Installation of Decentralized Wastewater Treatment System (DEWATS) in the Rohingya refugee camps in Cox's Bazar, Bangladesh

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1. Introduction

1.1. Humanitarian context

The International Organization for Migration (IOM) Water, Sanitation and Hygiene (WASH) unit in Bangladesh is working in the Rohingya refugee camps of Cox's Bazar, where approximately 862,277[1]. Rohingya refugees currently reside in 34 congested camps. Following the outbreak of violence in Rakhine State, Myanmar on 25 August 2017, over 700,000 Rohingya refugees fled across the border into neighbouring Bangladesh. Significant influxes have occurred following violent outbreaks in 1978, 1992, 2012, and in 2016. IOM Bangladesh hosts one of IOM's largest WASH programmes, serving close to 300,000 beneficiaries. The WASH unit is currently the Area Focal Agency (AFA) for 12 Rohingya camps.

1.2. Background

In highly congested settings, such as the Rohingya camps, WASH actors face challenges to deliver faecal sludge treatment processes which provide an effective removal of pathogens. The challenges are largely due to limitations on space, which places constraints on to the ability to include appropriate, safe and sustainable aerobic processes in the treatment train.

In 2018, the IOM WASH programme designed a new treatment mechanism—the Decentralized Wastewater Treatment System (DEWATS). The treatment mechanism works by solids/liquid separation through settlement and filtration as well as digestion of solids under anaerobic conditions. The Plastic DEWATS are composed of two processes: The Anaerobic Treatment System (ATS, in plastic tanks with filter material) and the infiltration process. The advantages are that 1) all materials used in this system are locally available; 2) the system is totally sealed with no sludge exposure and no smell (so well accepted by community; 3) the decentralized system reduces the distance from latrines pits, minimizes the transport cost and reduce the carbon footprint; 4) the system can be constructed in a short period with trained private vendors or volunteers; 5) one system can serve 5,170 users with only 65m^2 of land required for the ATS and 52m^2 of land required for infiltration.

In June 2019, Oxfam and Arup conducted a comparison study between 14 treatment systems used in the Rohingya refugee camps. The IOM DEWATS was placed in the best position for the following indicators: capacity to scale up, treatment effectiveness, skill requirement, whole life cost (WLC) and environmental and social context. The WASH Sector has recommended its design and IOM DEWATS is now widely used in this context. This system has the capacity to scale up by adding plastic tanks which create multiple treatment possibilities.

This portable version, using locally available plastic tanks, can be directly deployed in the field and can be replicable for different humanitarian contexts. This solution has been specifically developed to cope with the urgent need to address fecal sludge management gaps in densely populated humanitarian contexts.

1.3. Objectives of SoP

The SoP is an internal document to be used as guideline by IOM employees or implementing partners involved in the construction of DEWATS. The document will review the key design considerations explaining the treatment capacity and sizing of DEWATS. It will also give tools to staff involved in different steps of project implementation for proper supervision including the site identification,

[1] UNHCR Population Numbers - Bangladesh

coordination with authorities and permit information, site development, safety procedures and construction works.

2. Key design considerations

The IOM WaSH Unit has been confronted with a double challenge:

- Lack of space and access: treatment often occurs in crowded areas.
- Effluent infiltration rate into the soil is a major bottleneck.

In 2018 a specific process called DEWATS (Decentralized Wastewater Treatment System) including an Anaerobic Treatment System (ATS) along with an effluent infiltration design has been developed by the IOM WaSH Unit. The main objective of this compact system is to cut suspended solids and organic matter concentration to facilitate a better and sustainable infiltration of the effluent into the soil. Failing to contain suspended solids and organic matter ultimately clogs the soil porosity, jeopardizing a steady infiltration rate overtime.

