SFD Promotion Initiative

Domiz 1 Syrian Refugee Camp
Kurdistan Region of Iraq

Final Report

This Comprehensive SFD Report was prepared by GIZ.

Date of production: 16 July 2019

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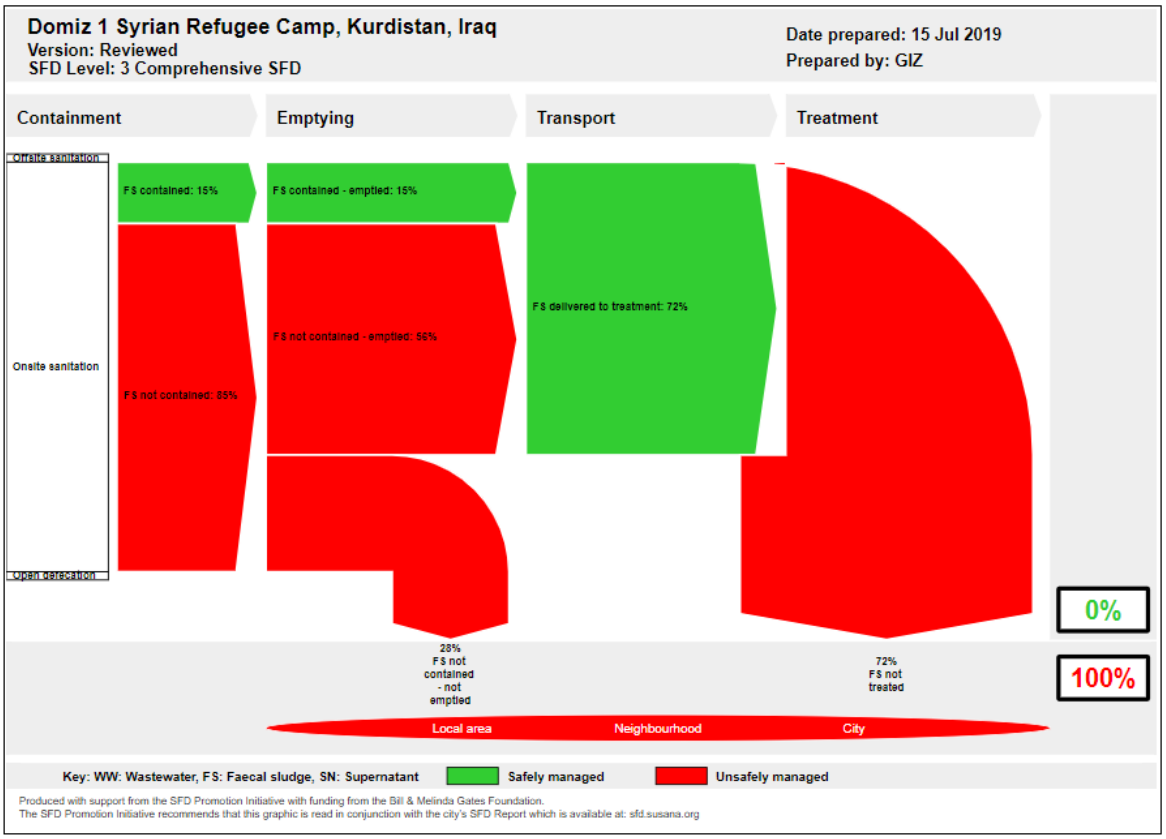
1. The Diagram



2. Diagram information

Desk or field based:

This SFD is based field work and assessments carried out in Domiz 1 camp.

Produced by:

GIZ (Martin O' Malley, who was deployed to UNHCR Duhok by RedR Australia, under funding from GIZ)

Update Input by:

In 2021 the following parties contributed key information to the review and update of this report, supporting the development of the Smart Sanitation Concept in the Duhok area: -

- GIZ
- GOPA Infra
- UPM

Status:

This is the Final SFD.

Date of production:

15/07/2019

3. General city information

Domiz 1 Syrian refugee camp is located on the outskirts of the Domiz Township, near the city of the Duhok, in the Kurdistan Region of Iraq. The camp was intended to be temporary in nature to provide shelter to those fleeing the war in Syria. Having been established in 2012 and currently being expanded and upgraded in July 2019, it is now reasonable to expect that the camp will be in place for the medium to long term.

The current registered population of the camp is 32,592 individuals. This remains relatively static, other than the 3% growth rate that has been applied. No significant population movements are known, such as for holidays.

Sanitation is provided to each shelter, with black water (toilet waste only) going into tanks that are then emptied by truck once they are full or start to overflow.

4. Service delivery context

Domiz 1 camp infrastructure development was carried out by many different agencies working under different funding and priorities and under extreme stress owing to the scale and nature of the influx. As a result of this, the camp infrastructure has a mix of different types, sizes and densities and consequently, it has varying quality across the camp.

Some infrastructural improvements have been carried out in the camp in the years since it was first established. More recently, the focus has been on reducing the ongoing operation and maintenance costs, particularly around sanitation, as the sanitation system is based on a short term design life expectancy and is labour and cost intensive.

The current sanitation infrastructure in Domiz 1 camp generally comprises of grey water and black water being separated at household level, with black water going to either holding tanks, containment pits or septic tanks. Some of the liquid entering these tanks percolates into the ground through the containment pit floor and walls and from cracks or leaks in the holding and septic tanks. Because the infiltration capacity of the soils is generally much less than the loading applied, the containment pits and holding tanks are desludged frequently.

Figure 1: Blockwork Holding Tank Domiz 1 (Source: Author, 2018)

Figure 2: Septic Tank & soak Pit, Domiz 1 (Source: Author, 2018)

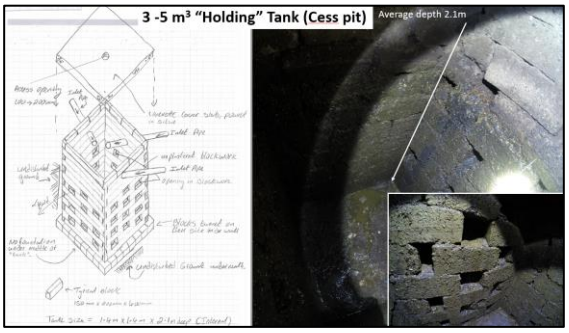


Figure 3: Permeable Holding Tank Domiz 1 (Source: Author, 2018)

Figure 4: Sealed Concrete Holding Tank Domiz 1 (Source: Author, 2018)

Grey water is directed from within to the household's into the street drainage for collection through V-shaped channels, which also collect surface run off and then deliver this through increasingly larger channels into the natural drainage, which is part of the Mosul Dam catchment area.

Figure 5: Desludging Holding Tanks Domiz 1 (Source: Author, 2018)

The desludged material is dumped into the environment without any treatment, about 2km from the camp, at a designated dumping site.

Figure 6: Desludged Material being Dumped into the Environment near Domiz 1 camp (Source: RedR Australia, 2019)

It is noted that this is exactly the same process for the host community also. In most situations in KRI, including the host community, black water is considered to be toilet water only and grey water is all of the other water outlets, including kitchen, washing, showers and laundry

5. Service outcomes

Existing service provision consists of desludging from the existing holding, septic tanks & Containment pits. There is currently a fleet of 8 trucks working in Domiz 1 and they operate 5 days a week for approximately 8 hours a day. The 8 trucks work constantly to keep up with the demand during the summer. In wintertime, the trucks are almost always behind in terms of keeping the tanks emptied as required, most probably related to inflow and infiltration of surface and ground water into the tanks.

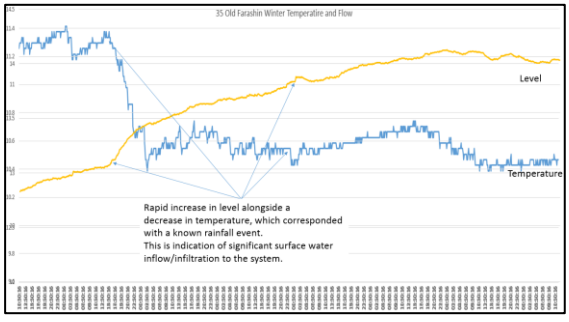


Figure 7: Monitoring of temperature and levels in tanks have shown the effect of rainfall and grey water addition to holding tanks within Domiz 1 (Source: Author, 2019)

The operational hours are restricted to 8 hours per day because there are many tanks within shelters and BRHA try to avoid disturbing people as much as possible. If one of the trucks breaks down, this then puts pressure on the others to take up the extra demand.

As a result of the black and grey water being put to ground, the risk of contamination of groundwater has always been significant and in testing of the water supply in 2017 it was found that the water had high levels of nitrogen and faecal coliforms present, indicating it is not fit for purpose. Several water bores in the camp had to be abandoned for potable water use owing to the measured contamination.

Figure 8: Grey water collection system of channels within Domiz 1 (Source: Author, 2018)

Figure 9: Grey water collection channels into the natural environment outside of Domiz 1 (Source: Author, 2018)

6. Overview of stakeholders

Domiz 1 camp is being managed and operated by an organization called the Board of Relief and Humanitarian Affairs (BRHA), which was established by the Kurdistan Regional Government to deal with camp management in refugee and IDP camps. The funding for this organization is currently coming from various humanitarian actors, UN, and NGO agencies.

The management of the camp is carried out with the support of various government departments, called Directorates.

Table 1: Domiz 1 Camp Stakeholders (Source: Author, 2019)

Key Stakeholders	Institutions / Organizations /
Public Institutions	BRHA Directorate of Municipalities Directorate of Water Outskirts Directorate of the Environment Directorate of Sewerage GIZ UNICEF UNHCR
Non-governmental Organizations	ACTED Peace Winds Japan

7. Credibility of data

Data has been collected from the field mainly, but also from discussions with various engineers and managers in Directorates and humanitarian organizations.

The collection of the data was part of a broader project looking into the issues and options for the sanitation system in Domiz 1 camp. This has been detailed more thoroughly in a report titled “Domiz 1 Syrian Refugee Camp Sanitation Assessment & Concept Options Report”, dated 04 June 2019 and prepared by RedR Australia Deployee Martin O’ Malley.

The data was collected over a 12-month monitoring period, including intensive assessments on site through, summer, winter, and the 2019 Ramadan period, in order to get a broad and thorough understand of the issues. This then facilitated the options evaluation.

While some information has been gleaned by talking to stakeholders, interested, and affected parties and refugees themselves, most of the observations are direct in terms of physical inspections on 10% of the tanks in the camps and level and temperature monitoring also carried out.

8. Process of SFD development

Development of the SFD was based on the known observations in the field on the different types of containment and desludging, as well as familiarity with the operational system over a year.

In 2020 and 2021 further work was carried out on the SFD by GOPA Infra and UPM as part of the development of the Smart Sanitation Concept funded by GIZ. This further work involved looking in more detail at the SFD production and the revising some of the inputted information to provide a more accurate graphic.

