

SFD Lite Report

Narok town Kenya

This SFD Lite Report was prepared by University of Leeds

Date of production/ last update: 22/09/2022

1 The SFD Graphic

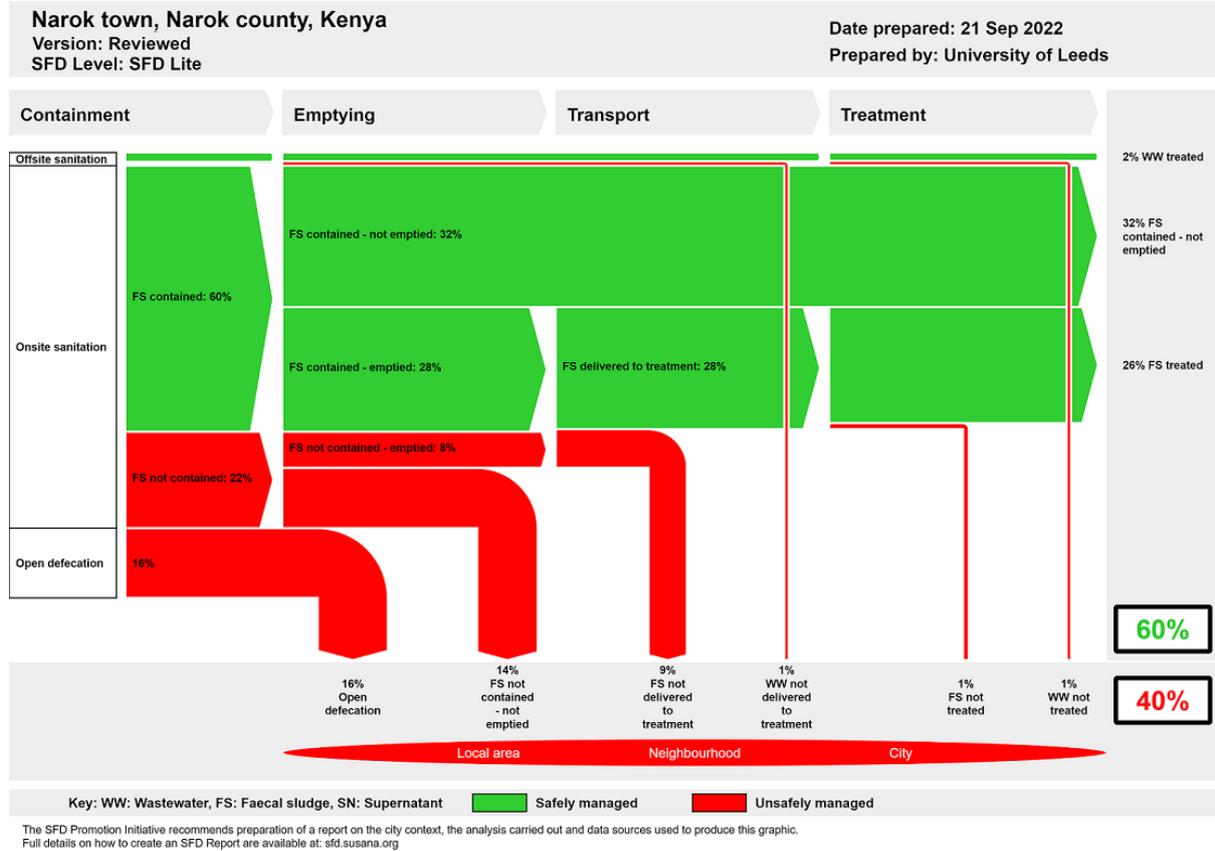


Figure 1: SFD Graphic for Narok town.

2 SFD Lite information

Produced by:

- Jin Igarashi, who is a student of MSc Water, Sanitation and Health Engineering, the University of Leeds as a part of data collection of MSc dissertation project.
- Also acknowledge the support by the Climate and Costs in Urban Sanitation (CACTUS) project team which is funded by Bill and Gates Melinda Foundation, especially insights from Prof. Barbara Evans and Dr Fiona Zakaria in the University of Leeds.

