SFD Report

Ouagadougou
Burkina Faso

Final Report

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SFD Report Ouagadougou, Burkina Faso, 2018

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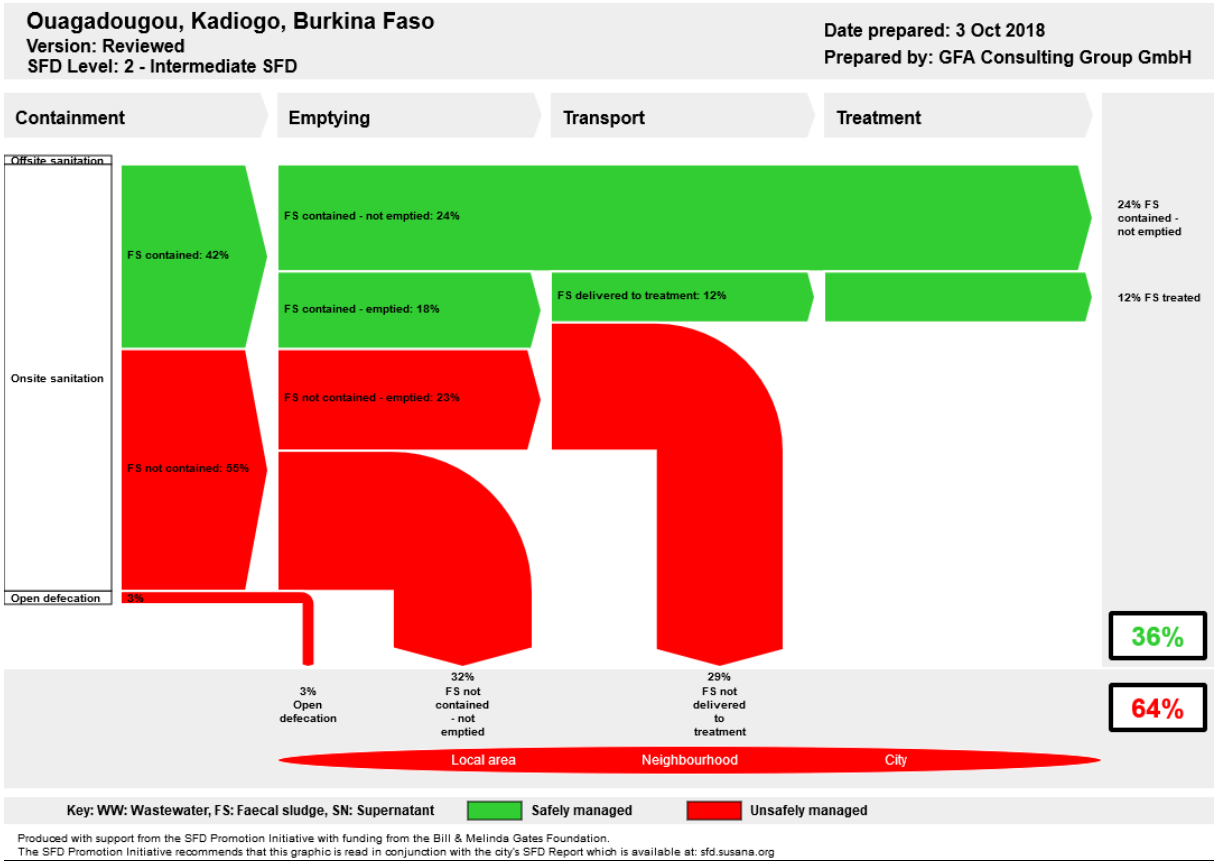
1. The SFD Graphic



2. Diagram information

SFD Level:

This is an Intermediate level SFD report.

Produced by:

This SFD report was produced by GFA Consulting Group GmbH.

Collaborating partners:

- Ministry of Water and Sanitation (MEA)
- General Directorate of Sanitation (DGA)
- GIZ Water and Sanitation Programme (GIZ/PEA)
- National Water and Sanitation Agency (ONEA)
- Municipality of Ouagadougou
- Manual emptier Association (ABASE)
- Mechanical emptier association /Emptier Association of Faso (AVF)

Status:

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3. General city information

Ouagadougou is the capital of Burkina Faso and the largest city of the country. It is located in the central region of Burkina Faso at an altitude of 305m above sea level with a total population of 2,532,311 in 2015 (INSD, 2015) and projected total population of more than 2.7 million in 2017 (ONEA, 2017). The population density is estimated to be 903 persons per km^2 within its municipal council area of 2,805 km^2. Additionally, the annual growth rate of the population is estimated to be 7.6% (INSD, 2006).

The annual temperature ranges between 12°C and 43°C with a mean annual rainfall range between 600mm and 900mm (Boubacar, 2013) .

Ouagadougou has a sewer system that a minority of the population is connected to (less than 0.4%) (ONEA, 2018). The majority is using onsite sanitation systems, mainly pit latrines (93%) (Voho, 2016) and septic tanks (4%) (ONEA, 2018). Faecal sludge emptying is done by vacuum trucks (77%) and manual systems (23%) (Voho, 2016).

4. Service outcomes

Ouagadougou has various sanitation technologies. An overview on technologies and methods used for different sanitation systems through the sanitation service chain is provided below.

According to different studies (Dah, 2013; Voho, 2016), 97% of the population has access to sanitation facilities, out of which 46.5% has access to sanitation facilities responding to the standards set by ONEA (ONEA, 2018). Less than 0.4% of the city population that have access to sanitation facilities is dependent on offsite sanitation systems. The rest of the population (3%) practices open defecation.

In order to assess the potential for emptying sanitation facilities, the national strategy of wastewater and faecal sludge management (SNGFAEUE, 2017) shows that 42% of onsite sanitation facilities in urban areas are indeed emptied. The proportion of mechanical emptiers is 77% against 23% of manual emptiers (Voho, 2016). 60% of mechanical emptiers dump at the faecal sludge treatment plant (Réseau Projection, 2013), while the proportion of faecal sludge delivered to the treatment plant which is treated is 100% (ONEA, 2018). However, when the treatment plant reaches its saturation point, 60% of mechanically emptied faecal sludge is dumped directly into the environment. In this context, certain unlined pits (traditional latrines) are very deep presenting a significant risk to groundwater pollution where water levels were estimated from 3 to 15 meters (Yameogo, 2008). Meanwhile, a certain proportion of faecal sludge emptied manually is also directly dumped into the environment (Voho, 2016).

Ouagadougou possesses three operational faecal sludge treatment plants, with the fourth still in a planning phase (ONEA, 2018). Treated faecal sludge is usually stored on site, waiting for further advanced physicochemical and heavy metal analysis to determine its potential use in agriculture. Besides the aforementioned stored sludge, the Community Association Namalgré-Zanga (ACONAZ) is a pioneer for the sanitization of urine and faeces. This activity started in 2008 in collaboration with Water and Sanitation for Africa (ex-Regional Centre for Water and Sanitation (CREPA)). In addition to the aforementioned pilot project, another pilot project for biogas production and electric power generation in Ouagadougou is ongoing. As part of the collaboration with the Bill & Melinda Gates foundation, ONEA secured funding for the constructing a pilot unit for biogas production from faecal sludge at the Faecal Sludge Treatment Plant (FSTP) of Kossodo in Ouagadougou. The overall goal of the project is to enhance the value and increase accessibility of faecal sludge services throughout the sanitation chain. The capacity of this unit is projected at 400 faecal sludge m^3/ day and a production of electricity of 2,160 MWh/ year.

5. Service delivery context

Burkina Faso included the protection of public health in its Public Health code in 1994. This code puts the Ministry of Health in charge of environment together with the ministries in charge of environment, water and sanitation measures intended to prevent drinking water pollution in order to protect the environment and public health.

Environment code (1997) amended by the Law No.006-2013/AN sets the basic rules that govern the environment in Burkina Faso.

The urban planning and building code (2006) under the Ministry of Urbanism and Habitat organizes and regulates town planning and infrastructure in Burkina Faso. This code aims at better control of the development of urban and rural centres.

The Code of Public Hygiene (2005) under the Ministry of Environment, Green Economy and Climate Change is the law on hygiene in Burkina Faso. The main purpose of the law is to preserve and to promote public health including the necessary awareness-raising policy for local authorities.

The decrees specifying and organizing the application of the code of public hygiene are:

- Joint order N…/PRES /PM/ MEA/ MS/ MEEVCC/ MATDS/ MEFD that defines and sets standards for the quality of wastewater discharges and excreta in the environment. The article 2 states that for the purpose of this order, the standards of wastewater and excreta discharges have maximum limit values for anthropogenic wastewater and excreta discharges in the environment.
- Joint order N…/PRES/ PM/ MEA/ MS/ MEEVCC/ MATDSI/ MEFD defines standards, criteria and indicators for access to sanitation services;
- Decree No.98-323/ PRES/ PM/ MEE/ MATS/ MIHU/ MS/ MTT regulates the collection, storage, transportation, treatment and disposal of urban waste. Article 28 states that each local authority shall draw up a strategic plan

for wastewater and excreta management for its community with the technical support of the Ministry of the Environment.

6. Overview of stakeholders

At the national level, the principal Ministries that intervene in sanitation are as follows: Ministry of Water and Sanitation (MEA), Ministry of Environment, Green Economy and Climate Change (MEEVCC), Ministry of Health, Ministry of Habitat and Urban Planning (MHU) and Ministry of National Education and Alphabetization (MENA). MEA is responsible for implementing national directorates and Water and Sanitation agencies. Most of these directorates and agencies have regional representatives. The following section summarizes the roles and responsibilities of each institution.

