SFD Report

Mansa
Zambia

Final Report

This SFD Report - Initial level - was prepared by GOPA Infra and BORDA Zambia on behalf of the GIZ Reform of the Water Sector Programme Phase II

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SFD Report Mansa, Zambia, 2023

Produced by:

GOPA Infra GmbH and BORDA Zambia on behalf of the GIZ Reform of the Water Sector Programme Phase II

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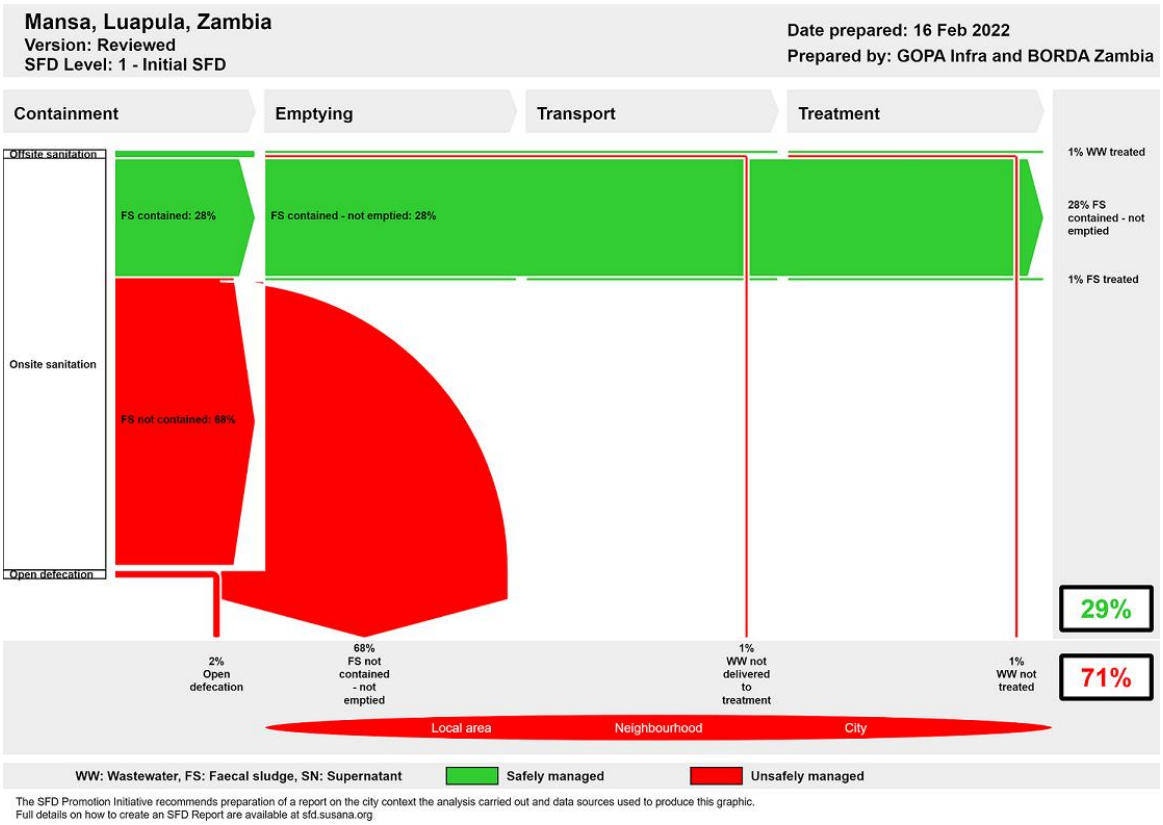
www.sfd.susana.org

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 an Initial level SFD report.

Produced by:

This SFD report was produced by Mainframe and BORDA Zambia on behalf of the GIZ Reform of the Water Sector Programme Phase.

Collaborating partners:

- GIZ Zambia Water and Energy Cluster.
- Luapula Water and Sanitation Company (LpWSC).
- Mansa Municipal Council (MMC).
- Ministry of Health (MoH).
- Scaling Up Nutrition Technical Assistance (SUNTA).
- GFA Consulting Group GmbH.

Status:

Final Initial level SFD Report.

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3. General city information

Mansa is the provincial administrative capital of Luapula province and the town consists of urban and peri-urban areas. According to the Central Statistics office (CSO) data on population and housing of 2010, Mansa district town had a population of 228,392 with an annual growth rate of 2.4% per annum. However, the population of Mansa urban stood at 145,336. For the purpose of this assignment, only Mansa Town was considered which is composed of the urban and peri-urban areas.

Mansa lies on the central African plateau, along latitude 11° south and longitudes 28° and 29° east. The weather of Mansa is characterized by four seasons namely cool dry winter that runs from June to August; dry warmer and more humid pre-rainy season from September to October; wet humid warm weather from November to March and post-rainy season from April to May. The average annual rainfall for Mansa is 1,250 mm.

4. Service outcomes

Mansa Town has a mix of both offsite and onsite sanitation systems with peri-urban areas being wholly serviced by onsite systems. Offsite sanitation systems in Mansa consists of a centralised conveyance sewer network that covers approximately 2% of the population and delivers wastewater to two non-conventional Wastewater Treatment Plants (WWTPs) which are in the form of wastewater stabilisation ponds.

Onsite sanitation systems, on which about 96% of the population relies, include septic tanks connected to soak pits and lined and unlined pit latrines. About 26% of the total population use septic tanks for their sanitation needs, while 70% rely on lined and unlined pit latrines.

It is estimated that the remaining 2% of the population practices open defecation.

The SFD graphic for Mansa has been generated from household data on the management of excreta and wastewater excluding data on the management of wastewater from communal toilets, public toilets, institutional facilities, commercial and industrial wastewater.

Sanitation services in Mansa Town are solely provided by Luapula Water and Sanitation Company (LpWSC) as there are no private service providers in sanitation. LpWSC services the population connected to the centralised sewer system and also offer limited services in emptying with a newly acquired vacuum truck. The truck is fairly new and it also services Samfya District, which is also a district under the jurisdiction of LpWSC. The emptying services are therefore in the initial stages.

Only about 1% of the faecal sludge in septic tanks is emptied and transported to a treatment plant where it is co-treated with the wastewater at the Suburbs Ponds. Emptying services are confined to septic tanks only as the quality of the pit latrine sludge cannot be pumped by the vacuum tanks due its thickness. This implies that the majority of the onsite sanitation facilities are never emptied as pit latrines account for the majority of these facilities. KIIs indicated that the practice is to simply bury them when they get full and build new ones to replace them.

Overall, the SFD graphic shows that 71% of the population has their excreta unsafely managed while 29% has their excreta safely managed.

5. Service delivery context

The Government Republic of Zambia (GRZ) has put up a very clear policy, regulatory and legal framework for water supply and sanitation services to guide the vision to achieve universal access to sanitation by 2030. To achieve this, the important policies that have been put in place include: The Zambia Vision 2030; the 7th National Development Plan 2017 – 2021; National Water Supply and Sanitation Policy of 2020, and UN Sustainable Development Goals 2015 – 2030. All these policy documents set clear objectives and targets on sanitation service improvement for both urban, peri-urban and rural areas which include Mansa Town. In addition, the Framework for Provision and Regulation of Urban Onsite Sanitation and Faecal Sludge Management and the Framework for Provision and regulation of Rural Water Supply and Sanitation in Zambia sets a robust institutional arrangement that clearly specifies the roles and responsibilities of all key players in the Sanitation Sector. The following are the major sector players:

- Ministry of Water Development and Sanitation (MWDS),
- National Water Supply and Sanitation Council (NWASCO),
- Zambia Environmental Management Agency (ZEMA),
- Mansa Municipal Council (MMC),
- Water Resources Management Authority (WARMA),
- LpWSC, and
- Cooperating partners such as International Funding Institutions (IFIs) and Non-Governmental Organizations (NGOs).

In addition, several laws and regulatory tools exist which provide a clear legal and regulatory framework for sanitation at both national and local level. These include the following:

- The Water Supply and Sanitation Act No. 28 of 1997.
- Local Government Chapter 281, Volume 16 of the Laws of Zambia.
- The Public Health Act Chapter 295, Volume 17 of the Laws of Zambia.
- The Environmental Management Act No. 12 of 2011.

