSPS to Kukrail IPS at Lucknow	15.7	2.15
Construction of Grid Connected Solar Power Plant at 345 MLD STP, Bharwara, Lucknow	12.75	1.74
Construction of House Connecting Chamber at Sewerage District-III Part-I, Lucknow	102.21	14.00
Construction of House Connecting Chamber at Sewerage District-III Part-II, Lucknow	56.91	7.79
Laying of Sewer line in Dist-4, Zone-4, Lucknow	158.53	21.71
Construction of 122 MLD STP at Bijnaur Road, Lucknow	249.65	34.2
Sewer House connection, Sewerage District-4, zone-4, Phase-2	95.15	13.03
Vikarmadiyat Marg & Near Area Sewer Laying Works, Lucknow	24.33	3.33
SMART CITY		
Sewerage Works for the Smart City, Lucknow (Sewerage District IV, Zone I, Part II)	165.94	22.73
Sewerage Works for the Smart City, Lucknow (Sewerage District IV, Zone I, Part II)	167.7	22.97
Sewerage Scheme at Smart City Sew Distt. 4 Zone-1 Part-2	302.12	41.38

Source: (NMCG, 2019), AMRUT Uttar Pradesh (http://amrutup.in/pages/project-list.html)

3.3 Equity

3.3.1 Current choice of services for the urban poor

The Ministry of Housing and Urban Poverty Alleviation (MoHUPA) in 2010 directed municipalities to allot a minimum of 25% of their annual budget as a fund to create basic services to the urban poor. In respect to the reform, the Lucknow Nagar Palika allotted a considerable amount of funds for the urban poor such as provision of basic services and development of infrastructure, implementing programmes/projects targeting the urban poor in the city. There are 609 slums in the city comprising of 148,117 households. Of the 609 slums, 502 are notified and 107 are non-notified. About 27% of the population lives in the slums (RCUES, 2017).

3.3.2 Plans and measures to reduce inequity

Under Pradhan Mantri Awas Yojna (PMAY), a total of 4,373 households have been constructed (MoHUA, 2020). There are 9 shelters which have been made under the National Urban Livelihood Mission (MoHUA, 2020).

3.4 Outputs

3.4.1 Monitoring and reporting access to services

Data on service levels should be collected, documented and reported to MoHUA according to the format prescribed by SLB framework.

Progress on SBM gets reflected on mission progress dashboard in the SBM-Urban website. Of 4,041+ Municipalities in 650+ districts, 3,802 ULBs are active. 75 million plus cities are being monitored separately.

3.4.2 Stimulating demand for services

The following activities may stimulate demand for services:

- Awareness generation on septic tank construction, regular emptying of septic tanks through awareness campaigns.
- Awareness campaigns on ill effects of environmental degradation because of disposal of untreated septage into local environment.
- Capacity building of ULB staff on septage management.
- Skill development for local masons and plumbers.
- Monitoring and regulation of private emptiers.

It is recognized that the end objectives and corresponding benefits of SBM cannot be achieved without proper management of faecal sludge and septage across the sanitation service chain. Further, it is well understood that sewerage coverage will not meet the complete sanitation needs in all areas, and a strategy which is a combination of onsite and offsite (decentralised and centralized) sanitation systems must co-exist in all cities and must be given equal attention. However, the current policies are not explicit enough and also do not provide an outcome-focused direction on this issue (MoUD, 2017).

3.4.3 Strengthening service provider roles

Funding is estimated for septage management initiatives under rapid assessment for FSSM supported by the MoHUA and GoI through National Alliance for Faecal Sludge and Septage Management (NFSSM). These funds can be used to buy vacuum tankers, building treatment facility, etc. LNN has to make use of these funds to strengthen the services. At present, there are no detailed plans for strengthening service delivery.

SBM majorly provides funds for access to toilets but thereafter lacks funds for treatment and disposal of sewage and FS throughout the service chain. The service delivery of sewage and FS treatment and disposal can be met through converging the two-national flagship programmes – SBM and NMCG. The ULB can take the benefit of the programmes and strengthen the services along the value chain and achieve the goals of both programmes.

4 Stakeholder Engagement

Due to the COVID pandemic, stakeholder interviews were conducted telephonically. The interviews were conducted with private tank owners and their staff. Overall, three KIIs were conducted: two with emptiers and one with superintendent engineer of Jalkal Vibhag (see appendix 7.1).

5 References

Census of India, 2011. *Directorate of Census Operations, Uttar Pradesh, 2011. District Census Handbook - Lucknow. [Online].* [Online]

Available at: http://censusindia.gov.in/2011census/dchb/0944_PART_B_DCHB_LUCKNOW.pdf [Accessed 16 October 2018]
[Accessed July 2020].

CRISIL, 2011. *Final City Sanitation Plan for Lucknow,* Lucknow: Japan International Cooperation Agency (JICA).

CSE, 2019. *Mainstreaming co-treatment of Faecal sludge and septage (FSS) in STPs in Uttar Pradesh,* New Delhi: Centre for Science and Environment.