Ministry of Water and sanitation: this ministry is responsible for the preparation and implementation of policies adopted by the government of Burkina Faso in water and Sanitation. This ministry supervises the General Directorate of Sanitation and National water and Sanitation Utility (ONEA) and has the responsibility of sanitation policies, and the implementation and maintenance of sanitation facilities. In addition, this ministry with the Ministry of Health and the Ministry of Environment, Green Economy and Climate Change has to prescribe mandatory rules of hygiene and ensure compliance. Ministry develops and monitors the implementation of wastewater and excreta sanitation strategies and ensures compliance with sanitation standards. In this context, it works with the Ministry of Environment, Green Economy and Climate change to ensure the adequate disposal of solid and liquid wastes, and the quality of water, air and soil.

General Directorate of Sanitation: the General Directorate of Sanitation is responsible for:

- Defining sanitation strategies, policies and pricing in urban and rural areas;
- Implementing and monitoring of national policies and strategies in water, waste and excreta treatment in relation to other ministries, departments, civil society organizations and other actors;
- Conducting and controlling rural sanitation programs;
- Ensuring technical supervision of ONEA;
- Planning, construction, design and implementation of urban sanitation programs;
- Monitoring the activities of companies and other private administrations involved in the sanitation sector;
- Following international organization programs.

The General Directorate of Sanitation has Regional Directorates. The Regional Directorate of Water and sanitation is responsible for contributing to the design, development, monitoring, follow-up, and evaluation of the implementation of policies and strategies of sanitation in their regions. It also ensures compliance with legislation and regulation in the field of water and sanitation and technical assistance to communal works on drinking water and sanitation.

National Water and Sanitation Office (ONEA): ONEA was established by the decree N°85/387/ CNR/ PRES/ EAU of July 28, 1985 as a public industrial and commercial institution. It has been transformed into a National society on November 2, 1994 by the decree N°94-391/ PRES/ MICM/ EAU. ONEA is responsible for collection, treatment, recovery and disposal of wastewater and excreta in urban and semi-urban areas. In this context, the responsibilities are: (i) Creation, promotion and improvement as well as management of: collective and individual (autonomous) sanitation facilities for sewage and excreta disposal in urban and semi-urban areas; (ii) Planning, design and implementation of infrastructure for wastewater and faecal sludge management; (iii) Promotion of on-site sanitation technologies and appropriate disposal of treated sanitation by-products; (iv) Investments into off-site sanitation systems etc.

Regional Water and Sanitation Directorate: this institution is responsible for contributing to the design, development, monitoring and follow-up, evaluation and implementation of sanitation policies and strategies under their own territory.

Municipality: The municipality of Ouagadougou has several sanitation-related functions. The local government of Burkina Faso has the jurisdiction on the:

- Development of municipal action plans for the environment;
- Protection of ground and surface water in collaboration with ONEA and General Directorate of Hydraulics Infrastructures;

- Waste, health, pollution and nuisances' management.

The involvement of local government in the sanitation sector is implemented through projects, programs, and cooperation with non-governmental organizations or government agencies and departments like ONEA and DGA.

Tab. 1: Institutions involved in faecal sludge management for Ouagadougou (SNGFAEUE, 2017)

Key Stakeholders	Institutions / Organizations /
Public Institutions	Municipality of Ouagadougou, National Office for Water and Sanitation (ONEA), Ministry of Water and sanitation (MEA), Directorate General of Sanitation (DGA), Ministry of Health (MS), Ministry of Environment, Green Economy and Climate Change (MEEVCC), Ministry of Urban planning and habitat (MUH)
Non-governmental Organizations	International Water and Sanitation Centre (IRC), Water Aid, Water and Sanitation for Africa (WSA)
Private Sector	Mechanical emptying association of Faso (AVF), Manual emptying association (ABASE)
Development Partners, Donors	GIZ/ Water and Sanitation Programme, AfDB, World Bank.
Others	2iE Institute, Aube Nouvelle University, University of Ouagadougou, Ecole Supérieure Polytechnique de la Jeunesse

8. Process of SFD development

The SFD was developed in consultation with project collaborators and local stakeholders in the field of urban sanitation in Ouagadougou. Key stakeholders were involved in several stages throughout the writing of this report. Interviews were conducted in person and by phone, depending on their availability. The stakeholders involved were: (i) ONEA: Person in charge for onsite sanitation services and for offsite sanitation services, (ii) MEA, Directorate General of Sanitation whose roles are defined in section 7, (iii) Directorate General of Statistics and Sectorial Studies responsible for the design, programming, coordination, monitoring and evaluation of development actions at sectoral level, (iv) Municipality of Ouagadougou and (v) Emptying service providers: Manual emptying association (ABASE) and Mechanical Emptying Association (AVF). Key assumptions were reviewed and confirmed by ONEA with the main stakeholder in charge of sanitation in urban areas.

10. Credibility of data

The quality of data from sources used for the SFD production was ranked high (52%) and medium (48%). Data were mainly taken from PSAO 2012-2020, the National Strategy for Wastewater and Faecal Sludge Management: Diagnostic Report (2017), different studies on faecal sludge management in Ouagadougou, updated ONEA (2018) reports and other studies. During key informant interviews, the data were triangulated through interviews, observations and knowledge of the service delivery context. Delivery context was developed through a literature review and based on a national, local policies and plans review in the sanitation sector.

9. List of data sources

ABASE. 2017. "Association Des Vidangeurs Manuels de Ouagadougou."

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SFD Ouagadougou, Burkina Faso, 2018

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Abbreviations

ACF	Action Against Hunger
ACONAZ	Community Association Namalgré-Zanga
CCEA	Municipal Committee for Water and Sanitation
CCEPA	Consultation Framework of Drinking Water Supply and Sanitation
CREPA	Regional Centre for Water and Sanitation
CRP	Regional Steering Committee
DGA	Directorate General of Sanitation
EAA	Water and Sanitation for Africa
FCFA	Franc CFA
FS	Faecal Sludge
FSM	Faecal Sludge Management
MEA	Ministry of Water and Sanitation
PN-AEP	National program- Drinking Water Supply
PN-AEUE	National Program- Wastewater and Excreta Sanitation
PN-GEA	National Program- Water and Sanitation Governance
PN-GIRE	National Program- Integrated Water Resource Management
SFD	Shit Flow Diagram
WSA	Water and Sanitation for Africa
WWTP	Wastewater Treatment Plant

1 City context

Located on the vast central plateau of Burkina Faso, the city of Ouagadougou is characterized by a set of flat lands that descend gently from south to north and by a lack of high points. The slopes are indeed weak and vary between 0.5 and 1% (Somé/Dagba Gbessin, 2010). There are no physical obstacles to the spread of the city, which is growing with a population growth of 7.6% (INSD, 2006) and the occupation of surrounding rural areas (Figure 1). Ouagadougou accounts for more than 2.7 million people in 2017 (ONEA, 2017) and the density of population is 903 persons per square kilometre (INSD, 2015).

The city of Ouagadougou rests on shallow and nutrient-poor soils. These are characterized by low infiltration and water conservation capacity. In the past, protection from possible invaders and ensuring a good water reserve guided the first occupants in the choice of this site. The capital of Burkina Faso is also located in the basin of Massili. It is crossed by four marigots from the south to the north and has a total of 4 inland dams of which three are used for the drinking water supply of the city (Somé/Dagba Gbessin 2010).

There are two cool seasons and two warm seasons during the year: (i) December to February corresponds to a relatively cool period during which average monthly temperatures range between 24 and 27°C. (ii) July to September is the second cool period, which is also wet. It corresponds to the rainy season that sets in with the arrival of the monsoon winds (fresh and moist) with temperatures varying between 27 and 29°C. (iii) March to June represents the driest and hottest period of the year. The Harmattan is gradually giving way to the monsoon. The month of April is a particularly the hot month (43°C) and (iv) October to November is the second hottest period and corresponds to the end of the rainy season. The mean annual rainfall is between 600 mm and 900mm. It is important to add that the number of rainy days has decreased and these are often very violent, favouring runoff and flooding. (Boubacar, 2013).