- Water Resources Management Act of 2011.
- The Statutory Instrument No. 112 of 2013.
- Statutory Instrument No. 100 of 2011.

6. Overview of stakeholders

There are various stakeholders in sanitation in Mansa Town and the district at large and some of the stakeholders that were engaged in this initial level SFD graphic development for Mansa Town include MoH, MMC, LpWSC, SUN TA, GFA and GIZ. A stakeholder engagement meeting was held in Mansa on the 7th February 2022 to bring the key players on board and set the strategy on methods of data collection and confirmation of data on population and sanitation facilities. The meeting also facilitated consultations on existing literature on SFD graphic generation for the city of Mansa.

The MoH provided population data that were reported to have been collected on head count and population density maps. On the other hand, MMC was also consulted on the jurisdiction boundary for the local authority urban and peri-urban areas in an effort to understand the Town and residential boundaries. LpWSC provided information on existing water supply and sanitation services in the study area and NGO SUN TA, GFA and GIZ provided assistance on existing literature and data on previous similar and on-going assignments.

Table 1: Key Actors in Urban Onsite Sanitation (Source: NWASCO, 2018).

Stakeholder		Responsibility
Group	**Stakeholder**	
Public	MWDS	Policy and Laws
	NWASCO	Service Provision regulation (setting service standards and regulation of emptying and transportation tariffs)
	ZEMA	Environmental protection regulation (licensing of transportation vehicles/ end use, treatment standards)
	MMC	Enforcement of sanitation systems and public health standards.
	LpWSC	Sanitation service provision to rural, urban and peri-urban areas.
Service Providers	Private Operator	Emptying and transportation/ O&M of treatment facilities under a delegated management arrangement with LpWSC.
Customer	Households, Commercial and Public institutions.	Responsible for investment in onsite sanitation (OSS) facilities e.g., constructionof standard containment facilities at a household level and connecting to sewer systems.
Cooperating Partners	GIZ, African Development Bank.	Sanitation improvement financing and capacity building of ZEMA, MMC, WARMA, NWASCO, and MWDS to effectively manage sanitation services.

7. Process of SFD development

The SFD graphic for Mansa Town was developed using a combination of methods including: literature review on existing sanitation services in Mansa; consultative meetings with identified stakeholders; and Observatory Surveys.

The assignment commenced with a sanitation and population stakeholder identification. The identified stakeholders were invited to a consultative meeting to discuss and share existing sanitation information that would support the development of the SFD graphic. It was thus agreed in the meeting that Mainframe and LpWSC would consult the stakeholders independently and request for relevant information. MoH for instance assisted with head count population data, MMC helped in providing Geographical Information System (GIS) shape files for mapping the study area whereas LpWSC provided existing literature on sanitation service provision in Mansa.

The data gathered were analysed and tailored to the requirements of the assignment with particular focus on area and population mapping. The mapping of the study area was defined in accordance with MMC urban and peri-urban boundary. The population of the urban and peri-urban areas was equally defined according to the MoH catchment population data falling within the boundaries of the town.

The existing sanitation service data provided by LpWSC was reviewed and types of sanitation systems in each catchment were indicated in each mapped out area. This was followed by assigning population percentages using each type of sanitation system.

Finally, hydrogeological assumptions were made on the likelihood of groundwater contamination based on soil type, lateral separation between water points and toilets, location of toilets and the method of water abstraction from groundwater source.

8. Credibility of data

The information used in the development of the SFD graphic relied on available sanitation information from LpWSC, MMC and MoH. The collected data are accurate and reliable. However, data gaps were observed which include:

- Existing sanitation data only covers the residential areas and excluded the central business district (Mansa Sanitation Survey conducted by LpWSC). Therefore, public places, institutions and industrial areas are not captured in the initial SFD graphic development.
- Population data collected from MoH were not arranged as per MMC urban and peri-urban boundary. The MoH population data were arranged as per catchment defined by the ministry. These data had to be tailored to the local authority jurisdiction based on the population density maps supplied by MoH.
- Limited hydrogeological data in the Mansa Sanitation Survey were observed. Assumptions were made on the average depth of the water table and average distance between water points and toilets.
- Data from the Baseline Survey Report for Mansa District was on the district level and not the areas of interest for this study.

9. List of data sources

The list of data resources include the following:

- LpWSC and NWASCO (2017). Mansa Sanitation Survey Baseline.
- Gauff (2017). Consulting Services for The Techno-Economic Study, Detailed Engineering Design and Preparation of Tender Documents for The Water Supply and Sanitation Improvement Project in The Urban Centres of Luapula Province.
- Gauff (2017). Existing sewer network infrastructure for Mansa.
- Gauff (2017). Mansa town location map.
- GFA (2022). Baseline Survey Report for Mansa District=Setting Water Supply, Sanitation and Hygiene Targets in the Preparation of Gender Sensitive District Water, Sanitation and Hygiene Investment Plans (D-WASH IPs).
- MDHO (2021). Head Count Population Per Health Facility Catchment Area in Mansa
- MMC (2022). Mansa Local Authority boundary GIS shapefiles.

SFD Mansa, Zambia, 2023

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Abbreviations

AC	Asbestos Cement
AfDB	African Development Bank
CBD	Central Business District
CSO	Central Statistics Office
CU	Commercial Utility
GIS	Geographical Information System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
IFIs	International Funding Institutions
ISTWSSP	Integrated Small Towns Water Supply and Sanitation Project
KII	Key Informant Interview
LpWSC	Luapula Water and Sanitation Company
MLG	Ministry of Local Government
MMC	Mansa Municipal Council
MDHO	Mansa District Health Office
MSS	Mansa Sanitation Survey
MWDS	Ministry of Water Development and Sanitation
NWASCO	National Water Supply and Sanitation Council
NUSS	National Urban and Peri-Urban Sanitation Strategy
NUWSSP	National Urban Water Supply and Sanitation Programme
OSH	Occupation Safety and Health
SFD	Shift Flow Diagram
SUN TA	Scaling Up Nutrition Technical Assistance
SPs	Stabilisation Ponds
UN	United Nations
WARMA	Water Resources Management Authority
WHO	World Health Organisation
WWSP	Wastewater Stabilisation Ponds
WWTP	Wastewater Treatment Plant
ZEMA	Zambia Environmental Management Agency

1 City context

Mansa is the provincial administrative capital of Luapula Province serving the province on administrative and commercial functions. The Town is situated on the central-southern African plateau approximately along latitude 11° South and between longitudes 28° and 29° East. It is positioned on a relatively featureless plateau between the Luapula River to the west and lake Bangweulu to the east (Figure 1).