The level of confidence around the information used in compiling this SFD is high.

The SFD accurately reflects the reality of the situation on the ground.

9. List of data sources

Data sources used to produce the SFD are as follows:

- Domiz 1 Syrian Refugee Camp Sanitation Assessment & Concept Options Report, dated 04 June 2019 and prepared by RedR Australia Deployee Martin O’ Malley
- Note on mission to Duhok UNHCR office 06 - 08 March – by Kawa Yahya and Vaheel Quchan UNHCR
- Investigation the Drainage capacity (Percolation Test) of four locations in Domiz 1, Dec 2017, by Dr. Najdat S. Abdulkhaliq of University of Duhok.
- Note on mission to Duhok UNHCR Office and Duhok Construction Material Laboratory Directorate, 24 – 26 October 2017 – By Kawa Yahya
- Duhok City Wastewater and Storm Water Master Plan – by the Directorate of Sewerage, Duhok
- Domiz 1 Desludging Assessment – by UNHCR and BRHA

Table of Content

List of tables

List of figures

Abbreviations

KRI	Kurdistan Region of Iraq
KRG	Kurdistan Regional Government
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
UN	United Nations
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations International Children's Emergency Fund
GOPA	Gesellschaft für Organisation, Planung und Ausbildung mbH
UPM	Umwelt-Projekt-Management GmbH
NGO	Non-Governmental Organisation
SFD	Shit Flow Diagram, also called Excreta Flow Diagram
WASH	Water, Sanitation and Hygiene
CCCM	Camp Coordination and Camp Management
BRHA	Board of Relief and Humanitarian Affairs
CERF	Central Emergency Response Fund
HRP	Humanitarian Response Plan
KAP	Knowledge Attitudes and Practices (Survey)
BOD	Biochemical Oxygen Demand
m	Metre
m^3	Cubic Metre
l	Litre
l/p/d	Litres per person per day
km	Kilometre

1 City context

Domiz 1 Syrian Refugee Camp was established in 2012 in Duhok, Kurdistan Region of Iraq (KRI), commencing in April of that year, in response to the influx of refugees from the war in Syria. According to the camp profile on the UNHCR Operational Data Portal website[1], the population is 32,592 registered refugees, as of 25 June 2018. They advise that this figure does not include “visitors”, of which there is believed to be a significant number, though there is no current accurate assessment. Visitors to the camp are considered to be mainly relatives who live in other camps or cities and who stay for more than one night. BRHA acknowledge that they do not have reliable figures for visitors, as there is currently no way to account for them. It was also mentioned by BRHA that some of the visitors could be relations of registered refugees provided with assistance in the camp, who do not wish to register themselves, for various reasons.

The figure used for the annual growth rate in the camp is 3%, according to BRHA. They also state that overall, the camp population is currently stable, with some expansions happening from time to time, but no major increase or decrease and this would be expected to continue for the duration of the camp.

Domiz 1 camp is located approximately 18km to the southeast of Duhok city, along the Mosul-Duhok highway. The camp was created as a separate settlement from the Domiz Township; however, the township is gradually expanding towards the camp, particularly in relation to the establishment of shops and services along the access road to the camp from the township. This is confirmed by UNHCR Duhok staff familiar with the camp.

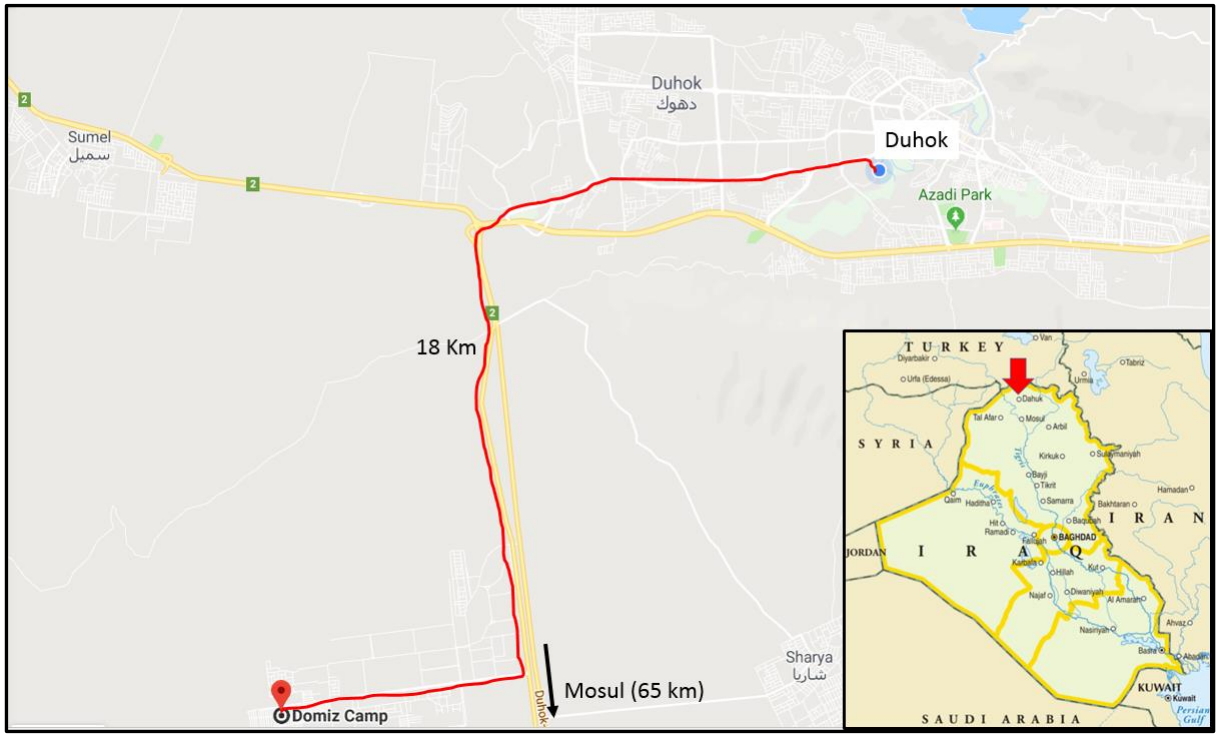


Figure 10 Location of Domiz/Duhok (Source: Author, 2019)

[1] https://data2.unhcr.org/en/documents/details/64277

The area around the camp is generally undulating, and arable farming is the main land use in the area, with one crop of wheat usually taken from the area. Some grazing also takes by roving, tended herds of mixed sheep and goat.

The soil is generally a sandy clay that overlies sandstone. The thickness of the soil layer varies, though is generally accepted as approx. 1.5m deep and the sandstone is granular until down to 5m deep, as indicated by percolation tests carried out by Dr. Najdat S. Abdulkhaliq of University of Duhok.

The climate in the area experiences some significant variations from summer to winter in terms of temperature and rainfall, as indicated in figure 10 below.

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature (°C)	5.7	7.5	11	15.7	22	27.9	31.9	31.4	27	20.5	13.7	7.6
Min. Temperature (°C)	1.2	2.5	5.5	9.6	14.8	19.6	23.3	22.6	18.3	12.8	7.8	3
Max. Temperature (°C)	10.3	12.5	16.5	21.9	29.3	36.3	40.5	40.2	35.8	28.2	19.6	12.3
Avg. Temperature (°F)	42.3	45.5	51.8	60.3	71.6	82.2	89.4	88.5	80.6	68.9	56.7	45.7
Min. Temperature (°F)	34.2	36.5	41.9	49.3	58.6	67.3	73.9	72.7	64.9	55.0	46.0	37.4
Max. Temperature (°F)	50.5	54.5	61.7	71.4	84.7	97.3	104.9	104.4	96.4	82.8	67.3	54.1
Precipitation / Rainfall (mm)	131	156	148	108	42	0	0	0	1	20	78	126

The difference in precipitation between the driest month and the wettest month is 156 mm. The average temperatures vary during the year by 26.2 °C.

Figure 11 – Duhok Weather by Month (Source: Weatheronline.com, 2019)

The undulating nature of the landscape gives rise to several sub-catchments within the camp, which influence the drainage of the sanitation system, and which will influence any future planning and infrastructure layout. Currently there are no plans to expand the camp and a process of improvement in the older sections, particularly in relation to sanitation is the only current planned works.

2 Service delivery context description/analysis

Domiz 1 Syrian refugee camp is located on the outskirts of the Domiz Township, near the city of the Duhok, in the Kurdistan Region of Iraq. The camp was intended to be temporary in nature to provide shelter to those fleeing the war in Syria. Having been established in 2012 and currently being expanded and upgraded in July 2019, UNHCR Duhok staff say that it is now reasonable to expect that the camp will be in place for the medium to long term, based on feedback from the population within the camp and also from the fact that most families are expanding their shelters and making them more sturdy and secure, presumably on the basis that they think they will be there for a further longer period.

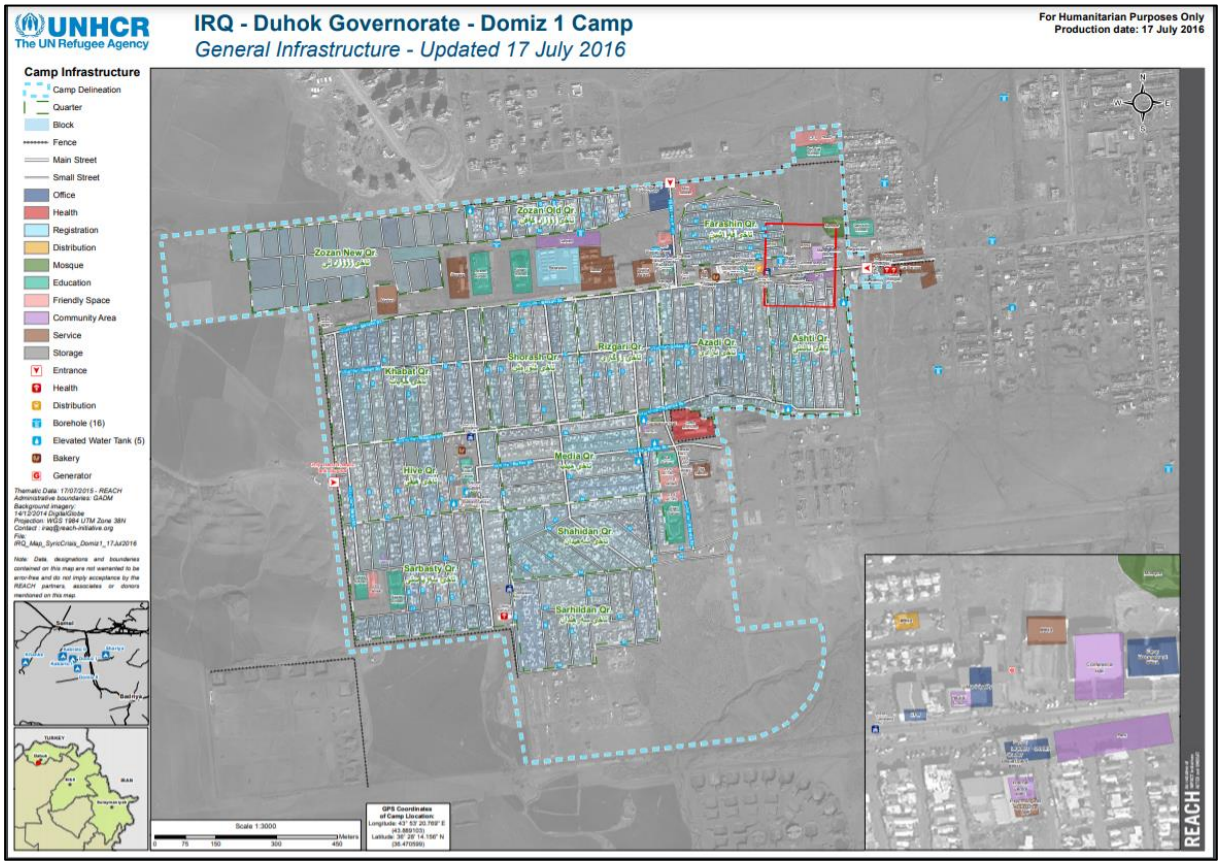


Figure 12 Domiz 1 Camp Layout Plan (Source: Reliefweb, 2019)