Collaborating partners:

- Narok Water and Sewerage Services Company
- SIMWAM (Wambugu) Company
- Central Rift Valley Water Works Development Agency

Date of production: 22/09/2021

3 General city information

Narok town is Narok county’s capital city which is the largest city on the way to Maasai Mara National Reserve from Nairobi. It became a municipality in October 2019 due to the rapidly growing population. Figure 2 shows the official municipality boundary and demographical data from the latest census in 2019. The municipality covers the area of Narok Township (Narok Town & Oleleshwa), Nkareta (Nkareta, Naisuya & Olopito) and part of Ololulunga ward (Ereteti & Nkoben) (Narok County, 2021). The population and the number of households are 117,609 and 31,757 respectively. The population density for the entire city is 146 persons/km², but the city centre area is 295 persons/km². Even though the boundary was changed due to having become a municipality, the population in 2009 was 42,505 (Japan International Cooperation Agency, 2012). The surprising rapid urbanization in a decade can be seen in Figure 2.

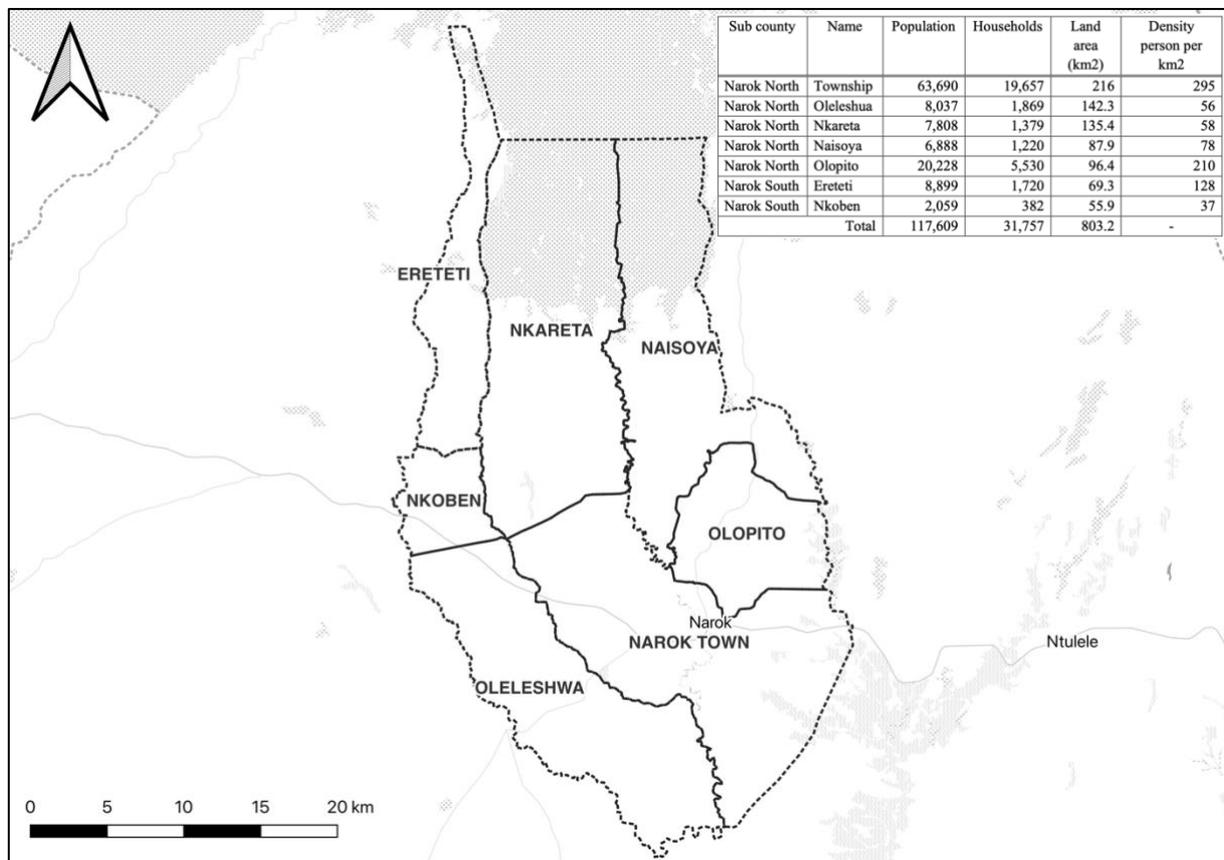


Figure 2: Official municipality boundary and sub-regional boundaries with demographical data in Narok town, Kenya (Kenya National Bureau of Statistics, 2019, pp.169-170).