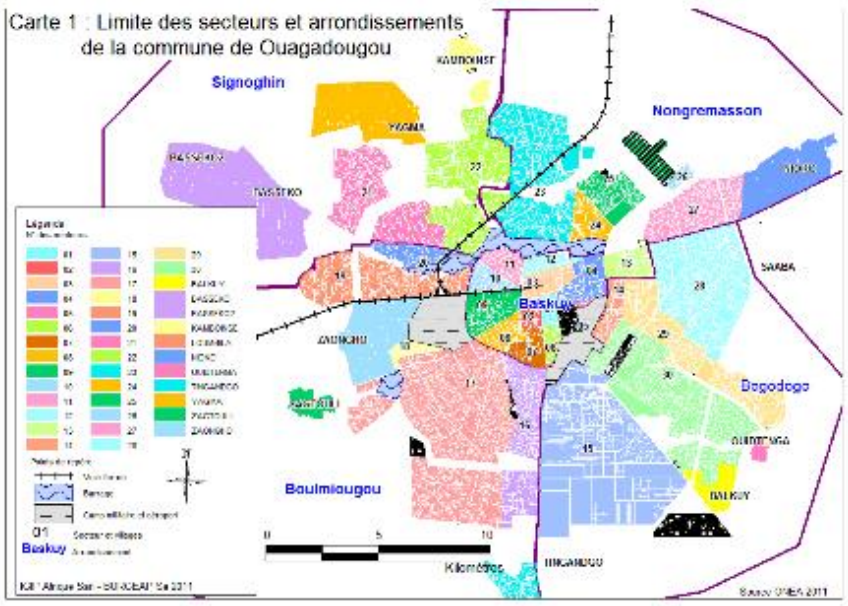

Figure 1: Ouagadougou city and municipality divisions (PSAO, 2012)

2 Service Outcomes

2.1 Overview

Ouagadougou has various technologies, services and methods used to support wastewater and faecal sludge management through the sanitation service chain (Figure 2). These include onsite and offsite sanitation systems. In the city, the offsite sanitation system is equivalent to the SFD classification referred to as “No onsite container. Toilet discharges directly to centralised combined sewer”. The septic tanks are connected to “don’t know where”. The lined pits have impermeable walls and open bottom, semi-permeable walls and open bottom which are assumed to have no outlet or overflow presenting low risk to groundwater pollution. This assumption is made according to the standards of onsite sanitation facilities promoted and constructed by ONEA (2018). However, unlined pits do present a high or significant risk to groundwater pollution. This assumption is made according to the geological and hydrogeological studies carried out by Yameogo (2008). The study of Voho (2016) shows that some households do not use sanitation facilities, which means that these practice open defecation. For details on quantitative estimations of those existing sanitation systems in the city of Ouagadougou, please refer to section “2.2 SFD Matrix”.

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					Significant risk of GW pollution Low risk of GW pollution					Not Applicable
Septic tank					Significant risk of GW pollution Low risk of GW pollution				T1A2C9	
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 T1A4C10
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										Significant risk of GW pollution Low risk of GW pollution
Pit (all types), never emptied, abandoned when full but NOT adequately covered with soil										
User interface 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 2: SFD Selection Grid for Ouagadougou

2.1.1 Offsite sanitation technologies

As part of the implementation of its strategic plan of sanitation (PSAO), the city of Ouagadougou is equipped with a low-pressure diameter sewer system (Figure 3), built for the collection and transport of wastewater to a lagoon station. It is expected that the treated water effluent from this station will be used for irrigation (PSAO, 2012; SNGFAEUE, 2017).

The Kossodo wastewater treatment plant, which comprises eight lagoons, was sized to treat a pollutant load of 6,000 kg/day of BOD5 and a volume of 5,400 m³ per day in the initial

phase. The extension of the Kossodo WWTP with five additional ponds to accommodate 11,600 m³/day was planned in the second phase that allowed the connection of 1,500 lots in the city centre. The sizing bases for calculating the pollutant load to be treated emitted by households was 40g BOD_5 load per day per inhabitant, and 72 litres per day per inhabitant volume released. In 2009, the detailed design report for the extension of the sewer network confirmed that the extension of the secondary sewer network planned in the city centre did not require an extension of the WWTP. Consequently, compared to the initial project, it is possible to densify the sewer network at the Baskuy borough and industrial zone levels, and carry out the planned extension work on the WWTP (PSAO, 2012).

The management and operation of the collective sewerage network is ensured by the management of ONEA's sanitation, including the collective sanitation service. For the moment, the management of public sewerage infrastructure carried out at Ouagadougou remains under the control of ONEA. The number of households connected to the collective network of Ouagadougou is too small (1110 or less than 0.4%) compared to the total population of Ouagadougou (ONEA, 2018).

Figure 3: Offsite sanitation network in Ouagadougou (PSAO, 2012)

2.1.2 On-site sanitation technologies

According to the National Strategy for Wastewater and Faecal Sludge Management (SNGFAEUE, 2017), the technologies for onsite sanitation management are mainly containment structures of excreta in dry or low water volume pits (unlined and lined pit latrines). The treatment process is the elimination of pathogens under anaerobic conditions and the mineralization of suspension, and in-situ storage of by-products.

In urban areas, the trend is towards the popularization of the single-pit VIP latrines (lined pits with semi-permeable walls and open bottom) by the rehabilitation of traditional latrines, followed by mechanical flush toilets or TCM (lined pits with semi-permeable walls and open bottom). The technologies used in urban areas are as follows (in order of importance): sanplat, VIP latrine with single or double pit and TCM, and Ecosan latrines. These latrines are not normally designed to be drained. But in case of emptying, these require destructive maintenance of the superstructure (SNGFAEUE, 2017). Faecal sludge from these facilities is sanitized after a few months. Their valorisation potential in agriculture is limited to soil amendments through the provision of minerals, despite low absorption capacity (SNGFAEUE, 2017).

The difficulties related to the management of these facilities are among others:

- Moving the slab for single pit latrines when the pit is full.

- High cost of double pit latrines.
- Difficulties experienced in emptying VIPs.
- Low feedback in the use of mineralized sludge experience.

The other form of onsite sanitation in Ouagadougou is septic tanks, which are commonly used in middle and high-income areas either in households, hotels, or public institutions (ministries, hospitals, etc.). In our case, the proportion of septic tanks (4.0%) reported is located in households (ONEA, 2018).

2.1.3 Shared and public toilets

The PN-AEPA implementation manual for rural areas recommends types of works for schools and communities. Several "packages" corresponding to different service levels are offered (PSAO, 2012). The dimensions of certain sanitation infrastructures have been revised to adapt to specific features of the urban area. For schools, package of sanitation infrastructures for primary schools includes: (i) 2 blocks of ventilated double pit latrines (Lined pits with semi-permeable walls and open bottom) with four cabins each: 1 block for boys and 1 block for girls with a cabin equipped for people with reduced mobility, (ii) 1 urinal for male students, (iii) 1 ventilated pit latrine block with 2 teacher stations: 1 cabin for men and 1 cabin for women, and (iv) 1 hand-washing device per block with a soak pit. Figure 4 below shows an example of a public sanitation facility constructed by ONEA.

Figure 4: Public facility constructed by ONEA

2.1.4 Toilets for community establishments

Community establishments mainly include markets, railway stations and places of worship.

The minimum package required includes the following infrastructures: (i) 2 blocks of excreta sanitation facilities with four cabins each: 1 block for men and 1 block for women with a cabin equipped for people with reduced mobility, (ii) 1 urinal for men, (iii) 1 ablution area with sump in the case of Muslim places of worship, (iv) 1 hand-washing device per block with infiltration sump (PSAO, 2012).

Depending on the geographical location of the establishment and the practices of users, excreta, sanitation facilities may be of different types: (i) Ventilated double pit latrine, (ii) Manual flush toilet, and (iii) Mechanical flush toilet connected to the collective sewer network (PSAO, 2012).

Showers for men and showers for women with a cabin equipped for people with reduced mobility are also possible in certain circumstances.

In unplanned neighbourhoods (unsettlement areas), lack of space makes it difficult to install sump bins for washing laundry. It was proposed to build community wash houses. Thus, this

type of infrastructure must be the subject to a pilot project and must be preceded by a household survey to verify the interest of households (PSAO, 2012).

2.1.5 Emptying service

The second component of the sanitation service concerns the practice of emptying which is an average of 42% for households in Ouagadougou (SNGFAEUE, 2017). In other words, almost half of the sanitation facilities are emptied.

Mechanical emptying is practiced in 77% of sanitation facilities (PSAO, 2012; Voho, 2016) which is the most common practice in urban areas (Figure 7). Manual emptying (23%), although very unhygienic, is more prevalent in semi-urban areas (Figure 5 and Figure 6). In all urban agglomerations, faecal sludge management remains a major issue and a major health and environmental concern to deal with. No indicator exists to measure and control anarchic spills and hazardous large quantities of untreated drained sludge in water bodies and free areas in the urban periphery. In addition, insufficient mechanical emptying operators and faecal sludge treatment facilities are a primary deficiency affecting the sustainability of faecal sludge management together with compliance of the principles of preserving human health and the environment. The figures below show emptying activities in Ouagadougou (Réseau Projection, AJDD/BF, and ABASE, 2016; Ikuzo Sarl, 2012).

Figure 5: Manual emptier (Reseau Projection, AJDD/BFand ABASE. 2016)

Figure 6: Manual emptier (ABASE, 2016)

Figure 7: Vacuum truck (Ikuzo sarl, 2012)

2.1.6 Transport service

The investigation carried out by Réseau Projection (2013) in Ouagadougou shows that 60% of mechanical emptiers dump at the faecal sludge treatment plant (Figure 10) and 100% of manual emptiers deposit the faecal sludge in the nature or near the households (Figure 8 and Figure 9).

The winter season has one of the highest influxes with nearly a hundred trucks daily dumping at Kossodo FSTP. During this period due to overload, the site is often closed to emptying trucks which are then obliged to either join the site of Gonsin or to deposit in the nature on the outskirts of the city exposing thus the riparian populations to health risks. Additionally, there is a rapid overload of faecal sludge at the treatment plants before the end of the planning period (SNGFAEUE, 2017).

Figure 8: Manual transport (ABASE, 2016)

Figure 9: Manual transport (Voho, 2016)

Figure 10: Vacuum trucks (Ikuzo sarl, 2012)

National Office of Water and Sanitation (ONEA) built faecal sludge treatment plants (FSTP) with the financial support of the African Development Bank and the World Bank. Actually, three over four faecal sludge treatment plants are operational in Ouagadougou within the framework of the implementation of the Strategic Plan for Sanitation in Ouagadougou.