The camp was created away from the Domiz Township in an area of land donated by the Government, and which is outside of the area of future infrastructure master planning for the city. For the purposes of creating the SFD, the extents of the camp are clearly known and defined, and which is fenced in along the boundaries. The camp is quite densely populated for the space it occupies, owing to the smaller plot size for the shelter allocation.

The current registered population of the camp is 32,592 individuals, based on the camp profile from 25 June 2018 (There are several figures quoted from various sources, but for consistency in this report, the above referenced document will be taken as the source). This remains relatively static, other than the 3% growth rate that has been applied. No significant population movements are known, such as for holidays. Visitors do attend the site, though there is no reliable data on this.

Domiz 1 camp infrastructure development was carried out by many different agencies working under different funding and priorities and under extreme stress owing to the scale and nature of the influx. As a result of this, the camp infrastructure has a mix of different types, sizes, and densities and consequently, it has varying quality across the camp.

Some infrastructural improvements have been carried out in the camp in the years since it was first established, as it has come to be realized that there is no immediate indication of a return of the residents to Syria. More recently, the focus has been on reducing the ongoing operation and maintenance costs, particularly around sanitation, as the sanitation system is based on a short-term design life expectancy and is labour and cost intensive. From surveys of the camp population about intentions to return to Syria or not, there was the realization that Domiz 1 camp is going to be in existence for the foreseeable future. Therefore, UNHCR Duhok staff have decided to review options in relation to the short to long term operational efficiencies in the sanitation system and that was the basis of the terms of reference for seeking the deployee from RedR Australia, with a sanitation engineering background.

The current sanitation infrastructure in Domiz 1 camp generally comprises of grey water and black water being separated at household level, with black water going to either holding tanks (20-45m^3), containment pits (1-17m3) or septic tanks (17m^3). Some of the liquid entering these tanks percolates into the ground through the containment pit floor and walls and from cracks or leaks in the holding and septic tanks. Because the infiltration capacity of the soils is generally much less than the loading applied, the containment pits and holding tanks are desludged frequently, generally weekly, with the material taken to the outskirts of the camp and emptied into the natural drainage, atop a hill, about 2km to the west of the camp.

Grey water is directed from within to the households into the street drainage for collection through V-shaped channels, which also collect surface run off and then deliver this through increasingly larger channels into the natural drainage, which is part of the Mosul Dam catchment area. In most situations in KRI, including the host community, black water is considered to be toilet water only and grey water is all the other water outlets, including kitchen, washing, showers and laundry.

The Domiz 1 camp is laid out in 14 distinct residential sectors or quarters, as shown in figure 13, and within each quarter, the shelters are arranged in blocks, generally consisting of anywhere from 2 to 20 shelters. The black water tanks are arranged such that they collect waste from these blocks either through pipes connected directly from the household to the tank or through a basic collection system, with household connections joining a collector pipe through connection boxes (called manholes here). This collector pipe then connects into the tank.

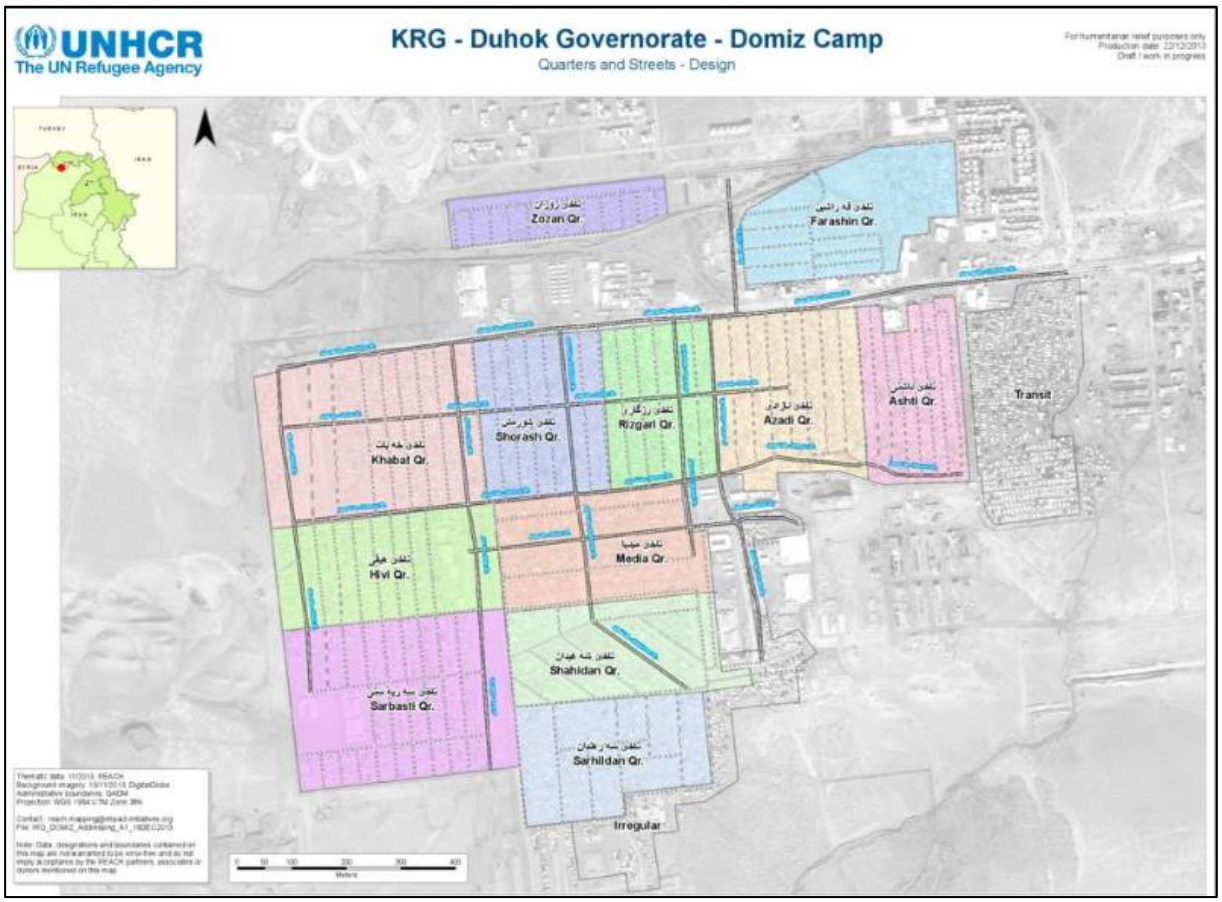


Figure 13 Domiz 1 Camp Residential Quarter Layout Plan. (At the time there were 12 Quarters, currently 14). (Source: UNHCR, 2015)

2.1 Policy, legislation, and regulation

This camp is administered under the UNHCR Codes for Shelter, WASH and CCCM. These various codes are available from the UNHCR website and are far too extensive to try to summarise here, other than to say that their intention is to provide minimum acceptable living standards to those who are defined as refugees during the emergency. Currently the camp management is done directly by BRHA, but according to the current camp manager in Domiz 1, this will be transitioning to a local NGO called the Barzani Charity Foundation in the next year. UNHCR Duhok support the camp infrastructure upgrades under their Shelter programme and UNICEF provide financial support to BRHA for the operation and maintenance of the water and sanitation systems.

2.1.1 Policy

2.1.2 Institutional roles

The Government of the hosting country has the primary responsibility for providing services to those fleeing the conflict in Syria. However, support of the humanitarian sector is brought in to assist where the hosting government identifies gaps and needs that it cannot meet. That has been the situation in KRI and, as previously mentioned, the hosting government established the BRHA to be the main agent in coordinating the response across the various sectors of health, WASH, Shelter and CCCM, with short term financial assistance and expertise being provided by the humanitarian sector in support of the government.

The sanitation system in the camp is operated and maintained by BRHA staff, through the funding from UNICEF. These staff include the drivers for the desludging trucks, various technical, supervisory, and monitoring roles to ensure that the service provision is adequate. This is also supported through the local WASH Cluster, which is chaired by BRHA.

2.2 Planning

2.2.1 Service targets

The service targets that were used when the camp was established are those from the UNHCR Emergency Handbook, as well as the internationally known SPHERE guidelines. In this context, targets are introduced through the contracting, or partnering, arrangements between donors, UN agencies and NGO's or other service providers working on the ground. A quoted example from UNHCR staff in Duhok is that UNHCR receives funding from a donor for the construction of an improvement to the camp, including sanitation, then UNHCR will partner with an NGO, who will then oversee and engage the various contractors. In the agreement between UNHCR and the NGO, there will be various targets included, based on the relevant WASH standards, in relation to the sanitation improvement.

2.2.2 Investments

Funding for the initial emergency response comes from the primary humanitarian funds, such as the Central Emergency Response Fund (CERF), various pooled funding among agencies. After the initial response a Humanitarian Response Plan (HRP) was formed and this targeted specific sectors, such as Shelter, WASH, etc. This then gave international donors the opportunity to put funding towards the various sectors, should they wish to do so.

More recently, individual donors have provided funding for the expansion of camps or the improvement in WASH/Shelter infrastructure. This has improved the living conditions within the camp by seeking to improve services. A recent example of this is funding provided by the Kuwait Fund for Arab Economic Development to UNHCR for upgrading 154 shelters in Domiz 1, including the installation of a blackwater collection system and septic tanks.