The water and sanitation services are provided by Narok Water and Sewerage Services Company (NARWASSCO). They provide water supply services to 6,519 households in the city (Water Services Regulatory Board, 2021). It had no longer owned sewerage systems by 2020. However, a new sewerage system (a loaned project that cost approximately 1.5 billion Ksh (US\$ 0.012 billion)) funded by African Development Bank (AfDB) was recently constructed and handed over to NARWASSCO in 2021. The city was completely relying on on-site sanitation systems before the sewerage was constructed (Central Rift Valley Water Works Development Agency, 2022). As of June 2022, sewer connectivity is still only 260 connections, and the

transition from on-site sanitation systems to the off-site system can be a major challenge in the city.

4 Service outcomes

SFD matrix in Table 1 summarises the proportions for each sanitation system. This section overviews different sanitation systems for each stage of the sanitation value chain.

Table 1: SFD Matrix for Narok town.

Narok town, Narok county, Kenya, 21 Sep 2022. SFD Level: SFD Lite

Population: 117609

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	2.1	95.0	95.0			
T1A2C5 Septic tank connected to soak pit	6.2			60.4	76.0	95.0
T1A4C10 Lined tank with impermeable walls and open bottom, no outlet or overflow	13.5			60.4	76.0	95.0
T1A5C10 Lined pit with semi-permeable walls and open bottom, no outlet or overflow	13.5			60.4	76.0	95.0
T1A6C10 Unlined pit, no outlet or overflow	13.5			60.4	76.0	95.0
T1B0C7 to C9 Containment tanks, fully lined tanks, partially lined tanks and pits, and unlined pits) failed, damaged, collapsed or flooded - connected to water bodies, or open ground or 'don't know where'	13.5			60.4	76.0	95.0
T1B11 C7 TO C9 Open defecation	15.8					
T1B7C10 Pit (all types), never emptied but abandoned when full and covered with soil, no outlet or overflow	13.5					
T1B8C10 Pit (all types), never emptied, abandoned when full but NOT adequately covered with soil, no outlet or overflow	8.3					

4.1 Containment

It is estimated that the population directly connected to sewerage is 2.1% (T1A1C2); 6.2% of the population use a septic tank connected to a soak pit (T1A2C5); 67.7% of the population use a covered pit latrine (T1A4C10, 13.5%; T1A5C10, 13.5%; T1A6C10, 13.5%; T1B7C10, 13.5% and T1B10C7 to C9, 13.5%); and 8.3% of the population use an uncovered pit latrine (T1B8C10). The rest (15.8% of the population) practice open defecation. However, when the rainy season comes, many of the pit latrines fail and overflow. Therefore, 13.5% of the population are assumed to have damaged, collapsed, and flooded latrines (T1B7C10) which may contaminate the environment (equivalent to 20% of covered pit latrines).