The design of DEWATS is standard and can serve 5,170 users. It's a 5 steps treatment system:

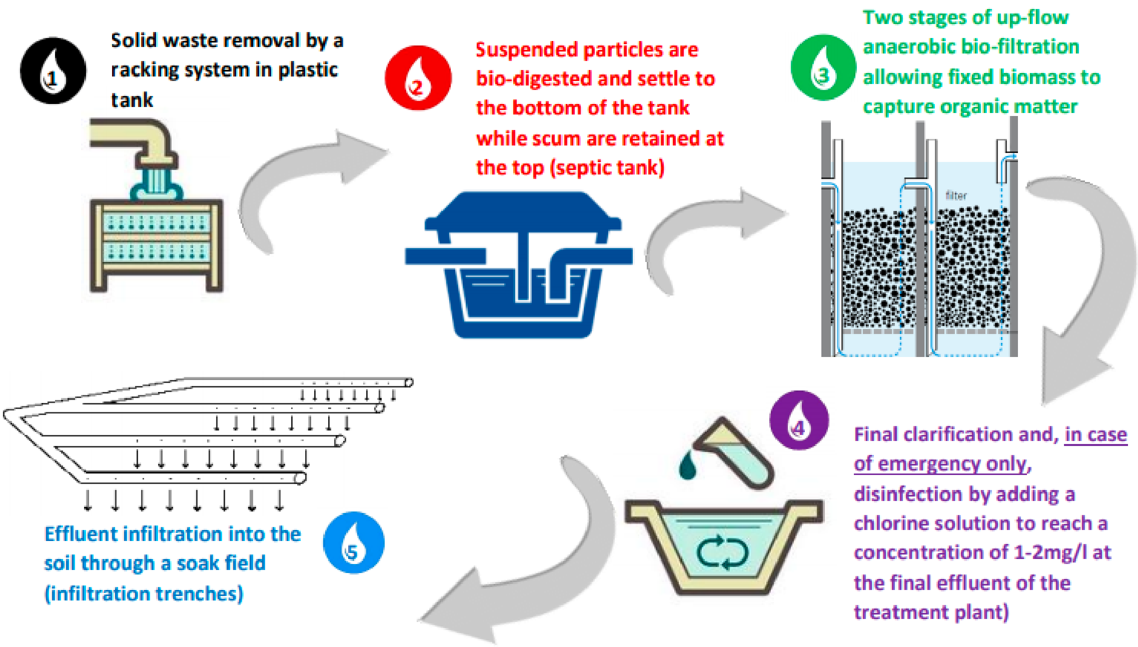

Figure 1: Plastic Tank DEWATS Flow sheet.

The Plastic DEWATS are composed of two processes: The Anaerobic Treatment System (ATS, in plastic tanks with filter material) and the infiltration process:

ATS specifications:

A total of 5 plastic tanks is needed

The first and second tanks (10,000 L and 7,500 L respectively) act as septic tanks by bio-digesting the sewage and retaining the majority of suspended solids

The third and fourth tanks (7,500 L each) act as Upflow Anaerobic Filters and are filled by a filter media (fragment of coconut husk which have a proven life expectancy when immerged in wastewater)

The last tank (2000 L) is used for final clarification or disinfection, in case of emergency

Each tank is fitted with a vent pipe filled with active carbon for odor elimination