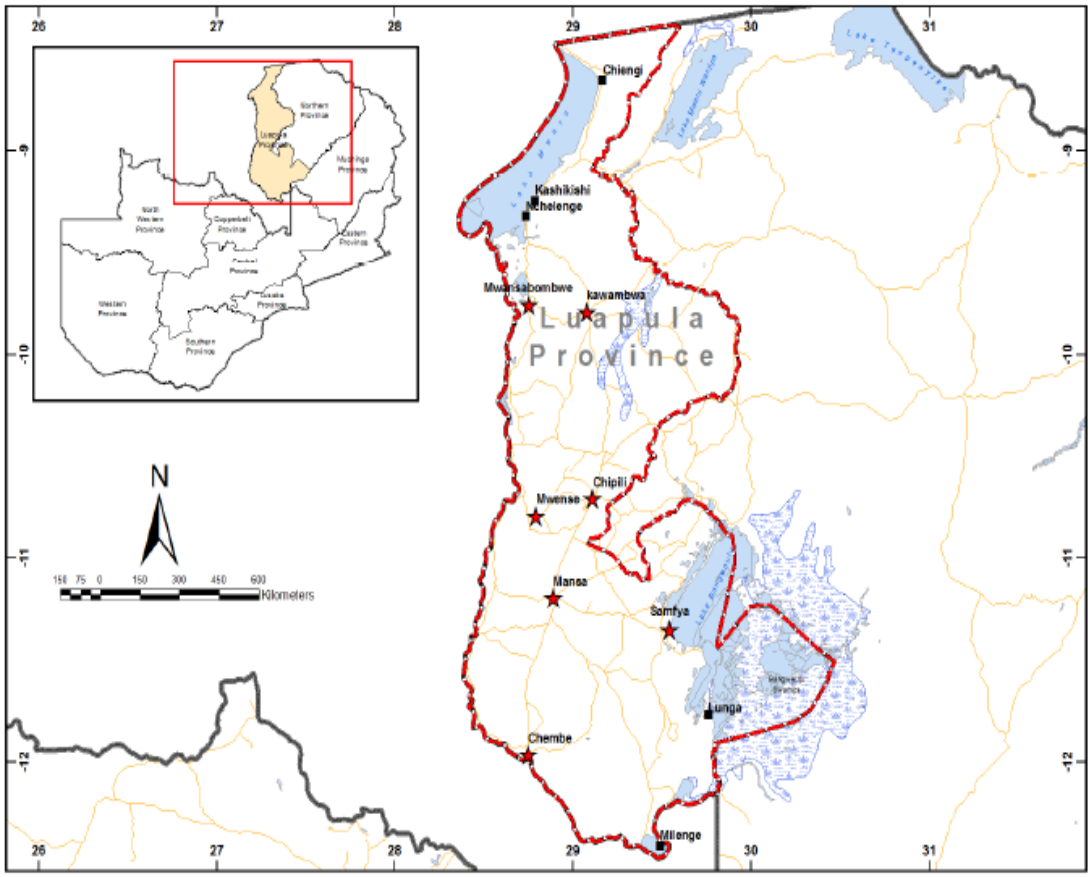

Figure 1: Mansa town location map (Source: Gauff, 2017).

The town boasts the merit of being reasonably well located at the crossroads of the Copperbelt-Congo Pedicle-Chembe-Kawambwa road running South to North (partly paved), and the Serenje-Samfya-Luapula Valley road (all paved) running South-East to North-West (Gauff, 2017).

1.1 Climate

The weather of Mansa is characterized by four seasons namely:

- Cool dry winter that runs from June to August;
- Dry warmer and more humid pre-rainy season from September to October;
- Wet humid warm weather from November to March; and
- Post-rainy season from April to May.

The geology of Luapula Province is generally characterized by granites which are widely extended in the northeast-southwest direction in the central and northern parts of the province. The north-western part is mainly characterized by quartzites and shales of Muva Super group which are widely spread and form Luongo Fold Belt. Volcanics of Older Precambrian are distributed near the boundary of granites. The south-eastern portion of the province is predominated by shales, sandstones and partly carbonate and psammites (Gauff, 2017).

1.2 Population

From the 2010 census on population and housing, Mansa district had a population of approximately 228,392 with a growth rate on an average 2.4% per annum (CSO, 2011). The current population of Mansa Town excluding Mansa rural is approximately 145,336 people (MDHO, 2021). The boundaries of Mansa Town are highlighted in red (Figure 2).

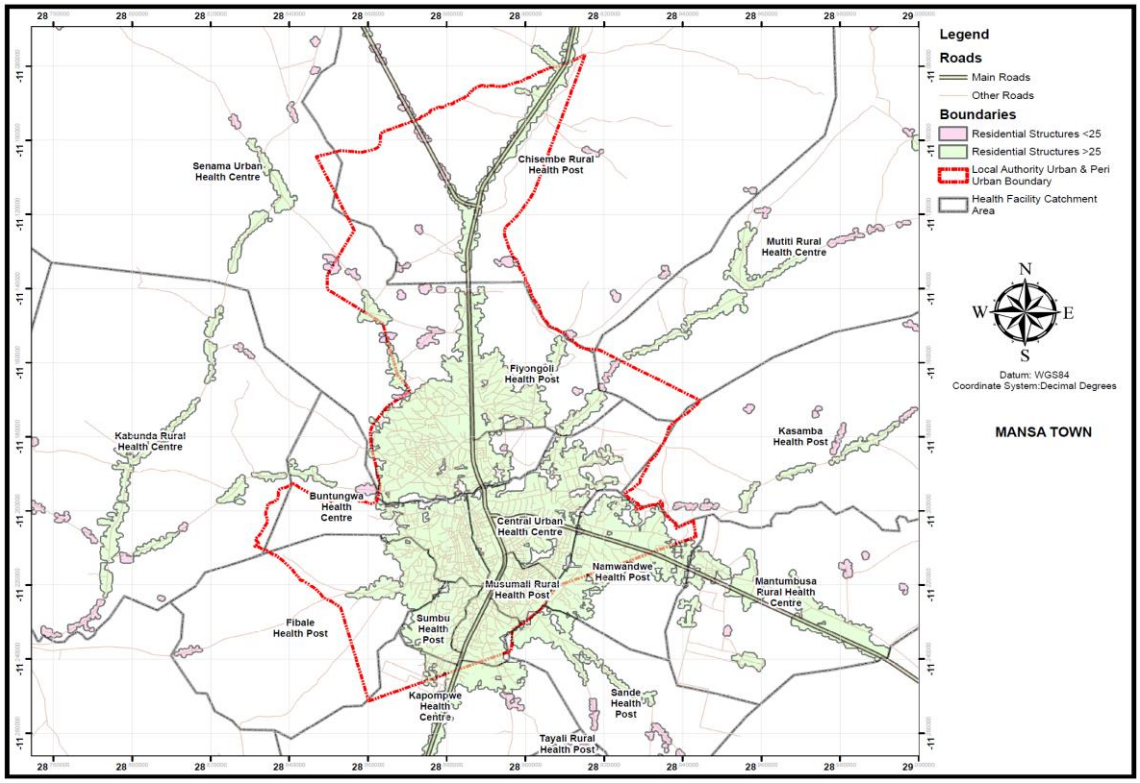

Figure 2: Mansa Town boundary (Source: GOPA, 2022).

2 Service Outcomes

2.1 Overview

Figure 3 shows the SFD selection grid that was generated for the development of the Mansa Town SFD.

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					Not Applicable
Septic tank					T2A2C5 T1A2C5					
Fully lined tank (sealed)					Significant risk of GW pollution Low risk of GW pollution					
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 Low risk of GW pollution
Lined pit with semi-permeable walls and open bottom	Not Applicable									Significant risk of GW pollution T1A5C10
Unlined pit										T2A6C10 Low risk of GW pollution
Pit (all types), never emptied but abandoned when full and covered with soil										T2B7C10 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							T1B11 C7 TO C9		Not Applicable

Figure 3: SFD selection grid.

The data used in the generation of the SFD graphic largely originated from the Mansa Sanitation Survey (MSS) conducted in 2017 jointly by Luapula Water and Sanitation Company (LpWSC) and the National Water Supply and Sanitation Council (NWASCO). The MSS Report provided the baseline upon which the SFD graphic for Mansa town was developed.

However, one deficiency of the report was that it only concentrated on the sanitation situation in residential areas. Public places and institutions including industries were not included in the MSS study. Despite this fact, the generated SFD graphic is considered credible as Mansa being a rural town has a very low transient population. Utilisation of public and commercial sanitation facilities in the Town is mostly by the local population that are considered already covered in the household studies.

The MSS study was commissioned with the goal of creating a sanitation database for the town as a first step towards improving sanitation reporting by the utility. Within the framework of improving sanitation reporting by the utility, the Commercial Utility (CU) needs to consider extending this approach to all areas under its jurisdiction for better understanding of situations on the ground and improved service delivery.

In consultation with LpWSC, Mansa Municipal Council (MMC), and Mansa District Health Office (MDHO), review of other available literature in addition to the MSS, was undertaken in desk evaluations of the town's sanitation status. Furthermore, Key Informant Interviews (KIIs), Focus Group Discussions (FGDs) and field observations were done in order to understand the sanitation status. A detailed explanation on the existing sanitation status is presented in the sections below.

2.1.1 Offsite Sanitation

Sewer Networks

Offsite sanitation system consists of two centralised conveyance sewer networks that delivers the wastewater to treatment sewer ponds. The two networks are on two separate ends of the town and they are called Sparks and Suburbs sewerage systems (Figure 4).