2.3 Reducing inequity

2.3.1 Plans and measures to reduce inequity

Ongoing assessments, such as KAP surveys (Knowledge Attitudes and Practices) seek to determine the level of service being provided for each of the shelters within the camp. Where issues such as overflowing water storage tanks filling up septic or holding tanks, then works to improve these are then included in the various planning and activities for humanitarian actors for the following year.

In some areas where residents have removed the ball valves from water storage tanks and these then result in overflowing septic tanks, this can affect the residents next to the containment system. Plans to improve the sanitation and water distribution system at this local level are included for the following years budget.

2.4 Outputs

2.4.1 Capacity to meet service needs, demands and targets

As with most emergency response situations, the Domiz 1 camp infrastructure struggles to cope with the demand and the peculiarities of the sanitation system installation, for various reasons already mentioned. As a result, the continual improvement is strived towards, where and when funding is available for such improvements, such as the already mentioned Kuwaiti support.

Unfortunately, one of the “self-defeating” aspects of being able to provide proper infrastructure in the camp is that there is no ability to collect operation and maintenance contributions from the residents. Therefore, the improvement of services is very much dependent on voluntary contributions from international donors. Perhaps in the future if this camp becomes an established community, then this can happen, but as long as it is under humanitarian management, it is unlikely that a tariff system will be used to improve services.

On the opposite side of the previous point is the fact that the longer that the camp is established, then the greater the expectations of the residents and authorities in terms of the quality of service to be provided. The residents themselves start to improve their shelters by extending the living space and making use of all available space on the plot, or even beside it. The authorities don’t wish to see a significant group of population living in substandard conditions, as this has the potential to create various social and economic issues later.

2.4.2 Monitoring and reporting access to services

As mentioned, various surveys are the main methodology for collecting information for monitoring of services and these are annual, at best. However, the monitoring and reporting of services in the camp is done to a level that means that most issues reported are responded to within a couple days. The hosting community in the vicinity of the camp may

not have the same level of service, as for them it is user driven in terms of calls for service and payment once the service is provided.

2.5 Expansion

2.5.1 Stimulating demand for services

As the camp population grows and expands at the projected rate of 3% annually, there will be greater demand on the services that are in place. That is the main reason why the humanitarian response is trying to get services adequately supported while funding is available, as this may not be the case later.

2.5.2 Strengthening service provider roles

This is perhaps the key area that needs to be developed going forward, as currently services are managed by or through humanitarian contributions. At some point when this funding dries up, it will be important that those in the community are able to deal with this or at least be able to support local municipalities in providing these services.

This again comes back to the ability to fund this also, so there is no easy solution to training and capacitating the community if there is no long-term ability to support. This needs to be looked at now with the various stakeholders to prevent a further burden on their systems once the humanitarian funding stops.

With humanitarian agencies receiving less funding, for a variety of reasons, both UNHCR and UNICEF local offices in Duhok have confirmed that they are looking at how the provision and management of the services will be handed over to the various local government directorates. UNICEF have advised that it is their intention to start putting funding to the local government so that they can then manage and provide the services, resulting in them having to upskill and train staff to look after the service provision. This is currently in discussion between UNICEF country representatives and the various, equivalent government authorities.

3 Service Outcomes

The sanitation service chain in Domiz 1 consists of collection/capture of waste in pour flush toilets, containment in either holding tanks, septic tanks, or lined pits. (Note: The term “tank” is the locally used term, however, most of the tanks are in fact pits with impermeable walls and open bottoms, as will be described in the following assessment description.) Emptying of the tanks is done by desludging trucks, which are based in the camp and these same trucks then transport this waste to an approved disposal site where it receives no treatment but is dumped at a designated location.

The system was originally managed through private contractors, at a cost of approximately $1million dollars per year. In 2017 UNHCR donated the desludging trucks to BRHA and the operation and maintenance of these is carried out by BRHA, with operational costs covered by UNICEF (2018).

As a result of the black and grey water being put to ground, the risk of contamination of groundwater is significant and in testing of the water supply in 2017 it was found that the water had high levels of Nitrogen and Faecal Coliforms present, indicating that it was not suitable for consumption.

3.1 Sanitation Chain Overview

3.1.1 Capture/Collection

Collection of faecal waste is via a squat toilet, which is based on the principle of using water to flush the toilet contents and providing a water seal to prevent odour from the containment system returning to the building. This collection system collects faeces, urine, water for anal cleansing and flush water, which collectively are called blackwater. Because of the diverse layout of the camp, generally in blocks of shelters, the containment system is located at the downhill end of the block and the faecal waste collection system consists of a small diameter pipe that connects the household toilet to a bigger, collector pipe that then transports the waste to either a septic tank, holding tank or lined pit.

The waste from kitchens, showers, wash hand basins and baths, called greywater, are directed into a separate system of channels, that removes this material from the camp through the natural irrigation system to the outside of the camp.

No open defection occurs in the camp, according to the camp managers, as the capture/collection systems are at household level. This wasn’t always the case and when there were communal toilets systems, there was open defecation happening in the camp.

3.1.2 Containment

As previously mentioned, grey and blackwater are separated at the shelter plots, with grey water going to open channels for surface water drainage and the blackwater goes to a containment system. In some instances, based on the assessment carried out, it is clear that the black and greywater is mixed at the household level and this wastewater then goes to the containment system. An example is washing machines discharging to the toilet.

The containment systems are generally referred to as septic tanks or holding tanks. Upon more detailed inspection in the sanitation assessment, it has been established by the author that many of these are more properly described as lined pits with semi permeable walls and open bottom, based on the SFD Users Guide. The details and sizes of the various tanks in the quarters is included in table 2, below. Note that the desludging assessment total tank numbers was outdated, as the document was no longer being updated at the time of the assessment, but the percentage representation was used for consistency.

Table 2: Containment type per quarter. (Source: Desludging Assessment, 2019)

Type of Facility	Number per quarter														
Count of Type of Facility	Column Labels														
Row Labels	Ashti	Azadi	Hivi	Khabat	Media	New Farashin	New Zozan	Old Farashin	Old Zozan	Rizgari	Sarbasti	Sarhildan	Shahidan	Shorash	Grand Total
Cesspool											1		2		3
Holding Tank	49	90	88	143	27			43	44	13	131	24	31	99	782
Holding Tank Connected in Line										62					62
Septic Tank						18	52								70
Simple Private Pit			3	3	6				15		3	6	6	14	56
Simple Shared Pit					2								1		3
Grand Total	**49**	**90**	**91**	**146**	**35**	**18**	**52**	**43**	**59**	**75**	**135**	**30**	**40**	**113**	**976**

From table 2 there are several different types of containment system. Based on the sanitation assessment, these have been shortlisted to three, as follows: -

1. Septic Tank and Soak Pit – At the time of writing there were 70 of these in Domiz 1 camp, mostly in New Farashin and New Zozan quarters. They comprise 15% of the total amount of containment systems (976). These are all 17m3 in size and are constructed from blockwork and plastered on the inside, thereby providing an internal seal. There is a partition wall in the tank that separates it into the primary and secondary chambers, with the ratio being 2:1. These tanks have a concrete base slab, as seen in figure 14. They have an outlet pipe installed slightly lower than the inlet and takes the “treated” liquid through to the soak pit where it can infiltrate through the walls of the pit into the surrounding ground. On many of the inspected tanks the outlet tee was either installed incorrectly or not installed at all, leading to solids and suspended particles passing through to the soak pit and the surrounding ground.

Figure 14: Blockwork septic tank ad soak pit, New Zozan, Domiz 1. (Source: UNHCR Duhok, 2019)

Based on the desludging assessment, most of these tanks are being desludged at least once a month on average.

2. Lined pit with no outlet and semi-permeable walls – These cover several the categories stated in table 2, including cesspool, holding tank, holding tank in line, simple private pit, and simple shared pit. At the time of writing there were 863 of these in Domiz 1 camp, in 12 of the 14 quarters, comprising 70% of the total amount of containment systems (976). They vary in size anywhere from 1m^3 or 17m^3 total volume. Because of the construction, as shown in figure 15, they are more accurately described as a lined pit with semi-permeable walls and no base. The intention of this containment system is to let as much liquid as possible infiltrate into the ground, through the permeable walls and the open bottom. The system requires regular desludging, between two and four times per month, as with up to twenty households connected to them, there is more liquid being added than what usually can infiltrate into the ground, particularly where grey and blackwater are mixed. This infiltration reduces the amount of desludging that must happen, thereby minimising the cost, but that does create a potential risk for groundwater.

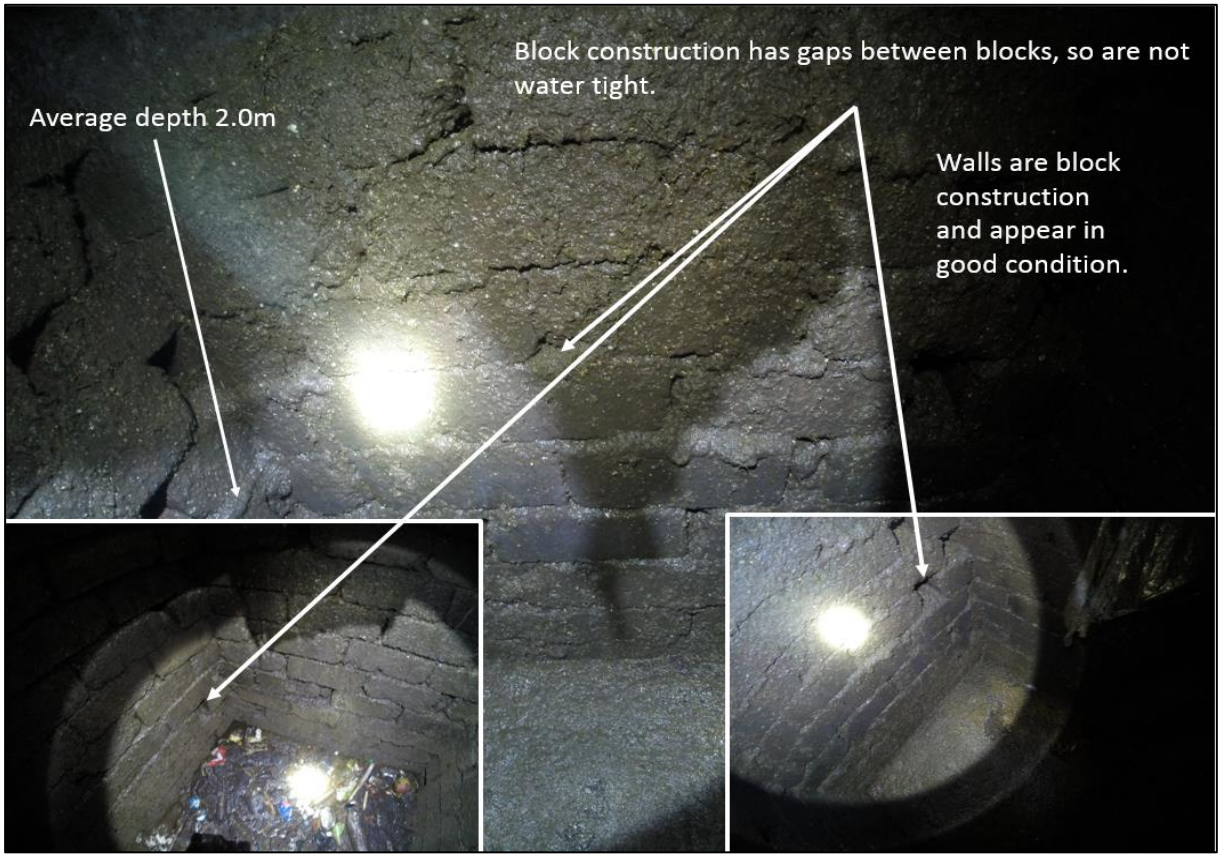


Figure 15: Lined pit with semi permeable walls and open bottom, Domiz 1. (Source: Author, 2019)

3. Holding tank – There are many tanks in Domiz 1 camp that are described as holding tanks, but for the purposes of this report, the only ones considered to be proper holding tanks are the ones constructed entirely from reinforced concrete, including the base. There are 96 of these in total, ranging in size from 20m^3 to 45m^3. The desludging assessment is missing information on some of these tanks relating to how many houses are connected, but it was

agreed with the camp management staff that a figure of approximately 15% of the camp residents are served by this type of containment system.