The treatment system put in place is the non-planted drying bed type. Each bed consists of a filter mass consisting of two to three layers according to the FSTP with one layer of sand riddled and washed (0.5mm), a layer of medium gravel (5-15mm) and finally a medium gravel layer (15-25mm). The percolate is then recovered by a network collector system composed of PVC pipes and treated by a lagoon system. Only the Kossodo faecal sludge treatment plant has a pumping station discharging the percolate into the wastewater treatment plant (WWTP) located near this site for treatment. The other stations are equipped with lagoon ponds for the treatment of percolate (SNGFAEUE, 2017).

Currently, the mechanical emptiers deposit the sludge at the FSTP without paying due fees. The consultations carried out by ONEA with the operators of the municipality of Ouagadougou provide for the payment of a disposal tax of 300FCFA (0.52 US$) per m^3 at the FSTP. This amount is accepted by all stakeholders. Provisions are being made for the operationalization of the payment of this tax (SNGFAEUE, 2017).

According to the activity report of ONEA (2017), the expenses of the stations are as follows (Table 1):

Table 1: Status of the use of faecal sludge treatment plants (ONEA, 2017)

FSTP	Start of service	Capacity installed (m3/day)	Perfomance 2016 (m^3/year)			Perfomance 2017 (m^3/ 9 months)		
			Scheduled	Performed	Charge (%)	Scheduled	Performed	Charge (%)
Zagtouli	Sep-14	125	32,055	38,375	84	27,125	63,207	233
Kossodo	Sep-14	125	38,875	102,799	264	30,000	83,002	277
Gonsin	Nov-16	160	6,700	5,634	84	24,120	20,873	87
Total		410	77,630	146,808	189	81,245	167,082	206

Table 1 shows the performance of the operational Faecal Sludge Treatment plants of Ouagadougou. The performed charge is greater than the scheduled one at the Treatment plants of Kossodo and Zagtouli in 2017. This justifies the overload of treatment plants and the fact that the sites are often closed to emptying trucks which are then obliged to either join

the site of Gonsin or to deposit in the environment as explained in section 2.1.6. In addition, the information collected during the interview with ONEA (2018) states that all of the faecal sludge delivered to treatment is treated (100%).

The treatment consists of a solid fraction which is scraped on the surface of the beds after a residence time of three weeks and then dried in the sun before being stored. This dried sludge is intended to be valued in agriculture according to PSA and Study reports. However, these are currently stored on existing FSTP sites awaiting for physicochemical and microbiological analyses for the safety of the by-product (absence of pathogens and heavy metals) to be used in agriculture according to its fertilising value.

Difficulties encountered in structuring the faecal sludge management system and in the construction and operation FSTP mainly are:

- Absence of legislation directly regulating the sludge management sector;
- Current overload of FSTP due to underestimation of the daily produced load in the city of Ouagadougou. The real frequency of daily emptying was not provided during the study by the emptiers;
- Lack of knowledge of the existence of heavy metal analysis laboratories which results in the storage of dewatered sludge within the FSTP (STBV) since the start of operations;
- Quality of the filter media does not allow for the infiltration of the percolate at an optimum rate resulting in a much longer residence time of the sludge on the beds than the one planned during the studies;
- High cost of capital investment;
- Weak structure of the faecal sludge emptying market;

In perspective, the financial support of the African Development Bank (AfDB) should allow ONEA to extend the experience of Ouagadougou in accompanying the structuring of the faecal sludge management sector in other cities;

A fourth station is planned to be built in Komsilga with the financial support from the World Bank to receive sludge from the city of Ouagadougou

2.1.7 End-use/ disposal

In the city of Ouagadougou, besides the treated faecal sludge stored at the treatment plants waiting for the advanced analyses (Physico-chemical parameters and heavy metals) for agricultural purpose, two types of end-use/disposal have been developed: (i) the practices of sanitization of excreta and urine to produce agricultural fertilizers and (ii) the industrial project of faecal sludge management for biogas and electricity production (SNGFAEUE, 2017).

Practices of sanitization of excreta and urine to produce agricultural fertilizers

The ACONAZ association is one of the pioneers of the treatment for the sanitization of urine and faeces. These activities have started in 2008 with the support of CREPA (current WSA (EAA)-Burkina Faso).

After the support of WSA, the ACONAZ association also benefited from the technical support and equipment of the NGO ACF, which has been able to provide poly-tanks and a tricycle for the transport of the sanitized by-products.

Work in the sanitation site consists of (i) collection and transportation urine and faeces from production sources in the sectors of beneficiaries of EcoSan toilets to the site for hygienisation, (ii) the dumping of raw urine into poly-tanks on the one hand, and raw faeces on the display platforms present on the site, on the other and (iii) monitoring of the process of sanitization of faeces and urine.

The ACONAZ association produces annually on average:

- 27,000 litres of sanitized urine. Each can of 20 litres of sanitized urine is sold at 200 FCFA (0.35 US$); a turnover of 270,000 FCFA (470 US$) / year for sanitized urine.
- 100 to 150 bags of 50 kg of treated faeces and each bag is sold at 2,500 FCFA (4.4 US$); which amounts to a specific turnover of 520,000 FCFA to 645,000 FCFA (904.4 US$ to 1,122 US$)

Industrial project of faecal sludge management

The pilot unit for biogas production and electric power generation in Ouagadougou is an industrial project in the field of sanitation (Figure 11). It is a variant of decentralized faecal sludge management. As part of the collaboration with the Bill & Melinda Gates foundation, ONEA secured funding for the construction of a pilot unit for biogas production from faecal sludge at the FSTP of Kossodo in Ouagadougou. The overall goal of the project is to make faecal sludge service more accessible to the population with a view of enhancing the value chain of sanitation. Specific objectives include the strengthening of sewerage network in Ouagadougou, improving the access of population to energy, boosting agricultural productivity, hands-on training of local workforce and job creation.

The capacity of this unit is 400m^3/ day of faecal sludge and a production of electricity of 2,160 MWh/year. It works according to the principles of methane fermentation. Microorganisms degrade organic matter in this biological process leading to the production of various gases including mainly methane and carbon dioxide. The unit operates on a co-operating sludge digestion system to which a co-substrate is added to facilitate the process of degradation.

The unit built in Ouagadougou consists of a reception and pre-treatment of sludge (screen/ grit remover), a settling basin with a daily production capacity of 100m^3 of concentrated sludge, a reception pit for co-workers, substrates, a shredding system of co-substrates, an acidification tank, a tank for hygienisation, a Continuous Stirred-Tank Reactor (CSTR) digester, a covered lagoon for the treatment of the liquid fraction, a dehumidifier, a device desulphurizer, a gasometer, two co-generators, and one of 100KW for electrical requirements of the site and 100MW for the production of electricity to be injected on the electrical network of SONABEL. Figure 11 shows the biogas and electricity production unit in Ouagadougou (SNGFAEUE, 2017).

Figure 11: Biogas and electricity production unit in Ouagadougou (SNGFAEUE, 2017)

Characteristics of the biogas and electricity production unit are in the Table 2 (SNGFAEUE, 2017).

Table 2: Characteristics of the biogas and electricity production unit (National strategy for wastewater and faecal sludge management, 2017)

Type of digester	**Continuous Stirred Tank Reactor**
Capacity	400 m^3/day
Electric power generator	100 MW
Need of co-substrate	9 t/day
Fertilizer production	7 t/day
Electric energy	2,160 MWh/year
Cost of realization	USD 3,482,000

2.2 SFD Matrix

Ouagadougou, Kadiogo, Burkina Faso, 3 Oct 2018. SFD Level: 2 - Intermedi
Population: 2791420
Proportion of tanks: septic tanks: 100%, fully lined tanks: 100%, lined, open

System label	Pop	F3	F4	F5
System description	Proportion of population using this type of system	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
T1A2C9 Septic tank connected to 'don't know where'	4.0	42.0	60.0	100.0
T1A4C10 Lined tank with impermeable walls and open bottom, no outlet or overflow	2.0	42.0	60.0	100.0
T1A5C10 Lined pit with semi-permeable walls and open bottom, no outlet or overflow	40.0	42.0	60.0	100.0
T2A6C10 Unlined pit, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	51.0	40.0	0.0	0.0
T1B11 C7 TO C9 Open defecation	3.0			

Figure 12: SFD Matrix for Ouagadougou

The SFD matrix above (Figure 12) shows that the proportion of the population whose interface discharges directly to a centralised combined sewer is 0.4% which corresponds to 0.0%. This is because the matrix only takes into account proportions greater than 0.5% (which is rounded to 1%). All the wastewater collected through the sewer system reaches the treatment plant and is treated (ONEA, 2018).

According to SNGFAEUE (2017), about 42% of all sanitation facilities in urban areas are emptied. The study carried out by Voho (2016) shows that 77% of those facilities are mechanically emptied and 23% manually emptied. In (2013), Réseau Projection investigated dumping areas in Ouagadougou and showed that 60% of vacuum trucks dump at a Faecal Sludge Treatment Plant. During the interview with ONEA (2018), it has been confirmed that 100% of the proportion of faecal sludge delivered to treatment is treated.

The summarized sanitation technologies used in Ouagadougou together with definitions used in the SFD assessment are presented in the Table 3 (see section 2.2.1). The percentages of population using these systems are presented too. The following sections

provide more details about the percentages for each step of the sanitation chain value together with assumptions made.