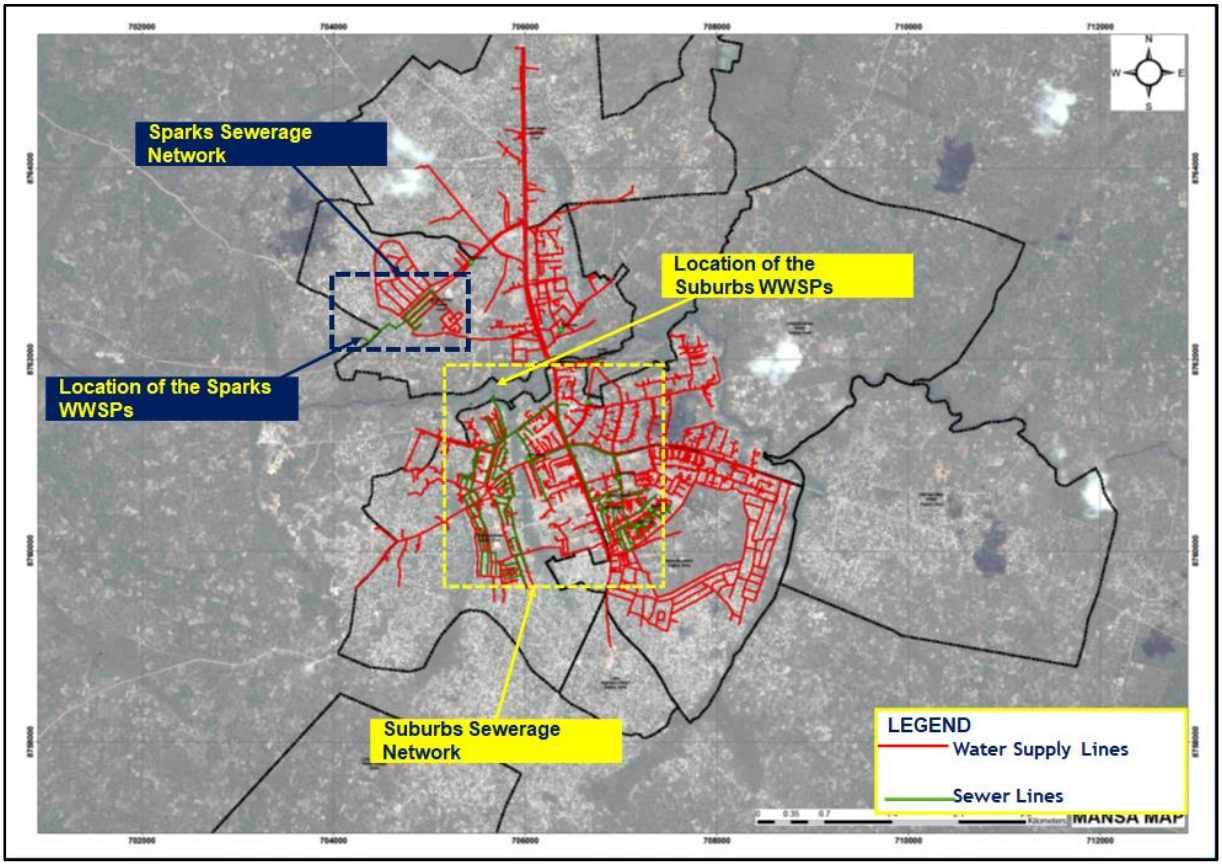

Figure 4: Existing sewerage networks for Mansa (Source: Author).

The Suburbs sewer system serves the town centre, medium density, low density and Suburbs residential areas and delivers wastewater to the Suburbs Sewage Treatment Ponds. The Sparks sewer system services the Sparks residential area and conveys wastewater to the Sparks Sewage Treatment Ponds (Figure 4).

In addition to residential areas, the Suburbs sewerage system also serves 14 institutions and 9 commercial buildings in the suburbs, medium density, low density, and town centre areas. The Suburb network consists of Asbestos Cement (AC) pipes with diameters of 250 mm, 200 mm, 150 mm, and 100 mm and it covers a total length of approximately 5.6 km.

The Spark sewerage system serves a total of about 150 medium-cost residential housing units in Spark Compound. The network is a 150 mm AC pipes covering a total length of 1.5 km. In general, the two sewerage systems are very old and are characterised with a number of sewer blockages and leakages. These assertions were confirmed by visible leakages in the system during physical surveys undertaken during the study. The other factor pointing to possible leakages/blockages in the systems was the revelation of low wastewater inflows into the ponds during the field surveys (Figure 5).

Figure 5: Blockages in some sections of the sewerage networks for Mansa Town (LHS: A blocked septic tank upstream of the Sparks Wastewater Stabilisation Ponds (WWSPs); RHS: Dry Maturation Ponds indicative of low flows) (Source: Author).

Treatment Systems

The two independent sewer networks have their wastewater separately treated in the Surbarbs and Sparks Wastewater stabilisation ponds.

Suburbs Sewage Ponds

The Suburbs WWSPs treats wastewater collected from the Suburbs Sewer Network. The ponds are located in the north-western region relative to the Central Business District (CBD). The system comprises a facultative pond and two maturation ponds. At the time of the study, the access road to the facilities was almost impassable by vehicles. The facultative ponds were also found heavily infested with aquatic weeds. Figure 6 shows the state of the Suburbs WWSPs and their state.

Figure 6: The Suburbs WWSPs with inserts on state of the Access Road and the Weed Infested Facultative Pond (Source: Author).

Very little data exists on the design aspects of the facilities as the depth of the units as well as the design and actual hydraulic and organic loading rates to the treatment plant, which are are not known. Available parameters found for the systems are only the approximate length and width of the units (Table 1) extracted from Google Earth.

Table 1: Design parameters for the Suburbs WWSPs.

Description	No	Length (m)	Width (m)
Facultative Pond	1	170	70
Maturation Pond	2	90	70

Very little inflows was observed to be getting to the ponds of which resulted into having no effluent from the facilities. In actual fact, at the time of the study, the last pond was observed dry and data from Key Informant Interviews (KIIs) indicated that this was the normal situation for the pond all year round.

It was stated from the residents that only the facultative pond that receives some wastewater has little water stagnant water in it and at no time has it been observed full in a long time. This implies that wastewater that gets to the ponds has an infinite retention time within the facultative pond. The presence of weeds in the ponds have also to a certain degree transformed the treatment process to that of a constructed wetland leading to the assertion that no effluent leaves the pond and the only water leaving the ponds is that which is lost due to evapotranspiration. As such, in terms of compliance to ZEMA Effluent Standards, it is taken that the wastewater is adequately treated as it does not pollute the environment.

One of the observed downside of the low flows to the Ponds is the illegal encroachment especially around the last maturation. The maturation ponds have never received any wastewater in a long time and people have taken them as available land for construction and have even gone in further constructing within the ponds as evident from Figure 6.

Sparks Sewage Ponds

The Sparks Sewage Ponds receive wastewater from the smaller sewer network located in the Sparks residential area on the north-western part of the town (Figure 4). The system comprises one facultative pond and one maturation pond. The system was designed with a septic tank upstream of the facultative pond to reduce the organic content of the sewage before it gets to the facultative pond. Unlike the Suburbs Ponds, the Spark Ponds were accessible. However, they were also infested with aquatic weeds (Figure 7).

Figure 7: The Spark WWSPs (LHS: The weed infested facultative pond with sewage in it; RHS: Dry maturation pond infested with weeds) (Source: Author).

Very little data exists on the design aspects of the ponds. Table 2 presents approximated dimensions of the ponds extracted from Google Earth. All the other critical parameters including the depth of the facilities, the design and actual hydraulic and organic loading rates of the plant are not known.

Table 2: Design parameters for the Spark WWSPs.

Description	No	Length (m)	Width (m)
Facultative Pond	1	35	20
Maturation Pond	1	35	20

As is the case with the Suburbs Ponds, the Sparks Ponds also has very low wastewater inflows resulting in no effluent from the maturation pond. This was validated by both, the physical surveys and the KIIs with technical staff from the CU. This implies that wastewater that gets to the ponds remains in the ponds forever and that which is lost does so through the process of evapotranspiration. The presence of weeds in the ponds has also most likely transformed the treatment process to that of a constructed wetland. From the perspective of compliance to ZEMA Effluent Standards, it is taken that the effluent is adequately treated as it does not pollute the environment, remaining confined to the ponds.