As mentioned, construction is by reinforced concrete, as indicated in figure 16 below.

Figure 16: Concrete holding tank, considered fully sealed. (Source: UNHCR Duhok, 2019)

As a result of the black and grey water being put to ground, the risk of contamination of groundwater is significant and in testing of the water supply in Domiz 1 camp in 2017 it was found that the water had high levels of Nitrogen and Faecal Coliforms present, indicating that the water is not fit for drinking.

3.1.3 Emptying

This is carried out by eight 10,000l vacuum trucks, provided by UNHCR in 2017, according to UNHCR Duhok staff in 2019. This same type of trucks can also be provided by private contractors, where needed, for extra capacity or to cover breakdown of the dedicated trucks according to the camp management staff. These staff monitor the various containment systems within the camp and direct the desludging service to the various locations when it is required to prevent overflow. Their knowledge of when the systems need to be desludged is gained through firsthand experience of walking around the camps or from calls from residents who live beside the containment systems and see that they are full.

The operational hours are restricted to eight hours because there are many tanks within shelters and BRHA try to avoid disturbing people as much as possible. If one of the trucks breaks down, this then puts pressure on the others to take up the extra demand.

The vacuum trucks have a flexible suction hose that is inserted into the containment pit in order to vacuum the faecal sludge (FS) out. There is difficulty in completely emptying the pit, owing to the narrow opening in the roof slab and the flexible hose, which often results in solids being left in the corners of the pit, away from the opening in the roof slab. For any of

the tanks that are larger than 8.5m^3, they are not fully emptied each time as the drivers only remove the volume of the truck from each of the containment systems, as mentioned in the assessment. The tank volumes in Domiz 1 are between 1 and 45m^3.

3.1.4 Transportation

The same vehicles that are used for emptying the onsite containment systems are also used for transporting the FS to the discharge site. The fleet of eight trucks working in Domiz 1 operate five days a week for approximately eight hours a day. The eight trucks work constantly to keep up with the demand during the summer. According to the BRHA sanitation monitor, in wintertime, the trucks are almost always behind in terms of keeping the tanks emptied as required, most probably related to inflow and infiltration of surface and ground water into the tanks.

The operational times are restricted to eight hours because there are many tanks within shelter boundaries and BRHA try to avoid disturbing people as much as possible. If one of the trucks breaks down, this then puts pressure on the others to take up the extra demand.

3.1.5 Treatment

At the time of this SFD being compiled, there was no treatment occurring on any of the material being desludged, it was being taken to a designated dumping location. However, in 2019 GIZ funded the design and construction of a wastewater treatment plant (WWTP) near Domiz 2 camp, and this was close to being finished construction at the time of writing. The treatment process is Waste Stabilisation Ponds (WSP), which is a passive system, using a series of ponds, as indicated in figure 9 below, to do the treatment.

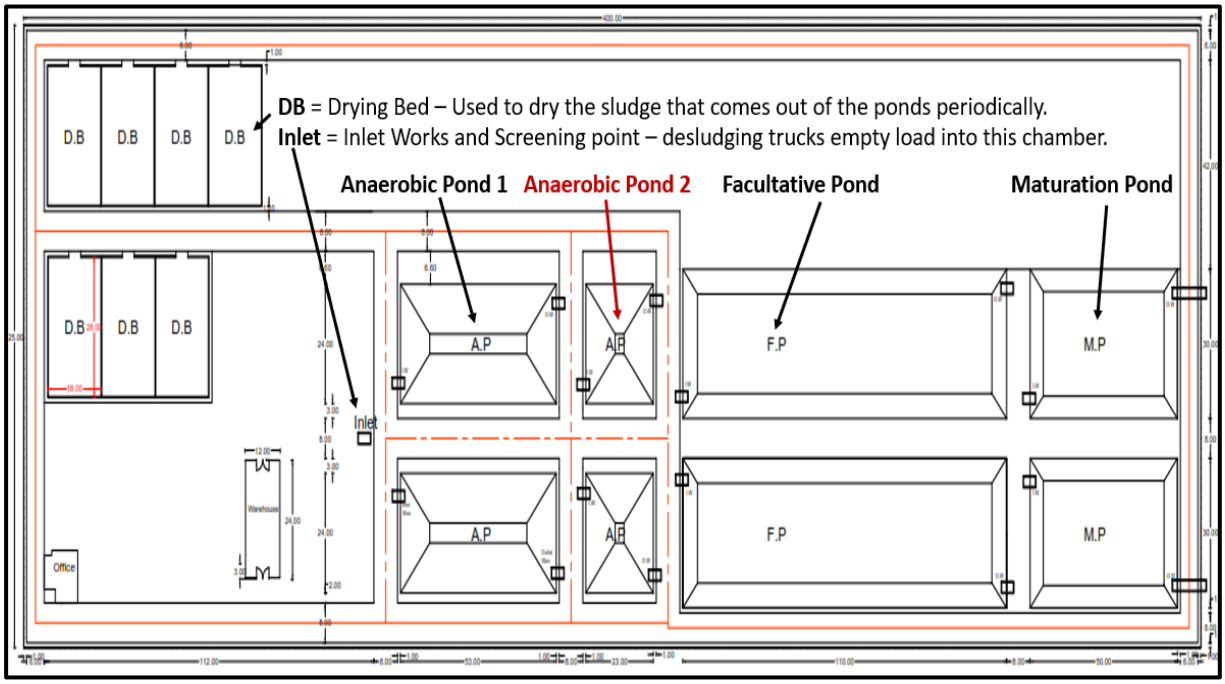


Figure 17: Waste Stabilisation Ponds Layout (Source: Dr Nashwan Shawkat)

The following description on the system is based on the operational plant in 2021, but the SFD diagram has not been amended, as no treatment was occurring at the time of the original writing. The plant was commissioned and began operating in January 2020.

Treatment is carried out as the faecal sludge travels through the series of ponds, starting with initial screening, to remove any large solids. The first ponds are anaerobic, followed by a facultative and maturation pond, that are aerobic in nature. The sludge that settles out in the anaerobic ponds is removed by pump to the drying beds when the sludge level in the ponds builds up past an established operational point and starts to impede the treatment capacity, through diminished treatment time.

Apart from the sludge pumps, the process is entirely passive (not requiring mechanical or electrical assistance), with the flow moving through the ponds, receiving treatment at each stage and the final effluent is then discharged into a wadi beside the pond's location. It is intended that at some point, when the treated effluent is at an acceptable level, the final effluent can be used for irrigation in the surrounding area. This would add a final stage of treatment, where the nutrients in the treated effluent would be taken up by the soil and plants and therefore using them beneficially.

3.1.6 Disposal/Reuse

As mentioned, the greywater disposal is to the wadi and on through the natural drainage, which eventually drains into the Mosul Dam. The blackwater is being discharged to a designated dumping location, which also flows into the natural drainage channels towards the dam.

Because the blackwater in the containment system does not stay for very long and thicken over time, it was previously described to the author by local UNHCR Duhok staff that this material was not liked by farmers for spreading on the land as it did not have the same qualities as material that thickens and breaks down over time in the pits, which reportedly provides a better fertilizer. This information was advised during the sanitation assessment in Domiz 1 and was confirmed camp management team during discussions in the field.

3.2 Containment System Assessment

UNHCR Duhok wanted to carry out an assessment on the sanitation system in Domiz 1 to then use this information as the basis to have all stakeholders agreed on the sanitation issues. Once agreement on the problem was achieved, options for the improvement of the sanitation conditions were to be evaluated with the stakeholders to arrive at an agreed approach on improving the sanitation conditions in Domiz 1. The following is the description of the sanitation assessment, which provides a detailed analysis of the containment systems, which are estimated to number at 1,050 in the camp, compared to the figure of 976 in the desludging assessment, as already explained.

3.2.1 Assessment Methodology

The assessment had four main components: -

- Physical inspection of the selected tanks. This involved the following: -
  - Review of the desludging assessment document to determine the frequency of the desludging compared with the number of users. (Frequently desludged tanks indicate an issue compared to tanks of the same size that are less frequently emptied and these were the priority for inspection.) The desludging assessment is a spreadsheet detailing the

individual containment systems in the camp and is maintained by the BRHA sanitation monitor, which was created by UNHCR Duhok staff.

- Emptying of the tank with a desludging truck and inspection of the internal structure of the tank using a camera and artificial lighting to observe structure condition and any evidence of leakage, in or out of the tank.
- Inspection of how the nearest households interact with the tank. For example, how close are the shelter walls to the edge of the tank, has access to the tank been restricted, etc.

- Inspection of the tank lid and surrounding ground to see how surface water interacts with the tank.
- Wastewater level monitoring in tanks. Level/temperature monitors were installed in some of the tanks that were inspected. These sensors measure the rise in level over time and the corresponding temperature of the black water in the tank over time. Having physically measured the internal area of each tank, it was possible to determine the flow rate into the tank based on the level increase.
- Characterisation of the black water through sampling of the material flowing to the tanks, but prior to it entering the tanks. The results were then compared with other testing being done by others from the tanks, as well as some historic testing done by UNHCR in 2016, also from the tanks and desludging trucks.

3.2.2 Selection of Assessment Locations

As previously mentioned, the desludging assessment for Domiz 1 was used as the basis for the sanitation assessment as the reference tool for selecting the tanks to be inspected. This process covered all the quarters in the camp, with all the different types of holding tanks, containment pits and septic tanks being represented in the assessment.