4.2 Emptying and transportation

4.2.1 Sewerage system

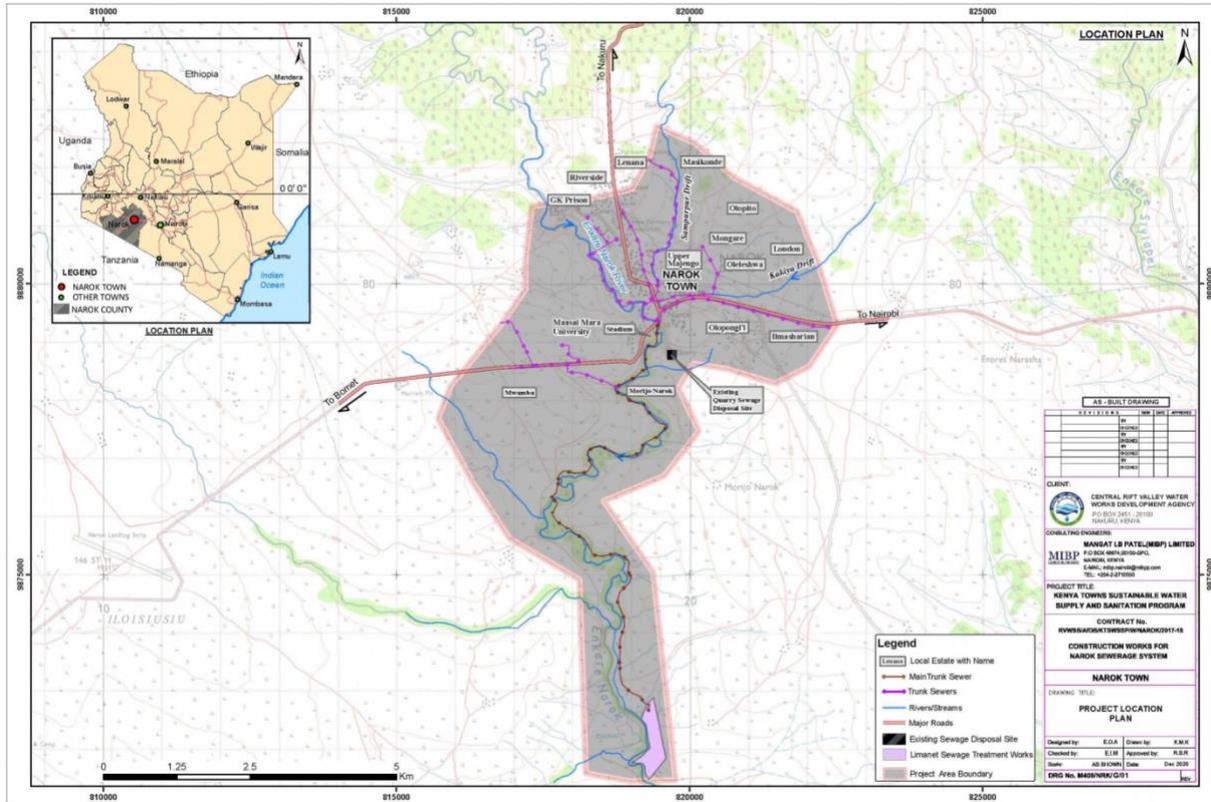


Figure 3: Location of Narok Town Sewerage Project (MIBP Consulting Engineers, 2021).



Figure 4: Left: A manhole along trunk sewer on 11 June 2022. Right: a manhole along sewer pipes (inside) on 6 June 2022.

The proportion of wastewater transported (W4a) to the sewage treatment plant is assumed as 95% because the sewerage system is still new. The AfDB project constructed conventional sewer pipelines which are 10.8 km of main trunk sewer, 14.2 km of trunk sewer and 28.7 km of secondary sewers with a gravity system in 2019 and just started their operations in 2021 (MIBP Consulting Engineers, 2021). Figure 3 shows the location of the sewer pipelines and

treatment plant in the city and Figure 4 shows a manhole on a trunk sewer and a manhole on a sewer pipe.

4.2.2 Faecal sludge management system

The proportions of faecal sludge emptied (F3), delivered to the sewage treatment plant (F4) are estimated as 60.4% and 76%. There are three mechanical emptying services providers – NARWASSCO, Wambugu and Naija. The proportions for use in the SFD matrix are estimated from interviews with NARWASSCO and Wambugu. Table 2 summarises their service coverages. NARWASSCO has two vacuum trucks (14,000L and 7,000L), Wambugu has a truck (11,000L), and Naija has a truck (unknown capacity). NARWASSCO and Wambugu serve 1,872 and 7,560 households respectively. The number of households served by Naija is estimated as 4,716 by making average between NARWASSCO and Wambugu. 14,148 out of 31,757 households can be emptied by them. However, private operators tend to dispose of faecal sludge at the manhole according to NARWASSCO. Thus, it is estimated that 76% of faecal sludge emptied by private operators is transported to the treatment plant (see section 5 and Figure 5).