It should be noted that under the Integrated Small Towns Water Supply and Sanitation Project (ISTWSSP), a conventional Wastewater Treatment Plant (WWTP) is currently under construction and, once commissioned, it will be the one to take up some of the wastewater going into the Sparks WWTP. Under the same project, rehabilitation works to the existing plants will be undertaken with some of the obvious being the rehabilitation of the access road to the Suburbs Ponds and also the rehabilitation of the ponds themselves to reinstate them to accommodate more wastewater. This includes removing illegal structures constructed around the ponds.

2.1.2 Onsite Sanitation

Containment

Table 3 summarises the types of containment technologies and the population that is serviced by each respective technology.

Table 3: Existing sanitation technologies in Mansa.

Sanitation Technology	Population (%)
Sewer connections	2%
Septic tanks	11%
Pit latrines	85%
Open Defecation	2%

It can be seen from the Table 3 that pit latrines are the major form of onsite sanitation system, servicing approximately 85% of the population. According to the Baseline Survey for Mansa District, most households in the district use improved traditional latrines which are latrines with slabs and covers that are not shared with other households (Figure 8). However, no technical information exists on how the substructures of the latrines are designed and constructed. The same applies to septic tanks as well.

Figure 8: Typical Traditional Pit Latrines used in Mansa Town (Source: Author).

The percentage contribution of excreta from different origins such as households, communal toilets, public toilets, institutions, commercial and industrial areas, restaurants and hotels in the MSS has not been reported in this study due to due to limited resources.

However, these facilities (i.e., public, institutional and commercial) have very little effect on the outcome of the SFD graphic as the transient population for Mansa Town is negligible.

Emptying and Transport

Emptying and transportation of faecal sludge is new in Mansa as this service is only confined to septic tanks. Emptying is done through a recently procured 10m^3 vacuum tanker under the African Development Bank (AfDB) funded ISTWSSP project whose aim is partly to improve sanitation services provision. The truck also services Samfya Town and will later service all areas under the jurisdiction of the LwWSC. From KIIs with utility technical staff, pit latrine emptying with the vacuum tanker has not been possible due to the low moisture content of the faecal sludge (hence thick sludge) and thus, not being fluid enough for suction. Emptying services were introduced recently (March, 2022) and it is a service that is being provided only by the utility. Since it is the utility providing the service, operations follow the provided Occupation Safety and Health (OSH) guidelines in terms of protective equipment for operators and also in terms of ensuring sanitary operational conditions during and after emptying.

Payment for the emptying services is in two categories; a category for domestic customers attracting an emptying fee of six hundred Kwacha (K600) (USD 31) and a category for commercial customers (i.e., commercial, public and industrial) which is pegged at seven hundred Kwacha (K700) (USD 36) per load. For both categories, the customers are expected to provide fuel for the truck charged at 20 litres within a radius of 2 km.

Since emptying operations are still in their rudimentary stage, the population that is currently serviced was estimated at only 1%. It is expected for this percentage to gradually increase with the knowledge of people being aware of its existence.

Treatment and Disposal

At the time of the study, the only available faecal sludge treatment facility in Mansa was the Suburbs WWSPs in which the faecal sludge is discharged for co-treatment with the wastewater. The emptied faecal sludge is discharged at the inlet of the facultative ponds. The ponds are however only accessible during the dry season as the roads are impassable in the during the rainy season. Plans to rehabilitate the road so that the ponds are accessible throughout the year are underway. Since facultative ponds are designed to treat low strength sewage, the disposal of septage into them has a high potential of destabilizing the treatment processes and as such not encouraged.

Under the ongoing AfDB funded project (ISTWSSP), there are proposals to have Unplanted Sludge Drying Beds to cater for the septage and the sewage sludge that will be generated from the treatment of the sewage.

2.2 SFD Matrix

Table 4 shows the SFD matrix.

Table 4: SFD matrix.

Mansa, Luapula, Zambia, 16 Feb 2022. SFD Level: 1 - Initial SFD
Population: 145336
Proportion of tanks: septic tanks: 100%, fully lined tanks: 100%, lined, open bottom tanks: 100%

Containment						
System type	Population	WW transport	WW treatment	FS emptying	FS transport	FS treatment
	Pop	W4a	W5a	F3	F4	F5
System label and description	Proportion of population using this type of system (p)	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 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
T1A1C2 Toilet discharges directly to a centralised foul/separate sewer	2.0	50.0	90.0			
T1A2C5 Septic tank connected to soak pit	3.0			1.0	100.0	90.0
T1A5C10 Lined pit with semi-permeable walls and open bottom, no outlet or overflow	25.0			0.0	0.0	0.0
T1B11 C7 TO C9 Open defecation	2.0					
T2A2C5 Septic tank connected to soak pit, where there is a 'significant risk' of groundwater pollution	8.0			0.0	0.0	0.0
T2A6C10 Unlined pit, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	59.0			0.0	0.0	0.0
T2B7C10 Pit (all types), never emptied but abandoned when full and covered with soil, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	1.0					

2.2.1 Distribution of Containment technologies

The distribution of containment facilities is detailed in Table 5.

Table 5: Containment technologies available in Mansa.

Containment Technology	Proportion of population (%)	SFD Matrix Classification
Offsite	**2%**	T1A1C2
Septic Tanks/ Conservancy tanks	**11%**	
Septic tank with soak pit	3%	T1A2C5
Septic tank with soak pit with significant risk of groundwater pollution	8%	T2A2C5
Pit Latrines - All Types	**85%**	
Lined Pit Latrines	25%	T1A5C10
Unlined Pit Latrines	59%	T2A6C10
Pit Latrines which get abandoned when full	1%	T2B7C10
Open Defecation	**2%**	T1B11C7TOC9

Offsite: Only 2% of the total population are serviced by the centralised sewerage systems. And based on the KIIs with the CU technical staff and coupled with field observations, this system has blockages and leaks. However, there is no data on how much wastewater leaks from the system into the environment. An assumption made based on the SFD guidelines on approximations for situations where no data exists made was that only 50% of the collected wastewater is delivered to the treatment plants. Thus, variable W4a was set to 50%.

In terms of treatment efficiency, wastewater that gets to the ponds has an infinite retention time within the facultative ponds, so it is assumed that, in terms of compliance to ZEMA Effluent Standards, the effluent is adequately treated as it does not pollute the environment, remaining confined to the ponds. However, there are always leaks, outages, breakdowns, etc., and thus, variable W5a was set to 90% to account for this.

Septic Tanks: According to the SFD matrix, 3% of the total population is serviced by septic tanks connected to a soak pit without significant risk to groundwater pollution and 8% of the population are serviced by septic tanks that have a significant risk to groundwater pollution. Most of the septic tanks in the town are reportedly not properly constructed, being full but still in use. Determination of the groundwater risk also took into consideration other factors like the nature of the hydrogeological conditions, distances between water points and sanitation facilities and reliance on groundwater where the OSS facilities are.

Pit Latrines: Based on the MSS, a total of approximately 25% of the population is serviced by lined pit latrines of which 59% are unlined pit latrines. This sanitation technology has no services for emptying, transportation and treatment. Under this sanitation technology, the risk of groundwater pollution is very high as the geological nature of Mansa has porous soil types and rock formations that could easily allow the excreta to directly leach into groundwater. To exacerbate the situation, a bigger proportion of the population utilising pit latrines rely on unprotected groundwater sources.

2.2.2 Emptying of onsite technologies

Only about 1% of the faecal sludge in septic tanks is emptied and transported to a treatment plant where it is co-treated with the wastewater. Emptying services are confined to septic tanks only as the quality of the pit latrine sludge cannot be pumped by the vacuum tanks due its thickness. This implies that most of the the onsite sanitation facilities are never emptied as pit latrines account for the majority of these facilities. KIIs indicated that the practice is to simply bury them when they get full and build new ones to replace them.

The low percentage can also be attributed to the fact that this service is a new model in Mansa. Thus, variable F3 for system T1A2C5 was set to 1%. However, septic tanks located in areas of high risk of groundwater contamination (T2A2C5) were assumed not to be emptied and thus, variables F3, F4 and F5 for these systems were all set to 0%.

In terms of pits, all types of pits (T1A5C10 and T2A6C10) were assumed not to be emptied and thus, variables F3, F4 and F5 for these systems were all set to 0%.