2.2.1 Technologies and methods used for different sanitation systems through the sanitation service chain

Ouagadougou has offsite sanitation (sewer) facilities to which about 0.4% of households are connected (ONEA, 2018). 3% of households do not have sanitation facilities (Dah, 2013; Voho, 2016). Probably, this part of households uses neighbour sanitation facilities or practices open defecation. According to Dah (2013) and Voho (2016) studies, 97% of the population has access to sanitation facilities of which only 46.5% (about 47%) are in compliance with national sanitation standards (ONEA, 2018). These standards ensure the proper construction of sanitation facilities that are connected to sewer, lined pits, septic tanks or improved latrines (VIP, TCM...). The remaining 50.5% are assumed to be the traditional latrines (unlined pits) as shown in the Table 3. For emptying and transport (see figures in sections 2.1.5 and 2.1.6), two types of emptying and transport are: mechanical (77%) and manual emptying and transport (23%) (Voho, 2016). The faecal sludge treatment in Ouagadougou is done by non-planted dry beds described in section 2.1.6. Furthermore, 100% of faecal sludge delivered to faecal sludge treatment plant is treated (ONEA, 2018). The end-use or disposal of treated faecal sludge is described in section 2.1.7.

Table 3: Percentages of the population using the existing sanitation systems

Terminology of Sanitation system used in Ouagadougou	SFD definition	The estimated population served by the sanitation system used in Ouagadougou	Reference	Percentage of population	Percentage used for SFD graphic
Septic tank	Septic tank connected to “don’t know where”	111,657	ONEA, 2018	4.0%	4%
Lined pits	Lined tank with impermeable walls and open bottom, no outlet or overflow	50,246	ONEA,2018	1.8%	2%
Improved latrines (VIP, TCM…)	Lined pit with semi-permeable walls and open bottom, no outlet or overflow	1,125,120	ONEA, 2018	40.3%	40%
Offsite sanitation (connected to sewer network)	User interface discharges directly to a centralised combined sewer	11,100	ONEA, 2018	0.40%	0%
Traditional latrines	Unlined pit, no outlet or overflow, where there is a “significant risk’ of groundwater pollution	1,409,554	Voho, 2016	50.5%	51%
Open defecation	Open defecation	83,743	Voho, 2016 and Dah, 2013	3.0%	3%

2.2.2 Percentages of the population using those systems and services along the sanitation service chain

The calculation of the access to standardized sanitation facilities is done by ONEA. ONEA assumes that 10 people are using a sanitation facility. According to the updated data given by ONEA (2018), 46.5% of the population (about 1,298,122 out of 2,791,420 persons) use septic tanks (4%), lined tanks with impermeable walls and open bottom (1.8%), improved latrines or lined pits with semi-permeable walls and open bottom (40.3%), while 0.4% are connected to a sewer system. The 50.5% are assumed to be using traditional latrines or unlined pits.

The assumptions made were drawn from different studies and reports from Dah (2013), Voho (2016), Yameogo (2008), Réseau Projection (2013), PSAO (2012) and ONEA (2018). It has been shown that 42% of onsite sanitation facilities in urban areas are emptied (SNGFAEUE, 2017). Mechanical emptiers account for 77% and 23% for manual emptiers (Voho, 2016), while 60% of the mechanical emptiers dump at the faecal sludge treatment plant (Réseau Projection, 2013). The assumption made about faecal sludge treatment has been agreed with ONEA (2018) and the manager of the faecal sludge treatment plants. All the faecal sludge dumped at the treatment plant is treated (100%). Otherwise, manually emptied faecal sludge is dumped in directly into the environment. As shown in the Tab. 2, the charge of a faecal sludge treatment plant can exceed designed capacity, which means that when the treatment plants reach their saturation points, ONEA closes the site. In this case, 60% of the truck emptiers that dump at the treatment plant are obliged to dump in the environment (Mechanical emptiers, 2018; ONEA, 2018). All this data was used to generate the SFD graphic. The SFD includes only technologies that are used by greater or equal to 1% of the population and with flows that are greater than 1% of the total. In this case, the percentage of offsite sanitation is 0, therefore it is not included it in the selection grid. All the other percentages at all stages of the sanitation service chain are summarized in Table 4.

Table 4: Data used to generate the SFD (Voho, 2016; SNGFAEUE, 2017; ONEA, 2018; Réseau Projection, 2013)

Terminology used in Ouagadougou	SFD terminology 1	SFD terminology 2	Percentages (%)	Emptied	Emptied (%)	FS to treatment plant (%)	FS treated (%)
Sewer connection	Offsite sanitation	No onsite container. Toilet discharges directly to centralized combined sewer	0.4	N.A	-	100	100
Septic tank	Onsite sanitation	Septic tank connected to 'don't know where'	4.0	Motorised	42.0	60	100
Lined pits	Onsite sanitation	Lined tank with impermeable walls and open bottom, no outlet or overflow	1.8	Motorised	42.0	60	100
Improved latrines (VIP, TCM…)	Onsite sanitation	Lined pit with semi-permeable walls and open bottom, no outlet or overflow	40.3	Motorised and manually	42.0	60	100
Traditional latrines	Onsite sanitation	Unlined pit, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	50.5	Manually	42.0	0	-
Open defecation	Open defecation	Open defection	3.0	N.A	-	-	-

2.3 SFD graphic

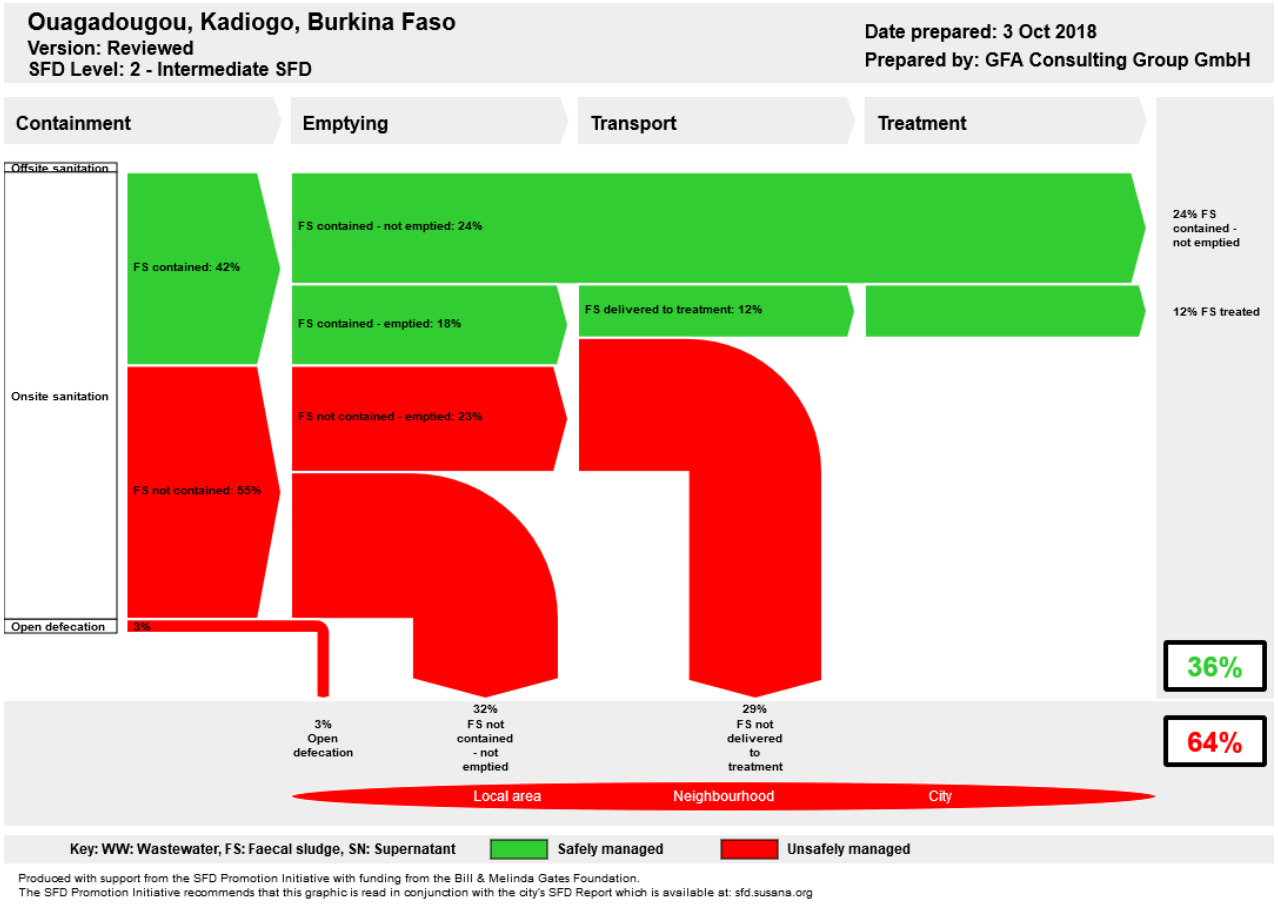

Figure 13: SFD graphic for Ouagadougou

This SFD graphic (figure 13) shows that 42% of faecal sludge is contained, in which 24% of FS is contained-not emptied and 18% is contained-emptied. In the later, 12% of FS is delivered to treatment and is treated, and 28% FS is not delivered to treatment. On the other hand, 55% is FS not contained in which 22% of FS is not contained but emptied. Globally, in Ouagadougou, 36% of FS is considered safely managed and 64% FS unsafely managed. The FS unsafely managed comprises 3% of open defecation, 33% of FS not contained and 28% of FS not delivered to treatment plant. The summarized sanitation technologies used in Ouagadougou together with definitions used in the SFD assessments are presented in Table 4 (see section 2.2.1). The percentages of population using these systems are presented too. The following sections provide more details about the percentages for each step of the sanitation chain value together with assumptions made.