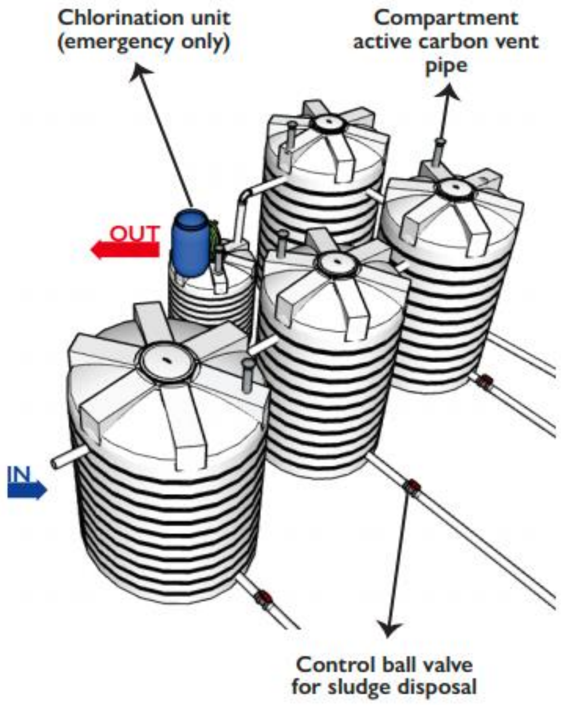

Figure 2: Anaerobic treatment system.

Figure 3: Infiltration trenches.

Infiltration trenches:

Soil infiltration tests were conducted, finding a rate of 60 l/m^2/d for semi-saturated sandy soil (within expected range for treated wastewater)

The infiltration surface of the Soak Field is given by the quotient of the effluent discharge and the infiltration rate: 3100 (l/d)/60 l/m2/d) = 51.7 m2

The length of the Soak field is given by dividing the infiltration surface by 2 x depth of the trenches (1.6m): 51.7 (m2)/1.6 (m) = 32 m

In the table below, we present the design considerations used for the sizing and capacity treatment of the DEWATS.

Key design considerations
Treatment Capacity

• Assuming Hydraulic Retention time (HRT) = 40 hrs in the third and fourth tanks (7,500 L each) acting as Upflow Anaerobic Filters and filled by a filter media (fragment of coconut husk).
• The volume of each tank is 7500 liters and usable volume = 60%
• Filter porosity of fragments of coconut husk = 70%
  ○ Total usable volume of each tank = 7500 x 0.6 x 0.7 = 3150 liters.
  ○ For the two tanks, usable volume = 6300 liters
• Using HRT = 40Hrs, treatment capacity = 3780 liters/day. However, we need to consider that the operations are taking place during daytime only. If we dispose 3780 liters on Day 1, 630 liters will be transferred from tank 2 to tank 4 the same day. Then, on Day 2, this volume will be transferred from tank4 to tank5 without spending 40hrs retention time. That's why the volume of wastewater treated per day must be limited to the usable volume of tank3 and tank4 (3150 liters).

⇨ **Keeping HRT >= 40hrs, DEWATS capacity ~ 3.1 m^3/day**
Users & pit latrines targeted
• According to field results and experimental evidence, the latrines used in the camps allow on-site volume reduction and reduce the frequency of desludging to 0.6 L/p/day. • Considering HRT = 40 Hrs and DEWATS capacity = 3.1m^3/d, then users = 5170 ppl
⇨ **Users = 5170 ppl or 258 pit latrines (20 ppl/latrine)**
Sludge Accumulation & sludge retention time (>1 year)

• If fecal sludge = 0.6 L/p/d, assuming 2% solids content
• A solids sludge accumulation rate of 4.4 l/person/year
Minimum sludge in first tank = 10% (1m3) and Maximum = 70% (7m3)
  ▪ Then in one year, 22750 liters of sludge accumulated
  ▪ Then tank 1 and 2 desludging is required every 6 months (11375 liters)
  ▪ Volume of sludge pit = 3.45 m^3 each (6 pits required)
• Less than 1-year retention time needed for faecal sludge where ambient temperatures are >20°C (WHO)
• The sludge will remain 6 months in septic tank and 12 months in sludge pit and will be free of pathogens after this period (18 months in total)
(Latrines are designed to store the wastewater more than 6 months in latrines pits).