Moreover, about 1% of the population have pit latrines that have never been emptied and abandoned when full (T2B7C10), where there is a 'significant risk' of groundwater pollution.

2.2.3 Transport of FS from onsite technologies

It was also assumed that all emptied faecal sludge from septic tanks (T1A2C5) is delivered to treatment (variable F4 set to 100%) since it is a new service provided by the utility and operations follow the provided OSH guidelines.

2.2.4 Treatment of FS from onsite technologies

There are no faecal sludge treatment plants and the faecal sludge is co-treated with wastewater at the Suburbs WWSPs, with the same treatment efficiency (as explained above) assumed (variable F5 = 90%).

Open Defecation: About 2% of the total population are not serviced by any type of sanitation technology and as such, they practise open defecation.

2.2.5 Risk of groundwater contamination

Hydrogeological Conditions

Hydrogeological data which is a key input component in the generation of the SFD graphic for the study area was obtained from the MSS. The study stated that only 31.4% of Mansa residential areas with septic tanks have been constructed in low water table areas and leaving 68.6% of septic tanks in high water table areas. Therefore, there is a 68.6% more risk to groundwater contamination by septic tanks. Table 6 shows the areas with septic tanks and the number of septic tanks in each area.

Table 6: Hydrogeological condition for areas where septic tanks are located (Source: MSS).

Septic Tanks in Low Water Table areas		
Residential Area	**No of Septic Tanks**	**Percentage %**
Suburbs	343	16.8
Musenga	231	11.3
Ministers Compound	68	3.3
Subtotal	**642**	**31.4**
Total No. of Septic Tanks	**2,045**	

Similarly, the MSS Report revealed that pit latrines in most residential areas are located in high water table areas with only 15.3% of the total number being in areas with lower water table (Table 7).

Table 7: Hydrogeological condition of pit latrines – Mansa Sanitation Survey.

Pit Latrines in Low Water Table areas		
Residential Area	**No of Pit Latrines**	**Percentage %**
Suburbs	1,767	12.7
Musenga	308	2.2
Ministers Compound	48	0.3
Subtotal	**2,123**	**15.3**
Total No. of Pit Latrines	**13,871**	

Lateral Separation between Sanitation Facilities and Groundwater Supply

Most areas with onsite sanitation facilities in Mansa, especially pit latrines, are not beneficiaries of reticulated water supply systems from the utility. This population therefore relies on groundwater sources such as shallow wells in most cases and boreholes in a little. Based on the MSS, very few areas within Mansa have lateral separation of greater than 30 m, which is the recommended distances between water points and sanitation facilities according to the World Health Organisation (WHO) Guidelines (Table 8).

Table 8: Lateral Distance between Water Point & Sanitation Facility (Source: MSS, 2017).

Residential Area	Lateral Distance between Water Points & Sanitation Facilities
Rosemary Park (Low Density)	Greater than 30m
Fairview (Medium Density)	Greater than 30m
Mutende	Less than 30m
Musenga	Less than 30m
Suburbs	Less than 30m
Ministers Compound	Greater than 30m
Zambia Compound	Less than 20m
Kaole	Less than 20m
Spark Compound	Less than 20m
Spark Extension	Less than 25m
New Mufulira	Less than 25m

Residential Area	Lateral Distance between Water Points & Sanitation Facilities
Town Centre	Less than 20m
Police Compound	Less than 20m
Prisons Compound	Less than 20m
Chitamba Dasto	Less than 20m
Namwandwe	Less than 20m
Kapesha	Less than 20m
Kabuta	Less than 20m
Chabala Muwe	Less than 30m
Fiongoli and Others	Less than 25m

The information in Table 8 was used to provide answers to some of the questions in the assessment of the risk of groundwater contamination from onsite sanitation technologies in the study area. However, there was a mismatch between the required ranges for the assessment tool and the data provided in Table 8 which puts the lateral separation for most facilities at less than 20 m. From observation, it was established that the lateral separation was more than 10 m in most of the systems.

Groundwater Contamination Risk

Based on data presented in Tables 6, 7 and 8 together with other data (i.e., data on soil type, actual observed lateral separation between sanitation and water source facilities and reliance on groundwater as sources for drinking water), the overall groundwater contamination risk for most areas in Mansa according to the Assessment Tool was a *Significant Risk*. A total of 68% of the population has their facilities posing significant groundwater pollution risk with the population on pit latrines accounting for 60% and that on septic tanks accounting for 8%. This translates into the final distribution of the containment technologies as shown in Table 5.

2.2.6 Uncertainty in the Data used for the SFD Matrix

The information used in the development of the SFD graphic relied on available sanitation information from LpWSC, MMC and MDHO. Data gaps were observed which include: existing sanitation data only covers the residential areas (Mansa Sanitation Survey). Therefore, public places, institutions and industrial areas are not captured in the initial SFD graphic development. However, this is not an area of concern as Mansa Town has negligible transient population.

The population data collected from MDHO was not arranged as per MMC urban and peri-urban boundary. The MDHO population data were arranged as per catchment defined by the District Health Office. Therefore, the population data had to be tailored to the local authority jurisdiction based on the population density maps supplied by MDHO. This process of tailoring is prone to errors in calculation resulting from assumptions in the population demographics.

2.3 Summary of assumptions

Offsite sanitation systems:

- ✓ 2% of the population are connected to the sewer system. It was estimated that only 50% of the wastewater is delivered to treatment (W4a = 50%) out of which, 90% is treated (W5a = 90%).

Onsite sanitation systems:

- ✓ The proportion of Faecal Sludge (FS) in septic tanks was set to 100% and the proportion of FS in lined tanks with impermeable walls and open bottom and pits was set to 100% according to the relative proportions of the systems in the municipality, as per the guidance given in the Frequently Asked Questions (FAQs) in the Sustainable Sanitation Alliance (SuSanA) website.
- ✓ Only about 1% of the faecal sludge in septic tanks is emptied. Thus, variable F3 for system T1A2C5 was set to 1%. It was also assumed that all emptied faecal sludge from these tanks is delivered to treatment (variable F4 set to 100%) and co-treated with wastewater at the Suburbs WWSPs, with the same wastewater treatment efficiency (variable F5 = 90%).
- ✓ Septic tanks located in areas of high risk of groundwater contamination (T2A2C5) were assumed not to be emptied and thus, variables F3, F4 and F5 for these systems were all set to 0%.
- ✓ All types of pits (T1A5C10 and T2A6C10) were assumed not to be emptied and thus, variables F3, F4 and F5 for these systems were all set to 0%.
- ✓ About 1% of the population have pit latrines that have never been emptied and abandoned when full (T2B7C10), where there is a 'significant risk' of groundwater pollution.

2.4 SFD Graphic

The SFD graphic for Mansa (Figure 9) shows that 71% of the population has their excreta unsafely managed while 29% has their excreta safely managed.