2.3.1 Risk of groundwater contamination

To assess the risks posed by sanitation practices for groundwater contamination, a review of available hydrogeological studies has been carried out. Yameogo (2008) confirms that the geological observation for Ouagadougou consists essentially of granitic-dominated formations injected with vein quartz and pegmatite. At different degrees, the alteration mantle has a thickness ranging from 0 to 40 meters, and is characterized by low permeability.

Drilling cuts highlight three superimposed aquifer horizons and specify their lithological characteristics from top to bottom:

- The superficial horizons of the alterites constitute quaternary cover (grey clay, laterites, and lateritic cuirass) and fine clay arenas. As seen previously, these aquifers are highly influenced by climatic hazards and by urbanization processes, having become very vulnerable to pollution due to water contamination with shallow water tables (3 to 15 meters) (Yameogo, 2008).
- The underlying fringe, because of its dominant clay, is characterized by significant gap between porosity and relatively low permeability. When saturated, it ensures good groundwater storage capacity within the aquifer system.
- The cracked base consists of granite affected by a thickness of tens of meters with cracks decreasing with depth. This level ensures the transmissivity function and is reached by most of the drilling carried out in Ouagadougou (Yameogo, 2008).

No quantitative information about lateral separation between sanitation facilities and groundwater sources was available (PSAO, 2012). However, most of the wells in Ouagadougou are located in the most densely populated areas (generally older quarters) and those wells are used alternatively for human consumption in case of drinking water cuts from ONEA. The sanitation facilities in those areas are mostly traditional latrines (unlined pits) with a high depth of their pits (Manual emptiers, n.d), which lead us to assume that those traditional latrines are unlined pits, with no outlet or overflow, where there is a significant risk of groundwater pollution due to the presented lithological characteristics.

2.3.2 Water supply/ Water production

The studies carried out by Kajyibwami J., Ganou A. and Bagniou D. (2016) in one old quarter of Ouagadougou (Dapoya) show the percentage of drinking water provided by different technologies. 76.1% of the households receive their drinking water from ONEA distribution network, while 32.6% use public water points. 15.2% use wells as their source of water which can be used in drinking, cooking or washing and 2.2% use other sources (Figure 14).

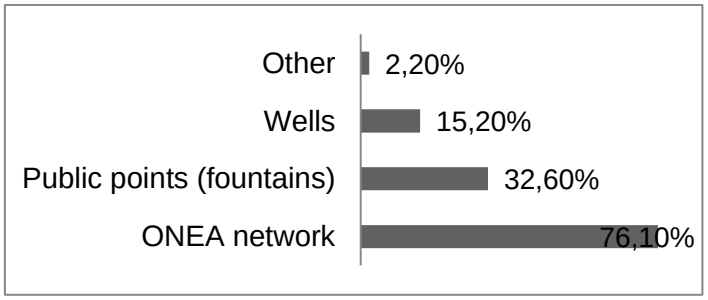

Figure 14: Source of water supply in older quarter (Dapoya) of Ouagadougou

2.3.3 Discussion of certainty/uncertainty levels of associated data used for the SFD Matrix

The main uncertainty in the data is the reliance on census data for technology types used to generate the SFD and their spatial distribution in order to estimate the percentage of the sanitation facilities with significant or low risk of groundwater pollution.

Important information about the types of sanitation facilities that influenced the outcome of the SFD diagram was obtained from ONEA (2018). For example, in terms of septic tanks and lined tanks, we have to clearly define “where does the outlet or overflow discharge to” based on the SFD methodology. In this case, we assumed that septic tanks are connected to “don’t know where” and that the lined tanks are of low risk to groundwater pollution. In addition, we assumed that all traditional latrines (unlined pits) are presenting a significant risk of groundwater contamination (see section 2.3 “SFD graphic description”).

3 Service delivery context

Burkina Faso is committed to reach the sustainable development goals (SDGs) by 2030 for universal access to drinking water and sanitation services. Moreover, the right to water and sanitation are rights enshrined in Burkina Faso's constitution since November 2015. Its supply is the sole responsibility of the Ministry of Water and Sanitation. The new National Program of Wastewater and Excreta Sanitation (PN-AEUE) for 2030 (PN-AEUE, 2016) states that every *Burkinabè* should have access to clean safe water and sanitation services according to the fixed standards.

The central government power in Burkina Faso is administered through ministries. At a local level, the power is delegated to the local government according to the general code of local authorities. In the case of Ouagadougou city, the law and institutions for the sanitation sector are the same as at for the national level. National institutions have regional offices in the city for administrating, implementing and enforcing relevant laws and policies.

3.1 Policy, legislation and regulation

3.1.1 Policy

The legal framework of wastewater and excreta sanitation is governed by a number of laws and regulations. Apart from the General Code of local authorities (CGCT), which has the purpose of marking out the prerogatives of the municipalities in the water and Sanitation sector, other texts stipulate the rights and obligations of households. In addition to provisions relating to adequate sanitation equipment, the texts advocate both the collective or individual systems of wastewater and discharge of excreta.

Constitutional law n°072-2015/ CNT revising the constitution of Burkina Faso article 18 states that: education, **drinking water and sanitation**, training, social security, housing, energy, sports, health, maternity and child protection, assistance to the elderly, people with disabilities and social cases, artistic and scientific creation constitute social and cultural rights recognized by this constitution which aims to promote these.

However, the implementing texts of this provision of the constitution are not yet available to allow an operationalization of this right.

Law No.23/94/ ADP on the Public Health code defines the rights and duties inherent in the protection and promotion of the population’s health in order to provide individuals and communities with a level of health that enables them to lead socially acceptable and economically productive lives.

In terms of sanitation of wastewater and excreta, the Code provides that in all agglomerations equipped with sewer systems, any new construction must be arranged in such a way as to lead rainwater, domestic and industrial water as well as sewage materials directly to it (article 52). However, pending the installation of offsite sanitation systems in cities, these can be equipped with on-site sanitation systems. This type of sanitation concerns all old and new buildings for residential use, offices or trading desks.

Individual sanitation must take place according to the following provisions:

- Common treatment and disposal of sewage and grey water must be made by a septic tank
- Treatment and separate evacuation of greywater must be carried out in urban perimeters using latrines with alternating and ventilated pits; and out of urban perimeters using single-pit, ventilated latrines
- Treatment and separate disposal of greywater must be carried out at the medium of an infiltration well (article 53)

3.1.2 Institutional roles

At the national level, principal Ministries intervene in sanitation. There is the Ministry of Water and Sanitation (MEA), Ministry of Environment, Green Economy and Climate Change (MEEVCC), Ministry of Health, Ministry of Habitat and Urban Planning (MHU) and Ministry of National Education and Alphabetization (MENA). The MEA is responsible for implementing national directorates and Water and Sanitation agencies. Most of these directorates and agencies have regional representatives. The following section summarizes the roles and responsibilities of each institution.

Ministry of Water and sanitation: this ministry is responsible for the preparation and implementation of policies adopted by the government of Burkina Faso in the water and Sanitation sector. This ministry supervises the General Directorate of Sanitation and National water and Sanitation Utility (ONEA). This ministry has the responsibility to set sanitation policies, implement and maintain sanitation facilities. In addition, this ministry together with the Ministry of Health and the Ministry of Environment, Green Economy and Climate Change have to prescribe mandatory rules of hygiene and ensure compliance. It shall develop and monitor the implementation of wastewater and excreta sanitation strategies and ensure compliance with sanitation standards. In this context, it works in connection with the Ministry of Environment, Green Economy and Climate change to ensure the adequate disposal of solid and liquid wastes, quality of water, air and soil.

General Directorate of Sanitation: The General Directorate of Sanitation is responsible for:

- Defining sanitation strategies, policies and pricing in urban and rural areas
- Implementation and monitoring of national policies and strategies in water, waste and excreta treatment in relation to other ministries, departments, organization of civil society and other actors
- Conducting and controlling rural sanitation programs
- Ensuring the technical supervision of ONEA

- Following with ONEA the planning, construction design and implementation of urban sanitation programs
- Monitoring the activities of companies and other private administrations involved in the sanitation sector
- Following the programs related to international organizations

The General Directorate of Sanitation has Regional Directorates. The Regional Directorate of Water and sanitation is responsible for contributing to the design, development, monitoring and follow-up, and evaluation of the implementation of policies and strategies of sanitation in their own territory. It also ensures compliance with legislation and regulation in the field of water and sanitation, and technical assistance for communal works on drinking water and sanitation.

National Water and Sanitation Utility (ONEA): ONEA was established by the decree N°85/387/ CNR/ PRES/ EAU of July 28, 1985 as a public industrial and commercial institution. It has been transformed into National society on November 2, 1994 by the decree N°94-391/ PRES/ MICM/ EAU. ONEA is responsible for the collection, treatment, recovery and disposal of wastewater and excreta in urban and semi-urban areas. In this context, the responsibilities are:

- Creation, promotion and improvement as well as management of sanitation facilities, both collective and autonomous (by individuals) for sewage and excreta disposal in urban and semi-urban areas
- Planning, design and implementation of infrastructure for wastewater and faecal sludge management
- Promotion of on-site sanitation technologies and appropriate disposal of treated sanitation by-products
- Investments into off-site sanitation systems

Regional Directorate of Water and Sanitation: this institution is responsible for contributing to the design, development, monitoring and follow-up, evaluation and implementation of sanitation policies and strategies in their own territories.