Table 2: The service coverages of mechanical emptying and transporting service providers in Narok town (Source: NARWASSCO, Wambugu).

	NARWASSCO	Wambugu	Naija
Exhausting equipment	1 No. of 14,000L vacuum truck 1 No. of 7,000L vacuum truck	1 No. of 11,000L vacuum truck	1 No. of vacuum truck (unknown capacity) ³
No. of direct staff	2 drivers, 2 assistants	1 driver, 2 operators	n/a
No. of people served	7,488 ¹	22,680 ²	18,864
No. of households served	1,872	7,560	4,716 ⁴
No. of households typically share toilets	6	14	n/a
No. of people per household	4	3	4 ⁵

Notes:

1. Approximately 3 per week per truck, rainy season is normally busy. 3 x 52 weeks x 2 trucks. 1 trip = average 6 households, emptying frequency is every 6 months assumed by officials, but an average of frequency can be longer and 1 year is used.
2. Average 45 trips every month, 1 trip can serve 14 households, emptying frequency is every 3 to 4 months assumed by officials, but an average of frequency can be longer and 1 year is used.
3. Naija has a vacuum truck. But the capacity of the vehicle is unknown.
4. The number of households served by Naija was assumed by making the average between NARWASSCO and Wambugu because Naija can be the second largest exhaustor in the city.
5. Assumed four people per household from the typical number of people in an urban area in Narok town from NARWASSCO data.



Figure 5: Left: Exhausting from a soak pit on 15 June 2022. Right: At the discharge bay at Limanet sewage plant on 15 June 2022 (14,000L truck).

4.3 Treatment

The proportion of wastewater (W5a) and faecal sludge (F5) treated at the sewage treatment plant is assumed as 95% since the plant is newly constructed. Limanet sewage treatment plant is a system of water stabilisation ponds. It is situated 15km away along the road from the city centre. It consists of four anaerobic ponds as primary treatment, two facultative ponds, six maturation ponds and two drying beds, and it also has an exhaustor discharge bay to handle Faecal Sludge (FS) from on-site sanitation. The effluent is discharged into Enkare Narok River (Figure 6 and Figure 7). The designed capacity of the plant is 3,500 m³ per day which targets 2028 (MIBP Consulting Engineers, 2021). As-built drawing of the plant is illustrated in Figure 8.



Figure 6: Left: Inlet facility at sewage plant on 8 June 2022. Right: Anaerobic pond at sewage plant on 8 June 2022.



Figure 7: Left: Facultative pond at sewage plant on 8 June 2022. Right: Effluent to Enkare Narok River on 8 June 2022.