GOI, 2015. *Mechanization and Technology Division, Department of Agriculture, Cooperation and farmer welfare, Ministry of Agriculture and farmers welfare, Government of India.* [Online]
Available at: https://farmech.dac.gov.in/FarmerGuide/UP/UI.htm
[Accessed August 2020].

JKLMC, n.d. *Jal Nigam- Lucknow.* [Online]
Available at: https://jklmc.gov.in/

LNN, 2015. *Revised City Development Plan of Lucknow city,* Lucknoq: Lucknow Nagar Nigam.

LNN, 2016. *Non Revenue Water (NRW) Assessment and Reduction Strategy for Lucknow- Detailed Project report,* Lucknow: Lucknow Nagar Nigam.

LNN, 2019. *Ministry of Housing and Urban Affairs: Smart city data.* [Online]
Available at: https://smartcities.data.gov.in/cities/Lucknow?filters%5Bogpl_module_domain_access%5D=3&filters%5Bfield_smartcity%3Aname%5D=Lucknow&format=json&offset=0&limit=9&sort%5Bcreated%5D=desc
[Accessed August 2020].

LNN, 2020. *Lucknow Nagar Nigam.* [Online]
Available at: https://lmc.up.nic.in/pdf/ListofSanitaryInspectors.pdf

Mansi Tripathi, S. S., 2013. Performance Evaluation of Sewage Treatment Plants in Lucknow City. *Hydro Nepal,* Issue 12, p. 7.

MoHUA, 2020. *Geoportal for Urban Missions.* [Online]
Available at: http://geourbanmissions.gov.in/?
[Accessed August 2020].

MoSJE, 2014. *The Prohibition of Employment as Manual Scavengers and their Rehabilitation,* Delhi: Ministry of Social Justice and Empowerment, Government of India.

MoUD, 2013. *Advisory on Septage Management ,* Delhi: Ministry of Urban Development.

MoUD, 2014. *Guidelines for Swachh Bharat Mission,* Delhi: Ministry of Urban Development, Government of India.

MoUD, 2017. *National Policy on Faecal Sludge and Septage Management.,* Delhi: Ministry of Urban Development, Government of India.

Mukesh, P. T. O.-., 2020. *Key Informant Interview* [Interview] (July 2020).

NIUA, 2005. *Status of Water Supply. Sanitation And Solid Waste Management in Urban Areas,* s.l.: National Institute of Urban Affairs.

NIUA, 2014. *Fourteenth Finance Commission (2015-2020) - Report,* Delhi: National Institute of Urban Affairs.

NMCG, 2017a. *National Mission for Clean Ganga.* [Online]
Available at: Available at: http://nmcg.nic.in/about_nmcg.aspx
[Accessed 2020].

NMCG, 2019. *Administrative Approval and Expenditure Sanction,* Delhi: National Mission for Clean Ganga- Ministry of Water Resources, River Development and Ganga Rejuvenation.

Planning Commision, 2002. *Tenth Five Year Plan- 2002 to 2007.Vol 2,* s.l.: PAS 2009-16 Service Level Benchmarking - Maharashtra. CEPT University.

RCUES, 2017. *Slum Free City Plan of Action - Lucknow,* Lucknow: Regional Centre for Urban and Environmental Studies.

Sandeep, P. T. O.-., 2020. *Key Informant Interview* [Interview] (July 2020).

Singh, O., gupta, J. & Warsi, A., 2012. *Climate of Lucknow,* Lucknow: Indian Meteorological Centre, Ministry of Earth Sciences.

SMCG, 2016. *State Mission for Clean Ganga-Uttar Pradesh.* [Online]
Available at: http://smcg-up.org/
[Accessed 2020].

TCPD, U., 2018. *Town and Country Planning Department, UP.* [Online]
Available at: http://uptownplanning.gov.in/post/en/introduction-of-development-area-lucknow
[Accessed July 2020].

TCPO, 2016. *Model Building Bye-Laws. Town and Country Planning Organization,* s.l.: Ministry of Urban Development, Government of India.

UDD, UP, 2019. *Uttar Pradesh Faecal Sludge and Septage Management Policy,* s.l.: Urban Development Department, Government of Uttar Pradesh.

UPJN, 2019. *Discharge measurement of 33 drains,* Lucknow: Uttar Pradesh Jal Nigam.

UPJN, 2020. *Uttar Pradesh Jal Nigam, Ganga Plan II- Gomti Action plan.* [Online]
Available at: http://jn.upsdc.gov.in/page/en/ganga-plan-ii
[Accessed 25 July 2020].

USAID, 2010. *A Rapid Assessment of Septage management in Asia: Policies and Practices in India. Indonesia. Malaysia. the Philippines. Sri Lanka. Thailand and Vietnam. Bangkok,* s.l.: United States Agency for International Development.

6 Appendix

6.1 Appendix 1: Stakeholder identification

Table 12: Tracking of engagement.

S. No.	Name of Organisation	Designation
1	Jal Kal Vibhag, LNN	Superintendent engineer
2	Mukesh	Private Tank operator
3	Sandeep Gupta	Private tank operator

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