➢ **6 sludge pits of 3.45 m3 for tank 1 and 2 to handle the sludge safely.**
Filter media
Fragment of coconut husk consist of a mixture of coconut epicarp (The thin and smooth outer layer that surrounds a coconut), fibers bound-up with parenchyma (typically composed of living thin-walled cells). The properties of this filter media are: • Filter material size ranges between 15 mm and 50 mm diameter. • Granular: to slowly filter the wastewater • Porous: to trap the bacteria essential for effective treatment • Spongy: to keep these bacteria active for longer period. • Resistant to compacting to allow air circulation bacterial feeding and durability.

⇨ **Fragment (15 mm and 50 mm) of coconut husk as filter media.**
Infiltration trenches
• Infiltration rate tests should be conducted at each site, before calculating the required trench size • Soil infiltration tests for wastewater were conducted, finding a rate of 60 l/m^2/d for semi-saturated sandy soil • The infiltration surface of the Soak Field is given by the quotient of the effluent discharge and the infiltration rate: 3100 (l/d)/60 l/m^2/d) = 51.7 m^2 • The length of the Soak field is given by dividing the infiltration surface by 2 x depth of the trenches: 51.7 (m^2)/1.6 (m) = **32 m.** • The recommended slope of the trench is 0.2% to 0.3%.
➢ **useful infiltration area = 52 m^2 and length of infiltration trench = 32 m**

3. Preliminary site identification and permit information

3.1. site identification prerequisite and check list

The Site identification is the first stage of project implementation and is essential. The camps are extremely congested, and it can be very challenging to identify a suitable location to accommodate the DEWATS. Some key parameters must be considered during the assessment:

- The population targeted considering that one system can serve maximum 5,170 users.
- The surface area of the site: 65 m^2 of land needed for the ATS and 52m^2 of land required for infiltration trenches.
- The soil infiltration rate must be tested and calculated for each site.
- The groundwater levels must be measured. If the water table in certain periods of year reaches the depth of 2.5 meters or less (i.e. less than 1.5 meters space from the bottom of the trench), the desludging pits and infiltration trenches won't be fully operational during the year.
- Flood prone area must be avoided imperatively.
- The infiltration trenches must be located at least 30m from the nearest water point.

Several IOM staff members from WASH or Site management units can be involved in site identification for DEWATS. Not everyone is familiar with the key specifications of DEWATS so its recommended to use the checklist below to anticipate and mitigate potential risks during the system implementation.

Preliminary site identification and feasibility check list for DEWATS:			
Project: **Latitude:** **Camp:** **Population:** **Date:** **Longitude:** **Block:** **name of engineer:**			
	Yes	*No*	*Action to address*
1. There is no faecal sludge treatment system in the assessed area or there are gaps in its capacity to meet the needs of the population. *If there is need for less than 5170 people, one line of DEWATS is required.* *If there is need for more than 5170 people, at least two lines of DEWATS are required*	☐ ☐ ☐	☐ ☐ ☐	
2. The land identified has at least a surface area of 65m^2 for the Anaerobic treatment system (ATS).	☐	☐	

3. The land identified has at least a surface area of 57m² for the infiltration trenches.	☐	☐	
4. The surface identified for the infiltration trenches construction cannot exceed 10 m in length.	☐	☐	
5. Infiltration rate tests has been conducted on site and confirm at least a rate of 60 l/m²/d *If no, recalculate the surface needed for the infiltration trenches as the quotient of the effluent discharge and the infiltration rate: [e.g. 3100 (l/d)/60 l/m²/d) = 51.7 m²]*	☐	☐	
6. Groundwater table at the end of rainy reason is deeper than 2.5 m. *If no, this location is not recommended, or a technique of mount system is required with elevated layers of sand.*	☐	☐	
7. Groundwater table at the end of rainy reason is deeper than 4.5 m *If no, the bottom of sludge pits needs to remain >1.5m from the water level. In the case where the volume of the pits is not enough for proper storage the alternative ways are: a) to transport and treat the sludge in another treatment plant or b) to use the pits (after having made them impermeable) for a lime stabilization treatment (following strictly the relevant guidelines) and then bury the stabilized sludge in the surrounding areas.*	☐	☐	
8. The closest water point is at a minimum distance of 30 m. *If no, we need to assess the presence of other source of water and discuss with the community living around and authorities in charge (Majhi, CiC, etc.) the possibility to decommission and construct a new deep tube well (if required).*	☐	☐	
9. TThere are shelters or communal facilities that requires relocation to ensure project feasibility. *If yes, we need to inform the site management officer in charge and authority (CiC, Mahji, etc.) to take action.*	☐	☐	
10. TThe site identified is in hilly area and exposed to landslides and/or present a risk for shelters or communal facilities around. *If yes, we need to inform the site development officer in charge and SMEP office (Site Maintenance and Engineering Project) and authority (CiC, Mahji, etc.) to take action.*	☐	☐	