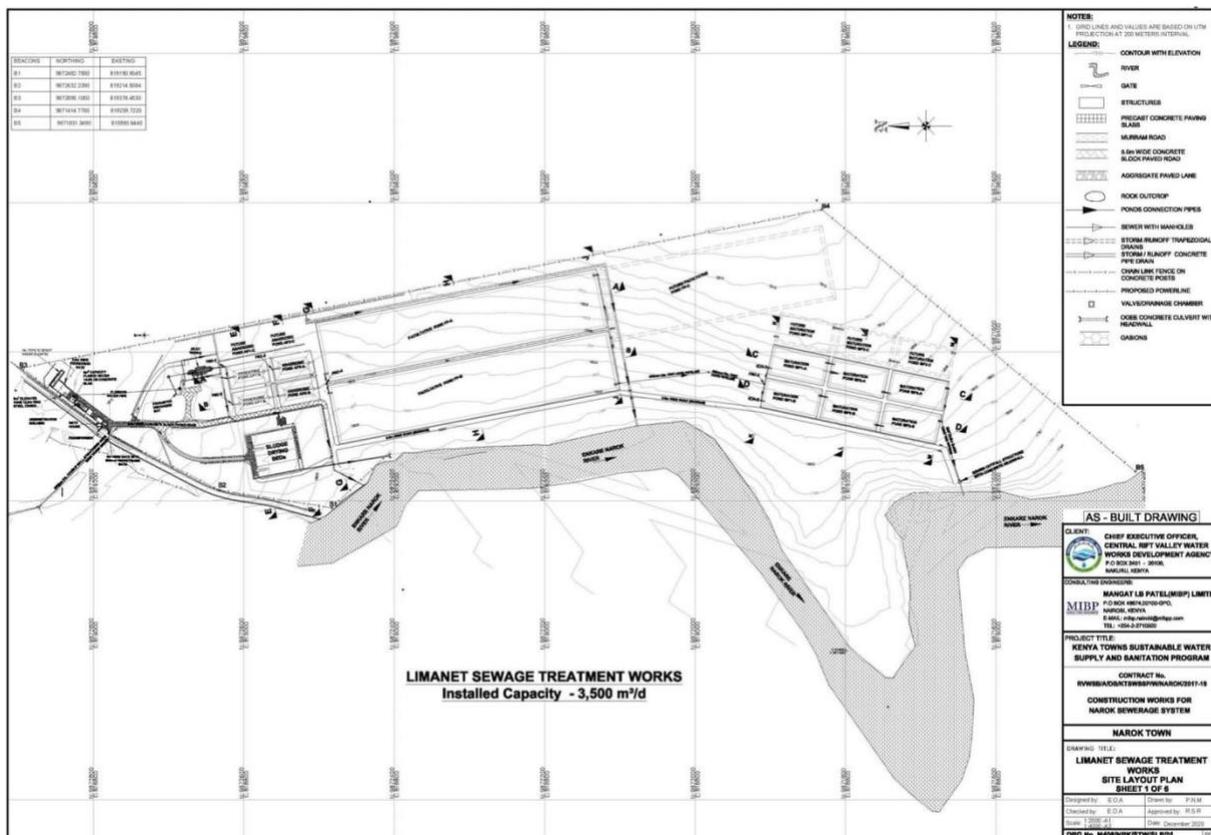


Figure 8: As-built drawing of Limanet sewage treatment works in Narok town (MIBP Consulting Engineers, 2021).

4.4 SFD Graphic

The SFD graphic (Figure 1) shows that 60% of excreta generated is safely managed and the rest (40%) is unsafely managed.

The safely managed excreta originate from FS contained - not emptied (32%), wastewater delivered to treatment and treated (2%) and FS delivered to treatment and treated (26%).

The unsafely managed excreta originate from wastewater delivered to treatment but not treated (1%), wastewater not delivered to treatment (1%), FS delivered to treatment but not treated (1%), FS not delivered to treatment (9%), FS not contained - not emptied (14%) and open defecation (16%).

4.5 Groundwater contamination

As mentioned in section 4.1, the city tends to have a problem of flooding and overflowing of faecal sludge from pit latrines during the rainy season. In this report, faecal sludge from 20% of all covered pit latrines is assumed to potentially contaminate the environment. However, since groundwater in the city is saline, very few households use the groundwater for drinking. Hence, the risk of groundwater pollution to residents' health is considered low.

5 Data and assumptions

5.1 The proportion of containment

According to the latest census in 2019 (Table 3), safely managed sanitation in the city is 1.31%, and basic sanitation and unimproved sanitation are 74.87% and 8.16% respectively. 15.75% still practice open defecation. However, this data from the census is when there was no sewage system in the city, the latest sewer connectivity needs to be applied to the census data.

Table 3: The proportion of SDG classification for each sanitation facility in Narok (Kenya National Bureau of Statistics, 2019a; Kenya National Bureau of Statistics, 2019b).

SDG classification	Mode	Households	Percentage
Safely Managed	Main sewer	417	1.31%
Basic	Bio-septic tank/Biodigester	32	0.10%
Basic	Septic Tank	1,993	6.28%
Basic	Cess pool	59	0.19%
Basic	VIP latrine	4,102	12.92%
Basic	Pit latrine covered	17,589	55.39%
	Sub-total	23,775	74.87%
Unimproved	Pit latrine uncovered	2,368	7.46%
Unimproved	Bucket latrine	222	0.70%
	Sub-total	2,590	8.16%
Open defecation	Open/Bush	5,002	15.75%

Note: The table is generated from the demographical data in the Kenyan census VOL.1 (pp.169-170) and the proportional data at sub-county level in the census VOL.4 (p.327). Each mode of sanitation facilities were classified as SDG category by the author.