Municipality: The municipality of Ouagadougou has several sanitation-related functions. The local government of Burkina Faso has the jurisdiction to:

- Development of municipal action plans for the environment
- Protection of ground and surface water in collaboration with ONEA and General Directorate of Hydraulics Infrastructures
- Management of waste, health, pollution and nuisances

The involvement of local government in the sanitation sector is implemented through projects, programs, and cooperation with non-governmental organizations or government agencies and departments like ONEA, DGA, among others.

3.1.3 Service provision

Service providers for faecal sludge management are ONEA, Emptiers and the municipality. The municipality of Ouagadougou ensures the coordination of these services at public and private levels in collaboration with ONEA.

In total, there are more than 50 mechanical emptying companies, one association of manual emptiers with 24 members (ABASE, 2017), and more than 200 manual emptiers who work individually and informally in Ouagadougou.

3.1.4 Service standards

Standards and regulations practices have improved but are not yet recorded in official texts (decrees, circulars, etc.). This may cause issues related to its legalities in case of litigation or conflict.

In fact, the municipality does not receive or draw up guidelines or at least guides for the management of sewage and excreta sanitation in order to exercise transparency as the authority responsible for the activity.

There is also no strategy developed by municipality for emptying and transport of faecal sludge with no respective allocation of budget. However, two initiatives have been taken. One is by the ministry of water and sanitation to revise standards, criteria and indicators for access to drinking water and sanitation services. The other one is by ONEA at the operational level, as part of the faecal sludge management of Ouagadougou city.

Standards, criteria and indicators of access to drinking water and sanitation services have been developed and validated in 2016. These now include the rejection standards of the choice of treatment systems, criteria and indicators of access to services, including sludge emptying. However, the technical reference that allows approving the works is not yet developed. Joint orders for its application are pending due to the formal adoption before implementation. These constitute the basis of assessment of services by users and the various regulators.

At the general level, the regulation of the sanitation service allows for organizing and governing relations between users and operators under the supervision of the authority. These are defined as:

- Emptying and uncontrolled disposal of material from latrine pits and septic tanks are prohibited.
- Trucks recognized by ONEA (manager of faecal sludge treatment plants) and local authorities provide transportation of faecal sludge.
- Faecal sludge discharged for soil improvement may be authorized by ONEA in collaboration with the Ministry of the Environment, Green Economy and Climate Change, the Ministry of Agriculture and the Ministry of Health.

More concretely, in the context of the operationalization of sludge treatment plants of the city of Ouagadougou, ONEA undertook the structuring of the management of faecal sludge. A draft partnership agreement between ONEA and the municipality of Ouagadougou was developed in collaboration with both parties (SNGFAEUE, 2017). This convention gives ONEA the construction and operation of faecal sludge treatment plants. ONEA led the development of participatory processes with all actors. It also developed texts that regulate

the exercise of professionally emptying activities. It includes the recognition of the emptiers by issuing an authorization, conditions of protection of the workers, and the obligation to pay for unloading and depositing the emptied sludge at the treatment plant. As part of the implementation of the partnership agreement with ONEA and Ouagadougou city council, different provisions should be established by an order regulating the benefits of the mechanical emptying of the autonomous drainage works in the municipal area of Ouagadougou. This decree specifies, among other things, the types of sludge acceptable at the treatment plant and the obligations of the emptying companies (SNGFAEUE, 2017)

3.2 Planning

3.2.1 Service targets

As the updated Strategic Plan of Sanitation in Ouagadougou (PSAO) is planned for 2020, projections have been made to calculate the needs for sanitation facilities during the period 2011-2020. The estimation shows that it requires 320,000 improved latrines to be constructed so that 100% of the population has access to on-site sanitation systems. The role of ONEA, through the implementation of the PSA, is not to build all of the latrines but to build a sufficient number of latrines on the whole agglomeration to create favourable conditions for the development of a lasting “snowball effect” as stated in PSAO2012-2020.

Two scenarios were considered for the construction of on-site sanitation structures. The first scenario proposes the construction of 8,000 subsidized latrines per year; it would cover 33% of the needs by 2020 and help bring ONEA’s contribution to the rate of access to family sanitation at 25%.The second scenario proposes the construction of 12,000 subsidized latrines per year; it would cover 37% of the needs by 2020 and help bring ONEA’s contribution to the rate of access to family sanitation at 44%. This second scenario has been retained which will require a strengthening of capabilities of ONEA but which may be feasible taking into account the expertise of ONEA, adopting cheaper technologies by significantly increasing the level of household subsidy and intervening in non-lot areas.

3.2.2 Investments

According to PSAO 2012-2020, the following table recapitulates the investment provisions for the contribution to access onsite sanitation facilities. The total cost of the updated PSAO 2012-2020 is estimated at 54.028 billion of FCFA (Table 5).

Table 5: Components of onsite sanitation service and their estimated costs

Component	Total amount (FCFA)
Onsite sanitation at the level of household	33,754,760,000
Collective and semi-collective sanitation	7,691,890,000
Sanitation at the institutional level (schools)	4,303,370,000
Sanitation at the institutional level (community)	350,000,000
Legal features	713,000,000

Management of faecal sludge	7,125,000,000
Monitoring and evaluation	90,000,000
Total	**54,028,020,000**

In summary:

- ONEA will contribute 17.2% of the total cost, corresponding to 9.276 billion FCFA (contribution from the operation).
- The beneficiaries (households) will contribute 13.5% or 7.312 billion FCFA.
- The municipality will have to find funds to contribute to the financing of PSAO of up to 8.1% or 4.390 of the budget. According to the current regulations, FODEPI should finance 30% of this amount or 0.159 billion. FODEPI provides support to industrialists for the following actions: studies, training and awareness, investments in the improvement of production processes aimed at reducing the pollution load emitted, and investment in effluent pre-treatment works (separation wastewater/rainwater, flow-measuring equipment...).
- The ministry of environment, water and sanitation, agricultural and hydraulics, health, and education will have to finance the legal arrangements for 3.6% or 1.830 billion FCFA.
- Remaining 30.601 billion FCFA representing 56.6% of the total cost of the updated PSAO will be in the form of grant to seek.

3.3 Equity

3.3.1 Current choice of services for the urban poor

The choice of a technical solution for the sanitation of excreta and wastewater including faecal sludge is based on the consideration of environmental criteria, urban, socio-cultural and economics. On this basis, three sanitation zones have been defined in the municipality of Ouagadougou (PSAO, 2012): Collective sanitation, semi-collective sanitation and onsite sanitation. Additional studies in the PSAO (2012) will allow to delineate precisely these areas and to size the required sanitation systems.

- Collective sanitation is reserved for areas with specific water consumption greater than 70 l/p/d with concentrated habitat is. It is suitable for sanitation for large consumers of water and industrial units. Sewer systems are not considered appropriate for scattered households. In that case, onsite sanitation is prioritized. However, it can be considered if the soil is characterized by low permeability or if the water table is high.
- Semi-collective sanitation concerns two types of situations: (i) areas of dense housing characterized by high specific water consumption outside the influence zone of the sewerage network (cities, administrative areas, hospitals), the areas of which can be equipped with decentralized collective sanitation units, (ii) areas of dense housing of average standing (individual house with private connection (BP) in the yard for example) with insufficient space in the yard to install infiltration catch basins or where

the infiltration capacity of the soil is too low to evacuate all the greywater produced. These areas can be equipped with mixed systems composed of small diameter networks collecting wastewater and excreta. This system will be implemented in the form of pilot projects and will be managed by ONEA (PSAO, 2012).

- The areas reserved for onsite sanitation include most of the territory from the municipality of Ouagadougou. It concerns the least densely populated areas and households with low to high water consumption. The range of subsidized onsite sanitation facilities offered to households has been expanded to take into account the environmental conditions of the area and the socioeconomic criteria.

3.3.2 Plans and measures to reduce inequity

The construction of 12,000 excreta sanitation facilities per year in urban areas and 1,800 in rural area is proposed to allow for an extension of the improved onsite sanitation structures to the population. In urban areas, the turnkey construction method was chosen. A grant of 80% is offered to households. Mass campaigns will help to generate demand from households.

The onsite sanitation facilities of schools and communities will be built according to the recommendations of MEA and sanitation programs.

- Separate 4-cabin block for men and women with a cab in each block equipped for the access of persons with reduced mobility
- Urinal for men
- Hand washing device for each latrine block built
- Air ablutions for places of Muslim worship

The implementation strategy, which is based on the principle of conditionality, specifies that the construction of sanitation facilities should be linked to a pre-existing sustainable management system. At the school level, in accordance with existing policy, support will be given to facilitate the integration of emerging themes such as water, hygiene, Nutrition, Health and sanitation in school curricula through teacher training and popularization of educational guides for the education of teachers and students.

The establishment of faecal sludge management channels must be part of every program of onsite sanitation facilities construction. The pathways include the following steps: emptying pits, transport of sludge to treatment plants, sludge treatment and burial or recovery.