3.2. Permit information

Once the site identified and assessed as suitable, IOM will take the steps to obtain the permit. This stage must start the earliest possible as it can be time consuming. It's recommended to involve the Site management focal point and the camp in charge (CiC), counterpart from government, and start the discussion and negotiations. When the site is approved verbally by all stakeholders, IOM will submit the needs assessment letter to be signed by the CiC.

This letter and all technical documents (drawing, and bill of quantities) will be submitted to the Refugee Relief and Repatriation Commissioner (RRRC) in Cox's Bazar for final approval. The office of the Refugee Relief and Repatriation Commissioner is the government agency under the Ministry of Disaster Management and Relief responsible for providing assistance to Rohingya refugees in Bangladesh. The final approval letter signed by RRRC must be submitted to CiC in the respective camp before starting the construction work. It's recommended to involve IOM liaison officer to fasten the process. This process can take up to four weeks and it requires to be anticipated to avoid any delay in project implementation.

4. Installation of DEWATS

4.1. Site development and slope protection

Figure 4: Site leveling and slope protection in Camp10.

The topography in the camps varies. Most of the camps are in hilly areas. Valleys should be avoided as they can be prone to flooding or zone that have shallow water table which is not suitable for DEWATS. Consequently, most of the suitable sites for DEWATS installation will be identified on the hillsides. It's essential to coordinate with site management, site development units and SMEP to assess the risk of landslides and to take action through slope protection and site development. The site must be properly leveled and compacted to accommodate the different components of DEWATS and ensure stability when the system will be operational.

4.2. Environment, Health and safety (EHS) procedures

- Safety:

The contractor in charge of construction should have clear EHS measures in place. They should provide to workers involved in the construction personal protective equipment (PPE: including safety shoes, helmets and gloves).

The contractor is in charge to identify the risks linked to the construction work and briefed the workers accordingly.

The contractor is in charge to ensure dignified working conditions to the workers in the field by behaving with respect, providing safe working conditions, weather protection (against sun and rain), limited working hours, proper tools and equipment, etc. More specifications are defined within IOM agreement.

The contractor prevents public access to the construction site by clear sign and preventive measures adapted to refugees (site fencing, guard, sign board writing in Burmese, etc.)

- Environment:

All waste produced by the construction are properly collected and disposed by the contractor in order to mitigate any negative impact on the environment and public health.

- COVID-19 measures:

The IOM WASH programme in Cox's Bazar has made adaptations to COVID-19 throughout 2020 through specific infection, prevention and control measures. It is expected that these will continue to be utilized in 2021 to ensure safe delivery, including training provided with adherence to physical distancing guidelines, wearing of face masks, adequate hand hygiene and adequate cleaning and disinfection of materials.

- Inspection:

All tools and work equipment must be inspected regularly. IOM supervisor and contractor manager should be responsible for this continuous inspection. Inspections can take the form of a check list (see below).

4.3. Construction work supervision and check list

The supervision of the construction of DEWATS is carried out by trained IOM WASH engineers. IOM is also working with trained private vendors and volunteers who know IOM expectations and requirements. In order to ensure proper supervision of construction and keep record of challenges, gaps in contract specifications and actions taken, its recommended to use the checklist below.