Initially it was intended to assess 10% of the total number of tanks within the camp, but this would depend on the assessment findings and whether there was a lot of repetition and whether there was value in continuing with the assessments after a broad base had been established. Ultimately 78 tanks out of the estimated 1,050 were inspected, as it was found that the various types of tanks were similar in construction and condition.

Each tank needed to be desludged to carry out the assessment and initially the intention was to use the list highlighted, however, this meant that the desludging trucks needed to be diverted from their programme to do this. Early in the assessment it became apparent that this created a drain on the desludging resources and therefore it was decided to go to tanks that had been emptied in the preceding days, as close as possible to the areas that were intended to be inspected. In total 78 tanks were physically inspected through the assessment period.

3.2.3 Assessment Findings

The detailed field assessments started in August 2018 and continued through to October for the initial deployment, but then went through the winter period in Domiz 1 after extension of the deployment was agreed from November 2018 to May 2019. Where possible, BRHA technical staff were involved in the assessments, to keep them aware of the findings, however this wasn’t always possible. All information that was collected during the assessments has been shared with the technical staff in Domiz 1.

The findings of the assessment can be summarised as follows:

1. No community mobilisation is ongoing in the camp in relation to the various services provided, such as overuse of water or mixing of grey and black water. To date, messaging has occurred on specific occasions to address issues, such as grey/black water mixing at the household level, rather than occurring on an ongoing basis through community outreach. Some of the camp technical staff feel that this should be ongoing.
2. Most of the underground structures inspected cannot be called tanks in the proper sense of the word. All of these are leaking to some degree and most of the older ones (pre-2016) that are called holding tanks should properly be termed as containment pits, as they are built such that liquid can percolate out of them. While some treatment will undoubtedly happen, such as reduction in solids and BOD, it does not allow treatment to take place through retention time, quiescent flow and solids and scum separation. These tanks usually have no base slab, and the walls are founded on blocks placed sideways on the excavated ground. The block walls are constructed with openings between the blocks to allow liquid escape. The tanks that are constructed as septic tanks have got a concrete base in place, usually with starter bars on the corners to allow columns to be tied to the base. The walls are constructed from block, but from one photo observed, it appears that in the newer constructed tanks, there are also ring beams placed around halfway on the height. From level monitoring carried out it appears that these tanks are also leaking very badly and acting similarly to the containment pits.
3. Desludging is carried out as follows in Domiz 1 camp, according to Imad from BRHA Camp Management technical staff: -
    a. 8 trucks in total operating in Domiz 1.
    b. Each truck 10m^3 capacity, but never filled more than 8.5m^3, according to source
    c. Each truck does 6 trips per day, including filling and emptying at desludging site.
    d. Trucks start after 8.30am because of the preference not to disturb families sleeping.
    e. 8.5 m3 x 6 trips =51m^3/truck/day
    f. 8 trucks then = 8 x 51m^3/day = 408m3/day
    g. Over five days this = 5 x 408m^3/day = 2,040m^3/week.
4. While carrying out the field assessment, a key piece of information relating to the desludging assessment records became apparent and was confirmed by the BRHA representative, was that the trucks do not fully empty any tanks that have a capacity of more than the truck, which is 10m3, though they say that the truck is never filled beyond 8.5m3. This equates to approximately 60% of the 1,050 tanks in the camp. In the desludging assessments where calculations have been made, based on the volume of the tanks multiplied by the desludging number per month is not correct. The operator's usually only take one truck load from any given tank and then move onto the next one. Therefore, this needs to be considered in all of the larger tank volume calculations.
5. Almost of all the tanks observed have had some form of shelter development over them. This varies in form from gardens planted on top of the tank lid, to shelter

expansion and walls being built over them to the tank cover being used as part of the shelter open area. In all cases this development causes operational issues, such as the following: -

a. Walls built over the tanks are likely to add pressure and cause structural issues in the future, particularly if further levels are added to the shelter. Changing moisture content in the ground may cause issues with existing structures in some places. This raises some hypothetical considerations for the long term:
    i. Are there liability issues for camp management, if they have allowed this expansion to happen over the tank and then it collapses?
    ii. Conversely, will people who damage the tanks through such construction be held accountable? Will they be sanctioned and if so, how?
b. Restricted access to the tanks for care and maintenance and even for desludging in some cases. Instances of the tank desludging access being inside the shelter are frequent, meaning that the desludging pipe must be given access through the front door, and this can result in liquids being leaked or dropped inside the shelter when the hose is being removed.
c. The ability to inspect the tanks is severely restricted in some cases where the tank is buried and only a small diameter (150mm) pipe is all that is left protruding to the ground surface.
d. In several cases water storage tanks and hot water cylinders are placed on top of the tank slab, beside the access pipe. While it may be unlikely that direct contamination can occur, it is bad practice to have these infrastructure components in such proximity.
e. In some places where the access between shelters has been removed, this requires the desludging operators to gain access through overgrown or rubble strewn areas. This creates a health and safety issue for the operator from trip hazards and potentially from vectors also.
f. Because of the restricted access to the tanks, it is impossible for the desludging operator to remove all the solids from the tank. This results in a buildup of solids and therefore reduction in capacity. This material will affect odours from and treatment capacity within the tanks.
g. The desludging process was observed to start at 8.30am during the assessment period. According to the BRHA monitor, the reason for this is that some tanks are inside the shelters, and it is not preferable to start earlier as people may be sleeping. This starting time obviously limits the time available for desludging, in an already tight schedule.

6. In a significant number of the inlet pipes to the tanks, there is a lot of material that is hanging in the ends of the pipes and backing up the pipes, known as bearding. This is likely an indication that the grade in the pipes is not sufficient for self-cleansing. Similarly, in the inspection chambers, there is a lot of buildup of solids and faecal material. This material will generate odours in the pipes going upstream and affecting the quality of the black water going through the pipes.
7. In a small number of tanks, it appears that there are dry lines, where the tank has not filled above in its operational life. This would indicate that soakage from the tank is sufficient, along with occasional desludging, to prevent the tank level increasing. While this reduces the amount of material to be desludged, it also

means that all the material that escapes the tank is going directly into the ground and potentially into ground water.

8. A lot of the tanks have the vents removed. This is usually because the tank is in an area where movement of people happens, and the vent may impede this access. In almost all cases where the vent was removed, the household's complained of odour in the vicinity of the tank.
9. Where the tanks have been subsumed inside the shelter area, there is risk of contamination from the tank overflowing. Generally, this does not happen, as the liquid backing up pipes is usually the first indication and causes calls to BRHA for desludging. The depth between the lid level and pipe level provides some protection, however several tanks were observed to have staining on the underside of the roof slab, indicating that at least occasional overflow is possible and UNHCR staff it was witnessed happening in several cases.
10. Trees planted beside tanks are going to be a major problem in a few years when the roots start to seek out the water in the tanks. As they grow and get bigger, they are going to cause problems on the tanks constructed from blocks, as roots will easily penetrate these.
11. Similarly, trees planted along the edge of roads or shelters where pipes have been installed, are going to start causing problems for the system before long. With apparent issues already related to grade, any up thrust in pipes caused by roots growing underneath will start to cause blockages and backup of liquids, with associated issues.
12. Most "manholes" that have been observed are very poorly constructed, with no smooth transition from pipe to chamber to pipe. Rather there are edges and square chambers that collect solids.
13. In a lot of cases there is no obvious indication of these manholes on the ground, as they have been covered by surrounding shelters. In some cases, the covers are concreted over completely, or planted on in gardens.
14. Because the desludging trucks take about 8.5m3, what regularly happens is that the large tanks only have one truckload removed to reduce the level and not delay the schedule. This causes issues with solids remaining, as highlighted above.
15. The biggest tanks used have only got one access point, therefore it is not possible to desludge the other side of the tank. In all the tanks observed, the inlet was at the opposite side of the tank, therefore most solids collect there and are not able to be removed, other than when they are pushed by flow to the side with the opening.
16. Some issues related specifically to the newer septic tanks that have been constructed: -
    a. Some do not have an opening in the middle of the roof slab, over the baffle wall, to allow desludging immediately on either side.
    b. These large septic tanks should have 3 openings of minimum 400mm x 400mm. One over the inlet and outlet tee, to provide access there and one over the baffle wall. Owing to the large size of the tanks combined with restricted access to openings, it is only possible for the desludger to empty directly below the opening. Hence solids that accumulate on either side of the baffle wall are not removed.

c. Most of these tanks have the baffle wall extending all the way to the underside of the roof slab. This is unnecessary and prevents air movement in the tank.

d. The openings in the baffle wall generally are in the middle and on the large size, it would create better hydraulic movement in the tank if there were two small openings, set to each side, rather than the middle. This will encourage better flow through the tank and likely reduce possible short circuiting.

e. Many septic tanks had no inlet or outlet tees. These are essential for the proper functioning of the tank and must meet the minimum standards for extending below the top water level of the tank.

f. Many of the tanks which do have inlet and outlet tees in place, have these oriented in a horizontal, rather than a vertical direction. This allows the solids to enter from either side and again pass to the soak pit.

g. Most tanks had no lip around the edge of the opening to prevent surface water from entering the tanks

17. Many of the desludging pipes used to access the tanks are broken off at ground level. Some of these have caps in place, but others have a concrete cover placed over. These pipes are entry points for surface water to the tanks and will likely be adding flow in rainy periods, or when washing of the ground is happening in the vicinity.
18. Most vents observed were about 500mm long, with a U pipe on top. Some tanks have vents that are approx. 2.5m high and this should be the minimum to get the ventilation higher than the access to dwellings and above where people walk.
19. Where cesspits have been installed, they are mostly covered with materials, owing to them not being inspected. Coverings vary from garden soil to water tanks, which have been observed.
20. In several places, shelter walls are very close to the tanks, some of which are excavated to 3m deep. Generally, wall foundations should be outside a line of 45o from the deepest part of the excavation, to ensure that the wall is being built on natural ground. While excavations observed were generally vertical, the bearing capacity of the virgin ground around the excavation will be impacted by the removal and fill. Evidence of cracking is obvious in a few shelters. At some point the question of liability or compensation may come up, so it is good to consider this in the context of land tenure in Shelter and Settlement Strategy.
21. Over time, the access to tanks has become restricted or pretty much eliminated by the expansion of the shelters. The result of this is a significant cost for rehabilitation or relocation/replacement of the tanks owing to the inability to get access. Any rehabilitation requires access by removal of the concrete lid in order get inside, with considerable difficulty in these restricted areas.
22. In the desludging assessment, the total volume, rather than the working volume of the tank has been used to calculate the flow per person per day. In most cases it's not possible for the tank to fill up to full volume, though in a handful of instances there was evidence of sludge material on the underside of the roof slab. Therefore, an agreed volume for the various sizes of tanks that takes this into consideration, should be used.
23. Based on the level sensor readings it appears that there is water entering the tanks from several sources. While it is hard to determine these exactly, by

comparing temperature readings in the tanks at the same time as the increased level, there are a few likely possibilities: -

a. Overflow of potable water from the roof storage tanks, perhaps due to faulty, or lack of ball valves. From assessments done, it is interpolated that 15-20% of the 1,050 tanks have this issue.

b. Water ingress to the tank from the surface around the covers. Rainfall and cleaning of the ground over and around the tank could enter from this location. In almost all the tanks that have been subsumed into shelters, there is evidence of staining from regular inflows from the surface. This is assumed to be in more than half of the 1,050 tanks

c. Corresponding increase in level and decrease in temperature corresponding to known rain events indicate that the systems installed are prone to surface water inflow/infiltration. Based on feedback from the camp management technical staff, this is an issue in most tanks, and this is supported by the comparison of summer and winter levels in the same tanks, where known rain events occurred. An estimate of the number would be around 70% of the 1,050 tanks are affected.

d. Grey water entering the system from individual household can be observed by comparing sudden increase in level and temperature around the same time.