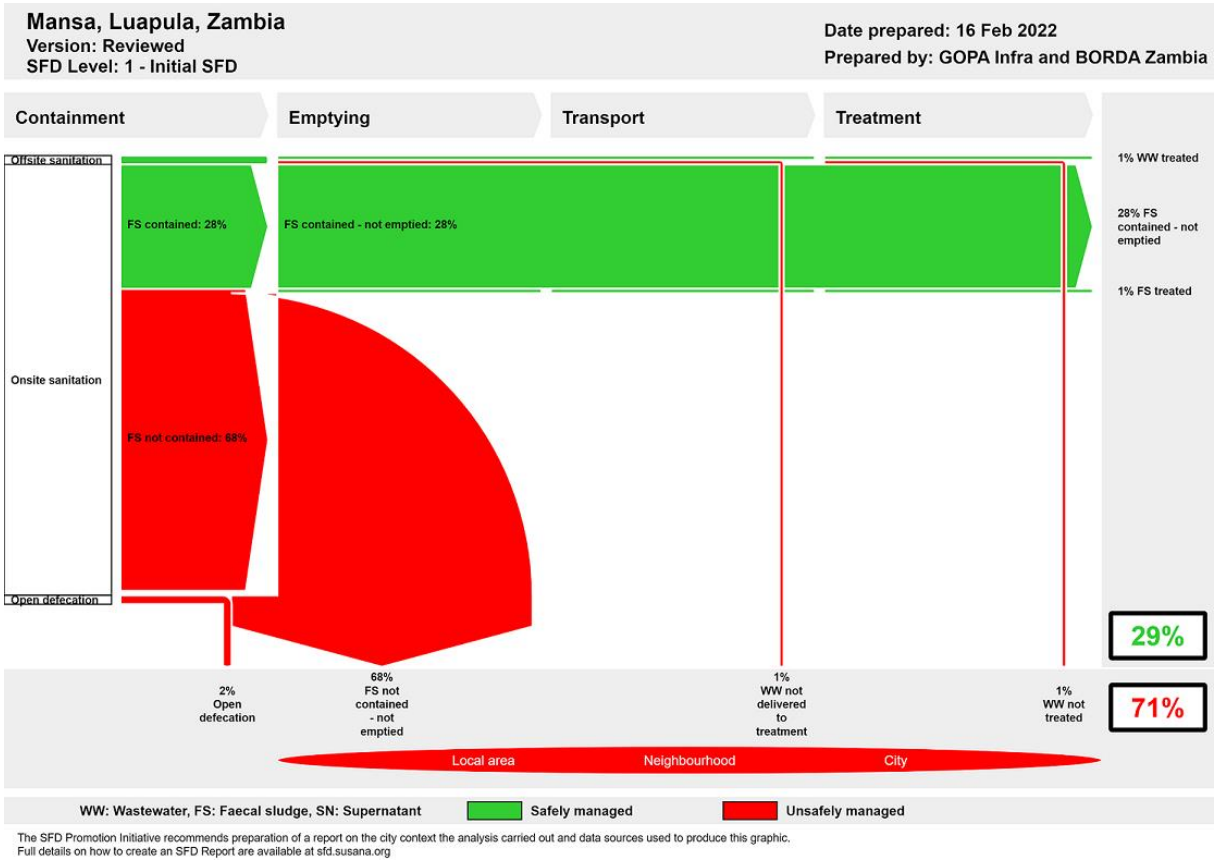

Figure 9: SFD graphic for Mansa.

The majority of the population in Mansa (96%) uses onsite sanitation, while offsite sanitation and open defecation account for 2% of the population.

For the offsite sanitation systems, about 50% of the population contributing to this system have their wastewater safely managed (1% WW treated on Figure 9) . The wastewater from the remaining 50% of the population is unsafely discharged into the environment (1% WW not delivered to treatment and 1% of WW not treated on Figure 9).

For onsite sanitation systems, just over a quarter of the total population use a system where the faecal sludge is safely managed (28% FS contained - not emptied on Figure 9). The vast majority of which are the population using pit altrines in areas with low groundwater risk who do not empty their facilities but safely abandon them when they get full.

Only 1% of the population use a system where their faecal sludge is emptied and transported to the treatment plant where it is co-treated with wastewater (1% FS treated on Figure 9). The emptying service is exclusively provided to households with septic tanks.

However, the majority of the FS from the population using onsite sanitation systems is unsafely managed (68% FS not contained – not emptied on Figure 9). And the majority of the population contributing to this flow is the population using pit latrines where groundwater contamination risk is significant.

Approximately, 2% of the total population have no access to basic sanitation services and hence practice open defecation.

3 Service delivery context

3.1 Policy, legislation and regulation

The Government Republic of Zambia (GRZ) has put up in place clear policies, regulations and legal frameworks for water supply and sanitation services to create an enabling environment to attain universal access to sanitation for all by 2030. The sections below outline the policy, institutional/ regulatory and legal frameworks for sanitation which applies at both national and local levels.

3.1.1 Policy

The following policies have been put in place to provide direction and guidance on the vision to achieve the universal access to safely managed sanitation for all by 2030:

The Zambia Vision 2030: The vision identifies inadequate access to safe water supply and sanitation as one of the human well-being and social development aspect that needs to be improved for Zambia to attain the aspiration to become a prosperous middle-income country by 2030. In this regard, the vision sets target to improve access to adequate, appropriate and environmentally friendly sanitation for at least 90% of Zambians by 2030.

The 7th Development Plan 2017 – 2021: Outlines the intended five-year developmental outcomes and goals to achieve the vision 2030. Thus, the plan outlines strategies and programs that are aimed at improving access to safely managed sanitation at all levels in Zambia.

National Water Supply and Sanitation Policy of 2020: The policy was developed based on the vision 2030 and the sustainable development goals and its implementation shall be through the National Development Plans. The policy sets clear and coherent policy measures that guide the improvement of access to adequate and safely managed sanitation for all. One of the objectives of the policy is to provide the legal and institutional framework for sanitation service delivery in Zambia.

National and Local Programs: The National Urban Water Supply and Sanitation Program (NUWSSP, 2011 – 2030) enables all urban residents, commerce, institutions and industry to have access to sanitation and utilize it in an efficient and sustainable manner for improved health, well-being and livelihood by 2030. Specifically, the National Urban and Peri-Urban Sanitation Strategy (NUSS, 2015- 2030) provides a framework for financing and implementing the sanitation component of the NUWSSP and has set a target to “provide adequate, safe and cost-effective sanitation services to 90 percent of the urban population by 2030”. To achieve this target, one of the objectives will be to improve access to sanitation and safely manage sanitation systems so as to reduce the incidence of water borne diseases outbreaks such as cholera.

At the local level, LpWSC has been undertaking various infrastructure projects to improve service delivery to its customers with the recent major project being the ISTWSSP that was funded by the AfDB. The ISTWSSP commenced in the first quarter of 2020 and is anticipated for completion in 2022. The project will see LpWSC improve its water production capacity as well as its sanitation infrastructure.

United Nations (UN) Sustainable Development Goals 2015 – 2030: Zambia is a member of the UN and all developmental programs and policy documents in the water supply and sanitation sector are aligned to the sustainable development goals (SDGs) No. 6 and its targets. All these policy documents and programs have set clear objectives, targets and an enabling environment on sanitation service improvement for both urban, peri-urban and rural areas which includes the town of Mansa.

3.1.2 Institutional roles

The Framework for Provision and Regulation of Urban Onsite Sanitation and Faecal Sludge Management and the Framework for Provision and regulation of Rural Water Supply and Sanitation in Zambia sets a robust institutional arrangement that clearly specifies the roles and responsibilities of all key players in the Water Supply and Sanitation Sector in Zambia. Figure 10 shows the institutional and regulatory framework and outlines the various roles and responsibilities of the key sector players in Zambia.