Construction work check list for DEWATS:			
Project: **Latitude:** **Camp:** **Population:** **Date:** **Longitude:** **Block:**			
Vendor name: **Phone number:** **Name of IOM representative:**			
	Yes	*No*	*Actions to address (date and signature)*
Site preparation and permit. (30 days)			
1. Authorization obtained by the government counterparts (CiC and RRRC)	☐	☐	
2. SMEP and Site development units prepared the site for DEWATS installation including slope protection, drainage construction, soil compacting.	☐	☐	
3. Site demarcation for ATS tanks; sludge pits and infiltration trenches	☐	☐	
4. Site preparation: Excavation of soil for Plastic Tank Base including providing center lines, local bench-mark, leveling, ramming and preparing the base, removing necessary roots and plants, protecting from leakage and leveling surrounding sites with excavated soil.	☐	☐	
Environment, health and safety (EHS) procedures			

5. The workers involved in the construction are wearing personal protective equipment (PPE including safety shoes, helmets, gloves).	☐	☐	
6. All waste produced by the construction are properly collected and disposed by the contractor.	☐	☐	
7. COVID-19 training provided with adherence to physical distancing guidelines, wearing of face masks, adequate hand hygiene and adequate cleaning and disinfection of materials.	☐	☐	
8. The contractor prevents public access to the construction site by clear marking and preventive measures adapted to refugees (fencing, guard, etc.).	☐	☐	
ATS Material			
9. **Plastic tanks:** Different capacity of Vertical tank (roto grade and ultraviolet ray protected), which complies with FDA (Federal Department of Agriculture, USA) requirements. (1 x 10,0000L; 3x7500L; 1x2000L).	☐	☐	
10. **Connections & inter-tank joining:** Connection to internal & external fittings and tanks to soak pit , **3" GI Nipple** Round thread (6" length 6 nos & 8" length 10 nos), **GI Socket 3"** both side threaded 8nos(female thread), **3" Bronze Nipple** 16 nos, 3" **Hose pipe** 18.29meter, **3" Hose Clamp** 16 nos(SS hose clamp), 3**" UPVC Elbow** 6 nos(D- Class), **3" PVC Tee** 6 nos(D-class), **3" UPVC pipe** 24.39 meter (D-class) for inner connection of Tank, **3" Brass Gate valve** 8 nos and **4" UPVC pipe** 9.15 meter (c-class) for enter connection of soak pit.	☐	☐	
11. **Connections & Fitting for Filtration tanks:** 2" **UPVC pipe** 33.54 meter (D-class), **2" UPVC Tee** (D class) 40 nos, **2" UPVC Cross Tee** (D class) 18 nos, **2" Cross Elbow** (D class) 16 nos, **PVC Net** top of PVC base 9sqm, **Plastic cable** tie 7 packet, **Coconut shell/coir (coconut husk)** for coconut shell 14 cum(and including cutting coconut in 8-9 parts then sun dry 3 days as per engineer direction), **Plastic mesh bag** (3'x1.5') (for coconut husk/shell) 250 nos, **Borak bamboo** (4" dia, 10 ft height) 8 nos and **1.25" PVC thread pipe** 12 meter, **1" PVC Thread pipe** 85.37 meter.	☐	☐	
12. **Vent pipe fitting**: **1.5" dia GI Tank Fitting** (GI Nipple Round thread) 5 nos, **1.5" dia PVC Elbow** (D class) 5 nos, **1.5" dia PVC Tee** (D class) 5 nos, **1.5" dia vent pipe** (gas pipe) with plug covers14 meter and **active carbon** filling 4 kg.	☐	☐	