24. One of the tanks that was inspected has obvious cracking in the side wall. This tank is beside a shelter, whose occupants complained of their shelter cracking, and the monitor was called to check if the tank had collapsed. In the initial review, there was no collapsing, but on more detailed review it was seen that the tank has got cracks. This damage and that from the shelter could be related to the increased moisture in the ground changing the bearing capacity of the soil in the immediate area, though absolute certainty on this is not possible.

3.2.4 Estimating the flow per person from level data.

From level monitoring carried out in 22 of the 78 tanks inspected, it has been possible to generate potential design figures for the grey and black water production. The monitoring was carried out initially in the summer and autumn, but then with the deployment extension to cover the winter period, it was possible to get a seasonal comparison. It was noted that in periods where there was no recorded rainfall, the summer and winter black water production figures remained relatively consistent per tank. This gives a good degree of confidence around these figures and by reasonable assumption, it is estimated that the grey water production should remain reasonably similar. However, discussions with individuals in household indicates that during the summertime there are more frequent use of showers, though the consequence of this cannot currently be measured.

3.2.5 Black water per capita – 20 - 25l/p/d

Level monitoring was carried out in 22 tanks in Domiz 1 during summer 2018 and in the same tanks over the winter period. Based on the level increase or decrease it is possible to calculate the volume, as the area of the tanks was known through the assessment. While these readings need to be acknowledged as approximate, they do give a reasonably reliable rate of flow into and out of the tanks. The reason for flow out is because, as already detailed, all the tanks assessed were blockwork, some with no base slabs and deliberately spaced

gaps in the blocks to allow liquid to percolate out and even the blockwork tanks with slabs were also found to be leaking.

Three tanks were omitted from the black water flow calculations because of known greywater input, or inaccuracy in the readings causing doubt about the validity of the information. But from the 19 tanks included in the final review, the average black water flow was calculated at 28l/person/day. Based on the temperature readings and the fact that a lot of figures were in the high 20's to low 30's, it's reasonable to believe that most situations have some grey water going into the tank and that a lower average is probably more accurate for the black water.

In the University of Duhok paper, this figure was calculated at 22l/p/d but was based on a lower water consumption figure. Figures used for black water production in Australian/New Zealand standards are 25l/p/d. Based on all of these factors, a black water design figures of 20-25l/p/d is considered to give a degree of conservatism suitable in this case where water consumption is estimated rather than measured.

3.2.6 Grey water per capita – 65l - 70/p/d

By taking the 120l/p/d for water consumption in the camp and using the typical value of 80% of this liquid going into wastewater. 80% of 120l is 96l, say 90l for rounding. Subtracting the black water figure of 20 - 25l from this, it leaves 65 – 70l of grey water per person per day, for ease of reference.

The University of Duhok Study estimated that this figure was 42l/p/d, but as noted, is based on lower water consumption. This is lower than typical figures used in Australia/New Zealand, but the water consumption figure is also lower, which gives confidence of the accuracy and relevance of the 65l to the current situation.

Something of note from the sanitation assessment relating to the grey water figure is that the Kabarto 2 Grey Water Treatment Plant was designed based on an expected flow rate of 42l/p/d, but the plant is receiving much less than that. This information came to hand on a visit to the plant and after talking to the operators. Grey water that comes from the Domiz 1 Northern Catchment must travel a significant distance in open channels, which allows for evaporation and infiltration into the ground.

3.3 SFD Matrix

The predominant method of dealing with black water in the Domiz 1 camp is via septic and holding tanks and containment pits that allow some liquid to infiltrate into the soil around and below the tank, but then must be emptied on a regular basis, with the desludged material dumped in the open about 2km from the camp.

Table 3: SFD Matrix Domiz 1 camp. (Source: Author, 2019)

Domiz 1 Syrian Refugee Camp, Kurdistan, Iraq, 15 Jul 2019. SFD Level: 3 - Comprehensive
Population: 32592
Proportion of tanks: septic tanks: 50%, fully lined tanks: 100%, lined, open bottom tanks: 70

Containment				
System type	Population	FS emptying	FS transport	FS treatment
	Pop	F3	F4	F5
System label and description	Proportion of population using this type of system (p)	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
T1A3C10 Fully lined tank (sealed), no outlet or overflow	15.0	100.0	100.0	0.0
T2A2C5 Septic tank connected to soak pit, where there is a 'significant risk' of groundwater pollution	15.0	100.0	100.0	0.0
T2A5C10 Lined pit with semi-permeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	70.0	100.0	100.0	0.0

Proportion of the population that use this type of system: - As summarised from the containment section.

- Septic tanks:
  - 15% of the camp population use this type of containment system, based on the sanitation assessment and using the number of tanks in that document as the basis for estimating the percentages.
- Lined pits with semipermeable walls and open bottoms:
  - 70% of camp population use this type of system, based on the same factors as above.
- Holding tanks:
  - 15% of camp population use this type of system, based on the same factors as above.

Proportion of the tank volume that is emptied:

- From the sanitation assessment carried out it has been identified that the tank structures are losing up to 30% of the incoming flow through leakage and subsequent infiltration to the ground. Therefore, for both systems we will assume the following: -
  - Septic tanks:
    - 30% of incoming flow leaks through the tank structure, as above.
    - Assume that another 20% of the liquid is infiltrated to the ground from the soak pit. This assumption is based on discussions with the camp management staff and desludging truck drivers and their experience in terms of the frequency of desludging from each tank.
    - Total amount of liquid infiltrated to the ground is 50%, therefore the other 50% is emptied and considered to be faecal sludge.
  - Lined pits with semipermeable walls and open bottoms: -
    - 30% of incoming flow leaks through the tank structure, as above.
    - There is no soak pit, so no further infiltration occurs, therefore 70% of the incoming volume is emptied and considered to be faecal sludge.
  - Holding tanks:
    - 100% of the material that is deposited in these tanks is considered to be removed. This figure is open to some debate, as the desludging trucks only ever remove 7-10m^3 of the material when they are being emptied. The reality is though that this then becomes the working volume of the tank. The assessment did not investigate detail at the consequences of this operation, but it is likely to result in sedimentation build up over time. For the matrix the 100% is seen as an acceptable figure in the absence of more detail.
- The assessment also indicates that there is grey water getting into some of these systems, but it has not been possible to determine with any degree of certainty what percentage of the overall tanks are affected and what the increased volume is. Therefore, it is not going to be accounted for in terms of differentiating materials.

Proportion of this type of system from which FS is emptied:

- Septic tanks:
  - It's estimated that 100% of the septic tanks have material removed from them on a regular basis but based on the desludging assessment and stakeholder input. These tanks are emptied up to twice a month.
- Lined pits with semipermeable walls and open bottoms:
  - 100% of these pits are emptied, as they don't have enough infiltration happening through the leakage to avoid regular emptying. Most are emptied up to four times a month.
- Holding tanks:
  - 100% of these are emptied. As mentioned, the volume removed remains in doubt, but all these containment systems are emptied, which is the question asked.

Proportion of FS emptied which is delivered to treatment plants:

- For all the containment systems, none of the emptied material is being delivered to a treatment plant. The emptied material is transported to a dedicated disposal site, as determined by the Directorate of Municipalities. Transportation of the faecal sludge is not a problem in this camp, as there are enough vehicles currently allocated.
- To highlight that transportation is not a problem in this camp, it has been given 100%, even though it is not going to a treatment plant. The material is being taken to a dedicated dumping site and so it is controlled, to an extent. The use of 100% is for consistency with the other SFDs produced in this area, as part of this exercise.

Proportion of FS delivered to treatment plants, which is treated:

- For all the containment systems, none of the emptied material is being delivered to a treatment plant. At the time of writing the material is being removed to a dedicated dumping site. Therefore, the figure used here is 0%.

4 Stakeholder Engagement

The preliminary stakeholder engagement was through direct meetings with the various directorates and other stakeholders to the Domiz 1 camp.

Once the assessment had been carried out and there were finds to present and options to be considered, then workshops were held in some detail with the various levels of the technical and management of the camp and supporting agencies. The purpose being that the options being processed, and one selection ultimately made, was done by the stakeholders as a group, rather than a recommendation made for them to support and adopt.

5 Acknowledgements

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To all the various stakeholders who participated in the assessments, workshops, discussions and casual fact-finding meetings, a great debt of gratitude is owed, as they gave their time unreservedly.

Thanks to NaSa colleagues who provided review and comment on the original submission.

6 References

RedR Australia Deployee Martin O' Malley, dated 04 June 2019, "Domiz 1 Syrian Refugee Camp Sanitation Assessment & Concept Options Report"

UNHCR, 06 - 08 March 2018, Kawa Yahya and Vaheel Quchan, "Note on mission to Duhok UNHCR office".

University of Duhok, Najdat S.Abdulkhaliq, December 2017, "Investigation the Drainage capacity (Percolation Test) of four locations in Domiz 1".

UNHCR, Kawa Yahya, 24 – 26 October 2017 – "Note on mission to Duhok UNHCR Office and Duhok Construction Material Laboratory Directorate".

Directorate of Sewerage, 2011 – "Duhok City Wastewater and Storm Water Master Plan".

UNHCR/BRHA, 2018, "Domiz 1 Desludging Assessment ".