Table 4 summarises the latest proportion of sanitation facilities in the city. 2.1% is estimated for sewer connection (T1A1C2). This includes an adjustment for 338 households which are assumed to connect to the sewer network, as 30% of 260 sewer connections are considered as multi-dweller connection with two households.

Table 4: The proportion for each sanitation mode after adjusting by using the current sewer connectivity data (Source: Table 3 and NARWASSCO).

Mode (Equivalent code of shit-flow diagram generator)	Households in census	Adjustment	Households after adjustment	Percentage
Main sewer (T1A1C2)	417	338	755	2.13%
Septic tank (T1A2C5)	2,084	-169	1915	6.2%
Pit latrine covered (T1A4C10, T1A5C10, T1A6C10, T1B7C10)	21,691	-169	21,522 > 17,218	67.71% > 54.17%
Pit latrine failed, damaged, flooded (T1B10 C7 to C9)	n/a	n/a	4,304	13.54%
Pit latrine uncovered (T1B8C10)	2,368	0	2,368	7.45%
Bucket latrine (T1B8C10)	222	0	222	0.70%
Open/Bush (T1B11 C7 TO C9)	5,002	0	5,002	15.74%

50% of 338 households can be reduced from both septic tank (T1A2C5) and pit latrine covered (T1A4C10, T1A5C10, T1A6C10, T1B7C10, T1B10C7 to C9) to re-calculate the latest proportion of sanitation facilities. Furthermore, 20% of households with pit latrine covered is assumed to have risk of flooded and damaged (T1B10C7 to C9). Hence, 13.5% is for T1B10C7 to C9, and 54.2% is for sharing in the rest four categories (T1A4C10, T1A5C10, T1A6C10, T1B7C10).

T1B8C10 is assumed as 8.1% by calculating the proportion of both pit latrine uncovered and bucket latrine. Open defecation (T1B11 C7 TO C9) is assumed as 15.74% from the latest census data.

5.2 The proportion of faecal sludge emptied, and proportion of faecal sludge transported to treatment

According to Table 5, 14,148 households can be emptied, and 10,803 households might be transported to the treatment plant safely in FSM.

Of which emptied = $F3 = 60.4\% (= 14,148 / (1,915 + 21,522) \times 100)$ of households are assumed to have been emptied by exhaustor trucks.

Of which transported = $F4 = 76\% (= 10,803 / 14,148 \times 100)$ of FS can be assumed to be transported to treatment.

5.3 The proportion of wastewater transported, and proportion of wastewater treated in the sewage treatment plant

In terms of the off-site system, 95% of wastewater can be assumed to be transported through sewer pipes (W4a) and treated in the treatment plant (W5a and F5) since the system is still new.

Table 5: The assumed service coverage by Limanet wastewater treatment plant in Narok town.

Operators	Component	No. of households emptied	% of transported	No. of households transported to treatment
NARWASSCO	Sewer pipes	338	100%	338
NARWASSCO	Machine-powered emptying and transporting	1,872	100%	1,872
Wambugu		7,560	70%	5,292
Naija		4,716	70%	3,301
	Total no. of households	14,486	-	10,803

Source: NARWASSCO, Wambugu and Table 2

6 List of data sources

References

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Key informant interviews (KIIs) in June 2022

- KII1, June 2022, interview with technical manager and sewer unit manager in NARWASSCO
- KII2, June 2022, interview with commercial manager and exhaustor drivers and operators in NARWASSCO,
- KII3, June 2022, interview with the manager of Wambugu

All data was collected by using the CACTUS project workbooks through the above interviews. The workbooks are downloadable from the following GitHub repository. <https://github.com/narwassco/cactus-workbooks>

SFD Narok town, Kenya, 2022

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