3.4 Outputs

3.4.1 Capacity to meet service needs, demands and targets

A calculation of the volume of sludge produced daily by 2020 was made on the basis of the specific production of sludge according to the type of sanitation facility. It appears that about 938 m^3 of sludge are to be produced daily, of which 888 m^3 will be liquid sludge to be transported to treatment plants and 40 m^3 will be hygienic sludge that can be manually handled and directly valued. Three sludge treatment plants are already operational and the fourth will be constructed (ONEA, 2017).

In order to ensure the transport of sludge to the treatment plants, it will be necessary to structure the existing and new emptying services: the mechanical emptying and the manual emptying. It would be desirable for manual emptiers to only operate hygienic sludge pellets. They should not intervene for the emptying of liquid sludge except in the case of inaccessible pits latrine and in the case of having suitable equipment.

The actions to be taken to structure the emptying services concern the following points:

- Census of mechanical and manual emptiers
- Empowerment of emptiers through a public-private partnership: provision of training (security, technical management, financial management, marketing), improvement of pumping and transport devices, and establishment of financial mechanisms to facilitate the acquisition of appropriate equipment
- Establishment of a device allowing to connect the emptiers and the households
- Establishment of legal measures to organize and regulate the transport and dumping of sludge and organizing the management of treatment plants
- Reinforcement of the complementarity between mechanical emptying and manual emptying by the creation of watertight transit pits to store the sludge drained by manual emptying machines before being taken back by tanker trucks and transported to treatment plants

3.4.2 Monitoring and reporting access to services

In the framework of PN-AEPA 2006-2015, sanitation management mechanisms varied according to the actors 'scale of action'. Framework of PN-AEUE 2016-2030 for integrated mechanism of monitoring and evaluation includes all national programs of National politics of water and sanitation (PN-GEA, PN-AEP, PN-AEUE, and PN-GIRE).

At the central or national level:

- Instances of the national finance law (national budget), single instrument, by which the national assembly votes the financial allocations to the development of the Water and sanitation sector
- Sectorial Dialogue framework
- National steering committee for the implementation of PN-AEP
- Annual reviews of the PN-AEUE to take stock of the implementation of the National program. It regroups mainly the state and its PTFs (NGO international organizations, bilateral or multilateral institutions) that support the efforts of government, resulting in the annual publication of country report
- Thematic groups namely: Governance, Drinking water Supply, sanitation, sector financing, monitoring and evaluation
- Consultation framework of drinking water and sanitation actors (CCEPA)

At the regional level, there is:

- Regional steering committee (CRP) which gave rise to a regional yearly review of program implementation. Regional reports are produced.

At the local level:

- Municipal Committee for water and sanitation (CCEA)
- Instances of the communal finance law (communal budget), single instrument, by which the municipal council decides on financial allocations for the development of water and sanitation services in the municipality

At the local level, the purpose of the monitoring and evaluation system is to verify that the implementation of the strategic plan for sanitation is carried out according to the plan and that the actions implemented lead to the expected results (SNGFAEUE, 2017).

ONEA is responsible for monitoring and evaluating the implementation of the PSAO, with active involvement of partners, particularly for the collection of data on completed. The monitoring and evaluation system includes:

- Creation of a steering committee and follow-up of the implementation of the PSAO (2012)
- Management of the database of onsite sanitation structures built at the household level. Service providers in charge of the construction of onsite sanitation facilities collect information to identify the structures and transmit this to the ONEA. It is proposed that an update of the data is performed every two years using ONEA water meter readings. In the area not served by the ONEA network, the update will be carried out by a service provider.
- Management of the database of subscribers to the collective sanitation network. ONEA will manage the subscribers but also all the data related to the control of the effluents and the performance of the WWTP.
- The selection of outcome indicators (measuring effects) that are simpler to collect than impact indicators (epidemiological data, quality of the environment) and measure the effectiveness of the strategies implemented.
- External mid-term and end-term evaluations of the implementation of the PSAO (2012)

3.5 Expansion

3.5.1 Stimulating demand for services

According to ONEA, a subsidy in kind, consisting of at least slabs (for sumps and VIP latrines), ventilation chimney shutters (for new VIP latrines and rehabilitations), a basin and siphon unit (for TMC), a door, two sheets of sheet metal (for new VIP latrines and rehabilitations) and solid bricks (for new VIP latrines and rehabilitations) is granted to households that have undertaken the construction of approved onsite sanitation infrastructure with the support of a facilitator. Trained masons are proposed for the construction of the sanitation facility with the supervision of technicians in charge of the

quality control of the works and free technical support: monitoring and control of the work by competent technicians mobilized by service providers under contract with ONEA.

Investments for sanitation infrastructure for mass uses are entirely financed by ONEA for public or community spaces such as School and community sanitation facilities.

According to the sewerage service regulations, connection to the public sewerage network is mandatory for any construction (building, residential house, commercial or office use) erected on land located in an area served by the sewer network.

3.5.2 Strengthening service provider roles

The needs in strengthening service provider roles are summarized in the Table 6 below:

Table 6: The needs in capacity building for operational actors of sanitation service chain (SNGFAEUE, 2017)

Operational actor	Capacity building needs
Households	○ Knowledge and application of operating containment facilities standards; ○ Knowledge of (potential) benefits and risks on the use of fertilizers derived from faecal sludge management; ○ Awareness to the population on the goods made from co-composts in agriculture and urban market gardening; ○ Awareness of the consumption of agricultural commodities produced with fertilizers from faecal sludge management
Communities (Regions and municipalities)	○ Development of FSM services (organization of the sector, construction and operation of FSTP, Monitoring of production of FS by-products processing, coordination, etc.); ○ Mobilization of financial and human resources; ○ Reinforcement of the material capacities of the municipality: staffing of rolling stock and protective corporal equipment of the involved staff; ○ Strengthening the human capacity of the municipalities (recruitment of experienced staff); ○ Follow-up of FS service operators; ○ Construction favourable environments to the sector; ○ Inter-municipal cooperation for the realization of a shared faecal sludge treatment plant.
Specialists for the construction of latrines, sumps, septic tanks, etc	○ Establishment of construction specifications for sanitation facilities for containment of wastewater and excreta; ○ Knowledge of how sanitation facilities do function; ○ Knowledge of techniques and approaches to construct sanitation facilities in the rule of art.
Manual emptiers and mechanical emptiers	○ Knowledge of risks related to activity; ○ Knowledge and application of standards inherent in the extraction, transport and disposal of sludge emptying; ○ Improved delivery of hygienic manual emptying; ○ Access to adapted technologies and suitable equipment for emptying full pit latrines including the most complex ones; ○ Routine maintenance of equipment; ○ Provision of efficient equipment repair services; ○ Access to finance; ○ Financial management of the activity.
Managers of FSTP and sewer system	○ Operations and maintenance of FSTP ○ Relations with customers and supervisory authorities of the quality
Farmers and vegetable	○ Knowledge of (potential) benefits and risks associated with the use of fertilizers derived from FSM; ○ Fertilizer application methods in function of soil and speculation; ○ Supports ongoing advice to facilitate, among other things, mechanisms facilitating access to low seed cost and the transport of agricultural products to sales outlets and thus reach their outlets and customers; ○ Capacity building of market gardeners so that members know how to (i) create and manage manure pits, (ii) reuse composts and manage their income;

4 Stakeholder Engagement

The Ministry of Water and Sanitation, the General Directorate of Sanitation, the National Water and Sanitation Utility and the Municipality were contacted. The project was explained, as well as the data that would be collected. Five key informant interviews were conducted on July 30th, August 2nd, 3rd, 9th, 10th, 14th, 18th, and 23rd of 2018 with principal stakeholders in relation to faecal sludge management in Ouagadougou to provide an overview of the situation of sanitation in the city.

A formal introduction letter explaining the project was sent to different sanitation services to explain the project and dataset to be collected. The five stakeholders involved were: (i) ONEA: Responsible for onsite sanitation service and offsite sanitation services, for collecting data on construction and, for the management of onsite and offsite sanitation facilities (ii) MEA: Directorate General of Sanitation whose roles are defined in section 7; (iii) Directorate General of Sectorial Studies and Statistics responsible for the design, programming, coordination, monitoring and evaluation of development actions at the sectoral level, (iv) Municipality of Ouagadougou and (v) Emptying service providers with Manual emptying association (ABASE) for information about traditional latrines, emptying, transport and Mechanical Emptying Association (AVF). Key assumptions were reviewed and confirmed by ONEA, the main stakeholder in charge of sanitation in urban areas. Very few documents were available on the internet.

5 Acknowledgements

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7 Appendix

7.1 Appendix 1: Tracking Stakeholder Engagement

The stakeholders were contacted by email, by phone and in person depending on their availability. The main outcomes were a better up-to-date understanding of the institutional framework in the sanitation sector, more accurate information on sanitation technologies and on private service providers in the sector. In addition, a better understanding was shared on faecal sludge treatment plants operations and perspectives in faecal sludge management in Ouagadougou.

7.2 Appendix 2: Stakeholder identification

Table 7: Stakeholder identification

N°	Names	Organization	Service	Contact
1	M. Sanou Tontama	ONEA	Direction of Sanitation	Tontama.sanou@oneabf.com, +22670204155
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5	M. Kabre Alassane	Municipality of Ouagadougou	Technical service	+22670813381
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7	M. Kabore Alassane	Mechanical emptiers association	president	+22670254068

7.3 Appendix 3: Typical drilling cuts with lithostratigraphic correlation