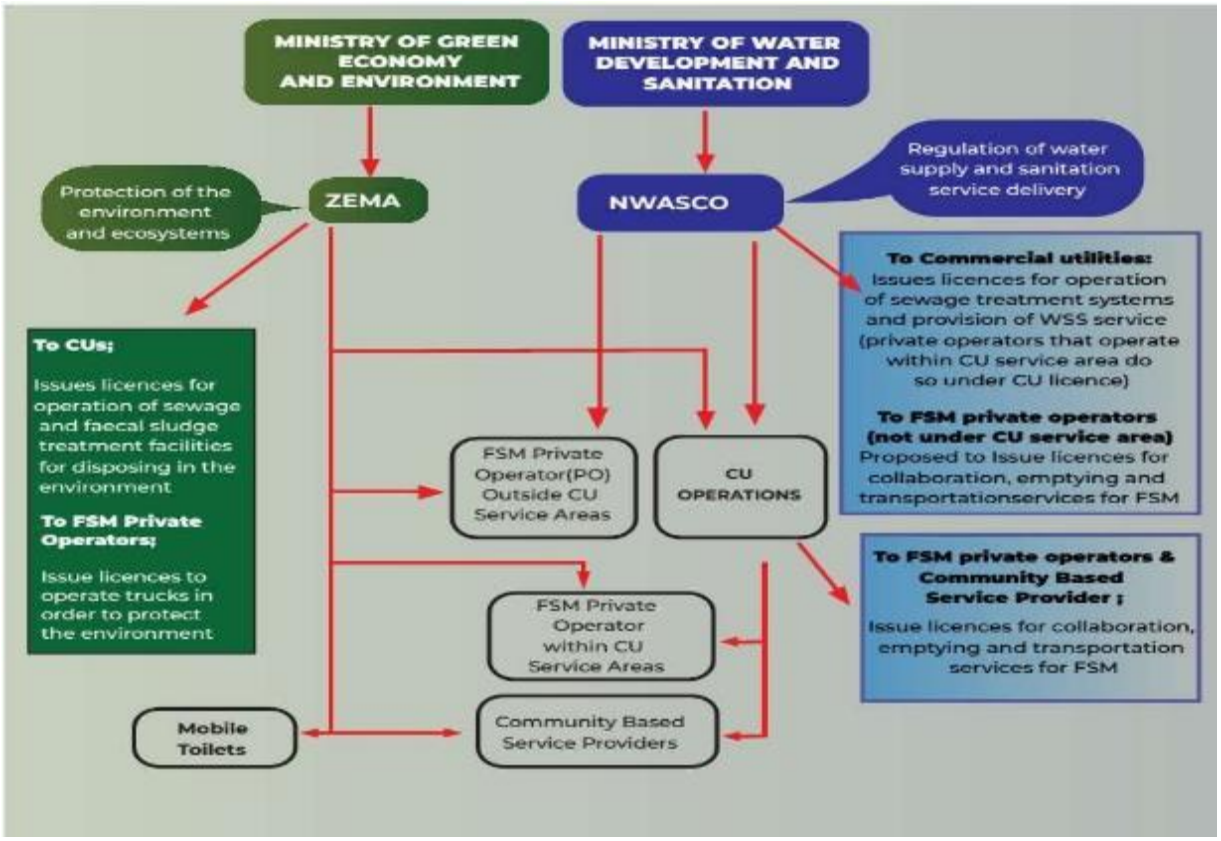

Figure 10: Regulatory Framework for Provision of Sanitation Services (Adapted from NWASCO, 2018).

At the local level, the following are the key players:

Mansa Municipal Town Council - Under the direction of Ministry of Local Government (MLG), MMC focuses on the enforcement of Ministry of Health's Hygiene regulations and the development of by-laws on sanitation service provision through the Public Health Departments. MMC also holds the majority of the shares in LpWSC and sits on the board as well as delegates' LpWSC for water supply service and sanitation provision as per the WSS act No.

28 of 1997. MMC, through Environmental Health Officers and Health Inspectors, are mandated to enforce and regulate the sanitation relevant laws related to the Public Health Act (Drainage and Latrine), Regulation 1994 (Amended 2006) related to collection, transportation and treatment of wastewater. MMC also has a mandate for other services that relate to the quality of the urban environment and therefore has a broader responsibility for sanitation that also includes solid waste management and storm-water drainage system for areas within Mansa town.

MCC also issues business levy licenses to all businesses operating in the town including service providers in solid and liquid waste management. There is however a weak enforcement when it comes to registration of businesses providing onsite sanitation (OSS) and Faecal Sludge Management (FSM) services in the Town.

Luapula Water Supply and Sanitation Company - LpWSC is the commercial utility delegated by MMC to provide water supply and adequate sanitation services to rural, urban and informal areas of Mansa District and the other districts under its jurisdiction i.e., Samfya, Mwense, Nchelenge, Kawambwa and Chembe. LpWSC is overseen and regulated by NWASCO and manages the current water supply and sanitation infrastructure for Mansa town.

National Water Supply and Sanitation Council (NWASCO) - According to the Framework for Provision and Regulation of Urban Onsite Sanitation and Faecal Sludge Management, regulation of sanitation service provision (including OSS and FSM) in Mansa Town is done through new licensing conditions of 2018 issued to LPWSC by NWASCO. Under the licensing conditions, any private operator providing sanitation services (e.g., emptying of OSS facilities) within the LPWSC's designated service area will do so under a delegated management contract with LPWSC. Private operators providing services outside the service areas of LPWSC need to obtain a permit directly from NWASCO (NWASCO, 2018).

Zambia Environmental Management Agency (ZEMA) - ZEMA is responsible for applying the legal framework for the protection of the environment and the control of pollution. Under the Environmental Management Act, no 12 of 2011, ZEMA regulates discharges into the environment and promotes water pollution monitoring and prevention programs based on enforceable water quality guidelines and standards. ZEMA is also responsible for issuance and enforcement of waste management licenses to any individual or entity who wishes to collect and transport domestic and commercial waste in town for environmental protection.

3.1.3 Standards

Several laws and regulatory tools exist which provide a clear legal framework for sanitation at both national and local level. These include the following:

The Water Supply and Sanitation Act No. 28 of 1997: Mandates NWASCO to regulate water supply and sanitation provision in urban, peri-urban and rural areas as well as provides for the formulation of utility companies who are responsible for water supply and sanitation service provision.

Local Government Chapter 281, Volume 16 of the Laws of Zambia: Mandates local authorities for provision of water supply and sanitation services in the respective districts. Service provision is delegated to the utility companies who are owned by the local authorities.

The Public Health Act Chapter 295, Volume 17 of the Laws of Zambia: Mandates local authorities to enforce public health protection.

The Environmental Management Act No. 12 of 2011: Mandates ZEMA to license, regulate and enforce environmental safeguards which includes treated wastewater effluent discharge standards.

Water Resources Management Act of 2011: Establishes the Water Resources Management Authority (WARMA) to set, regulate and enforce standards on surface and groundwater quality which are often receiving bodies of treated effluent. It further prescribes the minimum distances for structures including onsite sanitation facilities from natural water resources.

The Statutory Instrument No. 112 of 2013: Sets limits and standards for environmental protection including licensing of vehicles for transportation of faecal sludge and treatment facilities.

Statutory Instrument No. 100 of 2011: Provides for local authorities to manage solid waste in the areas of operation. Poorly managed solid waste systems lead to indiscriminate disposed of municipal solid waste into OSS facilities, making emptying services challenging.

4 Stakeholder Engagement

The stakeholders that were engaged in the development of this initial level SFD report development for Mansa include MDHO, MMC, LpWSC, SUN TA, GFA and GIZ. A stakeholder engagement meeting was held in Mansa on 7th February 2022 to bring the key players on board and strategies on the methods of data collection and data sources. The meeting also facilitated consultations on existing literature on SFD graphic generation for the town of Mansa.

MDHO provided population data based on head count and population density maps. MMC was consulted on the jurisdiction boundary for the local authority urban and peri-urban areas and provided Geographical Information System (GIS) shape files for the local authority boundary. LpWSC provided information on existing water supply and sanitation services in the study area. SUN TA, GFA and GIZ provided contribution on existing literature and previous similar and on-going assignment data.

5 Acknowledgements

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6 References

-Gauff (2017). Mansa town location map.

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LpWSC and NWASCO (2017). Mansa Sanitation Survey Baseline.

-MDHO (2021). Head Count Population Per Health Facility Catchment Area in Mansa.

-MMC (2022). Mansa Local Authority boundary GIS shapefiles.

-Six KIIs to stakeholders from the LWSC and MoH conducted in 2022 (further information in Appendix 3.

7 Appendix

7.1 Appendix 1: Stakeholder identification

Name of Organization	Name of Contact Person	Position	Influence (High/Medium/Low)	Interest (High/Medium/ Low)
LpWSC	Richard Chisembe	District Manager	High	High
LpWSC	Benson Kunda	GIS Technician	Medium	Medium
MMC	Thabo	Town Planner	Medium	Medium
MDHO	Mukamba Leslie	Malaria Elimination Officer	Medium	Medium
GIZ	Bwalya Mwape	Junior Advisor	High	High
GFA	Mwaba Kapema	Water Supply & Sanitation	Low	Low

7.2 Appendix 2: Stakeholder Tracking of Engagement

List of stakeholders that were directly engaged in the study	Date of Engagement	Purpose of Engagement	Maximum 100 words summary of outcomes
LpWSC staff – District Manager	01.02.2022 to 11.02.2022	Request for existing sanitation for Mansa town, data collection for the ECAM/SFD	Existing sanitation data for Mansa town shared, LpWSC participated in the data collection and generation of the SFD, also facilitated in the data collection for ECAM GHG estimation
MMC staff – Town Planner	03.02.2022 – 04.02.2022	Request for GIS Shapefile for MMC jurisdiction boundary	Consultative meeting was held and GIS shapefile shared
MDHO staff – Malaria Elimination Officer	07.02.2022 – 09.02.2022	Request for head count population data for Mansa.	Consultative meetings were held and head count population data shared

Mansa, Zambia, 2023

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