Domiz 1 Camp profile, Syrian Refugees, Duhok, Iraq – 25 June 2018 (https://data2.unhcr.org/en/documents/details/64277)

Domiz 1 Desludging Assessment – UNHCR/BRHA, 2017

The Sphere Handbook, 2018

UNHCR WASH Manual – Practical Guidance for Refugee Settings

UNHCR Emergency Shelter Standard

UNHCR Emergency Handbook Camp Coordination and Camp Management (CCCM)

7 Appendix

7.1 Appendix 1: Stakeholder Identification

Table 4: Stakeholder Identification Table. (Source: Author, 2019)

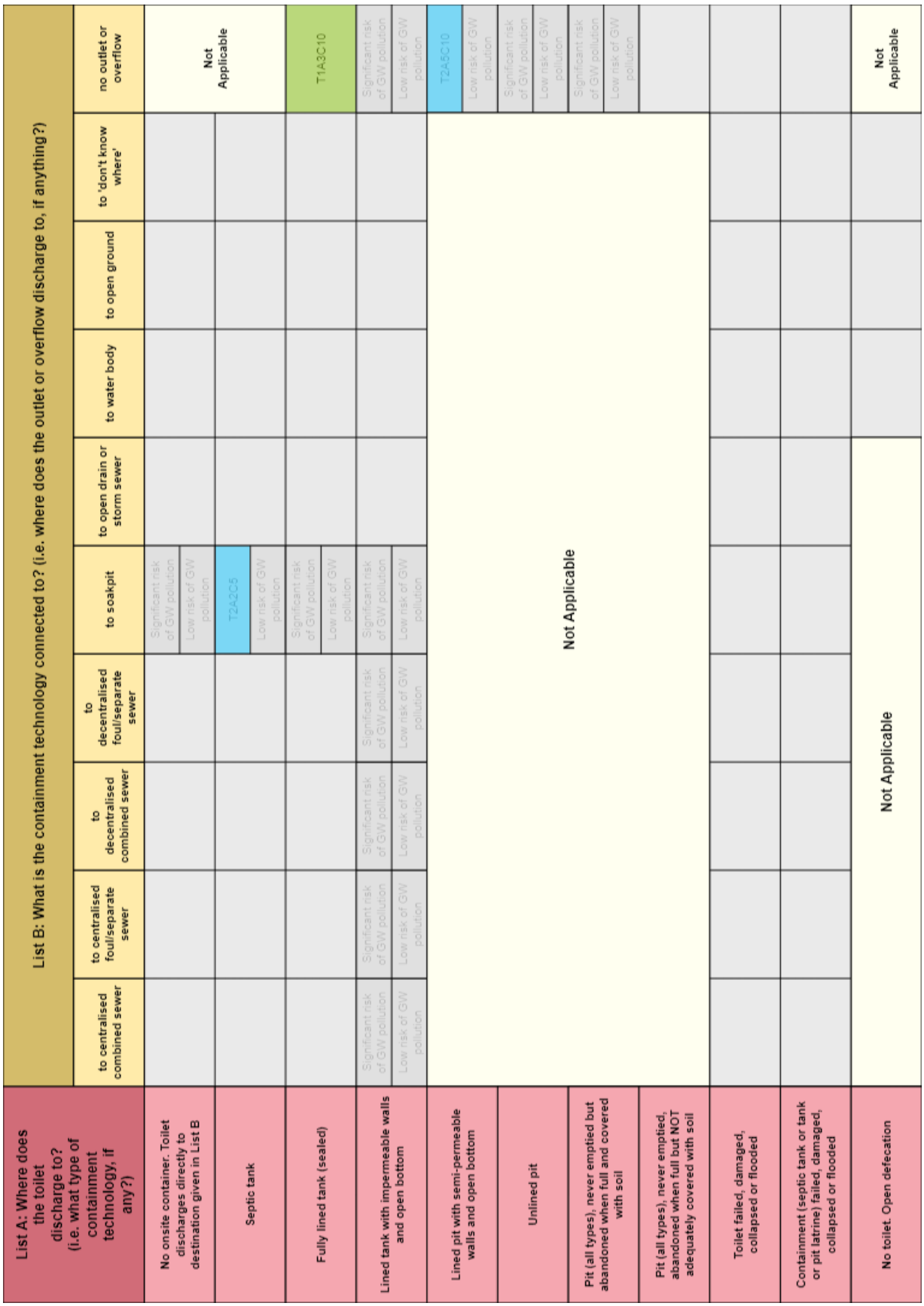
No.	Stakeholder Group	In Duhok Context	Roles
1	Government Departments	Directorate of Sewerage Directorate of Water Outskirts Directorate of Municipalities Directorate of the Environment	Provide information on sewage master plan. Provide information used estimating the volume of water used. Provide information on the waste management. Provide information on the testing of the water.
2	UN	UNHCR UNICEF	Provide information on the camp management. Provide information on the services management and camp establishment.
3	NGO	ACTED Peace Winds Japan	Provide information on the construction of the WSP. Provide information on the KAP surveys.

7.2 Appendix 2: Tracking of Engagement

Table 5: Tracking of Stakeholder Engagement. (Source: Author, 2019)

Name of Organisation	Contact Person	Designation	Date of engagement	Purpose of engagement
Directorate of Sewerage	Mr. Subhe Mr. Sinan Shaba	Director Engineer	10 June 2018	Introductions, background to the project and interview.
Directorate of Municipalities	Mr. Haval Mr. Sherzad	Director Engineer	10 June 2018	Introductions, background to the project and interview.
Directorate of Water Outskirts	Mr. Dindar Mr. Vagar	Director Engineer	11 June 2018	Introductions, background to the project and interview.
BRHA	Mr. Assad	Engineer	11 June 2018	Introductions, background to the project and interview.
Directorate of the Environment	Mr. Hassan	Engineer	12 June 2018	Introductions, background to the project and interview.
UNHCR	Various technical	Engineers	19 – 21 February 2019	Presentation of findings to the internal technical team and options discussion.
Duhok Sanitation Steering Committee	Mr. Assad	WASH Cluster	20 January 2019	Presentation of assessment findings to the group.
Domiz 1 Camp Management Technical Staff	Various technical	Technical Staff	16 April 2019	Presentation of options and agreement on option selection.
Duhok Sanitation Steering Committee	Mr. Assad	WASH Cluster	30 April 2019	Presentation of options and agreement on option selection.

7.3 Appendix 3: SFD Selection Grid

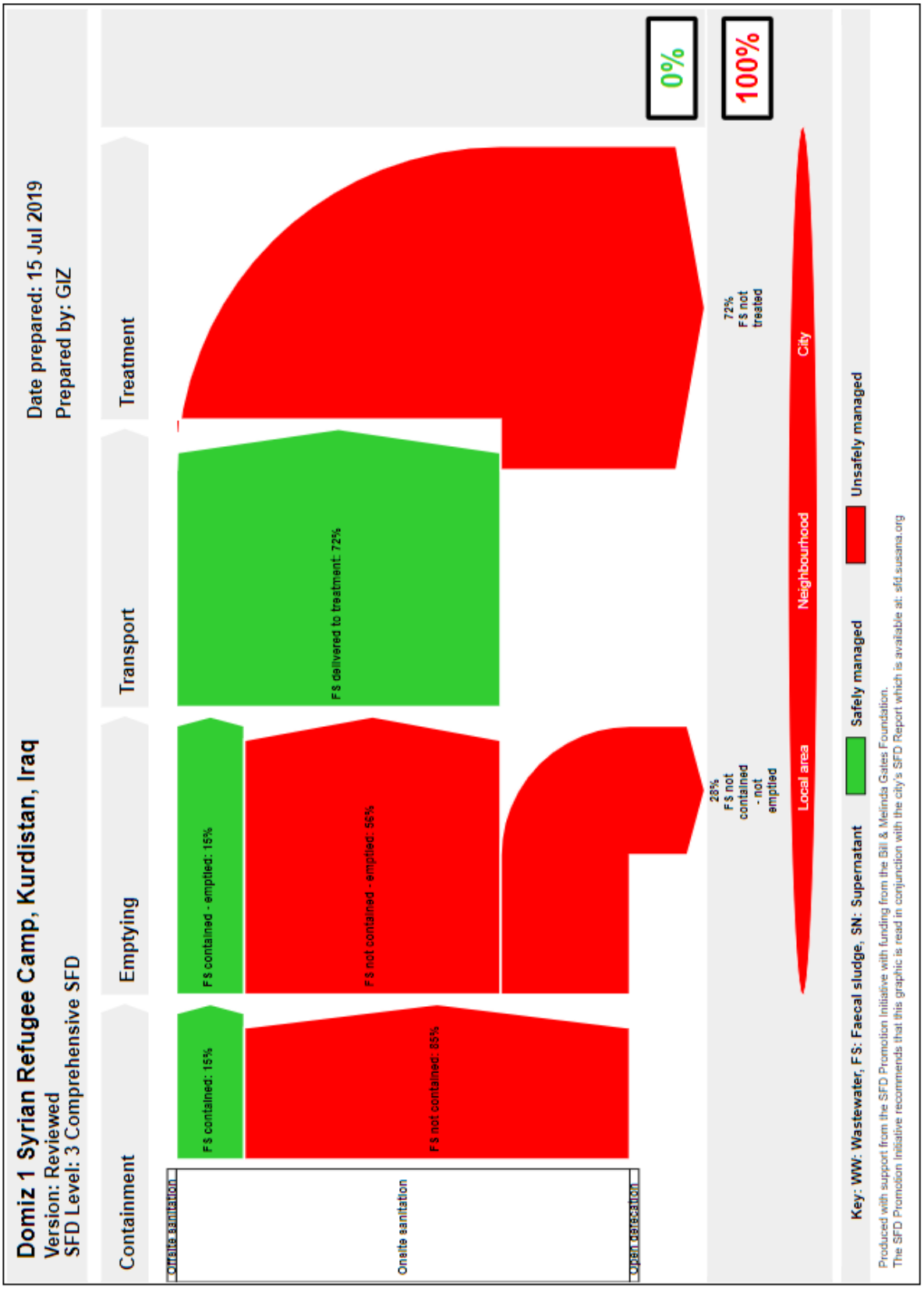


7.4 Appendix 4: SFD Matrix

Domiz 1 Syrian Refugee Camp, Kurdistan, Iraq, 15 Jul 2019. SFD Level: 3 - Comprehensive
Population: 32592
Proportion of tanks: septic tanks: 50%, fully lined tanks: 100%, lined, open bottom tanks: 70

Containment				
System type	Population	FS emptying	FS transport	FS treatment
	Pop	**F3**	**F4**	**F5**
System label and description	Proportion of population using this type of system (p)	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
T1A3C10 Fully lined tank (sealed), no outlet or overflow	15.0	100.0	100.0	0.0
T2A2C5 Septic tank connected to soak pit, where there is a 'significant risk' of groundwater pollution	15.0	100.0	100.0	0.0
T2A5C10 Lined pit with semi-permeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	70.0	100.0	100.0	0.0

7.5 Appendix 5: SFD graphic



SFD Domiz 1 Syrian Refugee Camp, Kurdistan Region of Iraq, 2019

Produced by:

GIZ (Martin O' Malley, who was deployed to UNHCR Duhok by RedR Australia, under funding from GIZ)

Editing:

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