13. 14 m^3 of fragment (from 15 to 50 mm) of coconut husks: mixture of coconut epicarp, fibers bound-up with parenchyma to be used as filter media in tanks 3 and 4.	☐	☐	
ATS construction work (15 days)			
Base preparation for 2000 liters tank			
14. **Earth work excavation** for the base of 2000L tank including provision of center lines, local bench-mark pillars, leveling, ramming and preparing the base (0.93m^3).	☐	☐	
15. **Brick works** in Foundation of wall with first class bricks in cement/sand mortar (1:6) (1.13m^3) filling the interstices with mortar, raking out joints, cleaning and soaking the bricks at least for 24 hours; screening of sand before use; necessary scaffolding, curing at least for 7 days.	☐	☐	
16. **5" thick brick** wall in Base of Tank (8.36m2) finishing construction with first class bricks and cement mortar (1:4) and making bond with partition walls and properly raking out of joints between bricks, including necessary cleaning and soaking the bricks for at least 24 hours before use and screening.	☐	☐	
17. **Sand filling** (F.M. 0.5-0.8) in the base; using dry sand and creating proper levelling, as per instruction of Engineer-in-charge.	☐	☐	
18. **Polyethylene Sheet:** Providing single layer polythene sheet (0.18 mm thick) weighing one kilogram per 6.5 square meters in floor or anywhere in ground floor underneath the cement concrete.	☐	☐	
19. **Brick Soling:** One layer of brick flat soling in foundation of tank base with first class or picked jhama bricks including preparation of bed and filling the interstices with local coarse sand, cover the brick-soling with polythene sheeting.	☐	☐	
20. **Plastering & Net Finishing:** Minimum 12 mm thick cement plastering using mortar ratio (1:4). The work includes screening of sand cleaning the surface, scaffolding and curing at least for 7 days, water/electricity/other charges and as per drawing and instruction of the Engineer in-charge.	☐	☐	
Sludge pits construction			

21. **Earth work:** Excavation of earth for setting in all kinds of soils/stony layers for installation of RCC sludge pits. Digging 10' deep pits, removal of soil, stacking of soil, placing of 4' dia RCC rings, and back fill the pit with necessary compaction. All complete as per instruction of IOM Engineer.	☐	☐	
22. **RCC Ring:** RCC ring (1:2:4)- outer dia 4ft, height 1ft, thickness 2.25". Supplying, fabrication, and fixing 6mm dia MS rod @ 150mm in both direction (vertical & horizontal),with 0.50" down graded 1st class brick aggregate & 1.6 FM sand. Top three rings should be jointed using cement mortar.	☐	☐	
23. **RCC Slab:** Supply, fittings & fixing of pre-cast ring cover 4' dia size, thikness-3" made of 1:2:4 mixing ratio, 8mm dia ms rod (60G) 6" C/C both way as per the drawing.	☐	☐	
24. **3"Cement concrete Work:** CC casting [recommended mixing proportion 1:2:4] using picked jhama chips, including supply, screening, washing, mixing, laying, compacting to levels and curing for at least 7 days including the supply of water, electricity and other charges and costs of tools and plants etc. all complete and accepted by the Engineer in-charge (Cement: Scan/Rubi).	☐	☐	
25. **Inside Mortaring (high density proportion 1:4):** provide mortar joint in top three joints of RCC rings at both sides, 1.5" bit (width) should be maintained, and curing is essential. All work completed as per direction of IOM Engineer.	☐	☐	
26. **Brick Box with 2.5" thickness RCC slab:** 5" thick brick wall, over 3" thick concrete base, finished with plastering on both sides and net cement finishing. The box should be covered with 2.5" thick RCC slab, provided 6mm dia rod @4"C/C in both directions, (inner dimension of the box; 20"X20"X15"), drawing attached.	☐	☐	
27. **3" GI Connector :** Supply, Fitting & Fixing of good quality 3" dia GI Connector fitting with PVC pvc pipe & as per design and as per direction of Engineer in charge.	☐	☐	
Infiltration trenches – construction work (15 days)			

28. **Earth work:** Excavation of earth for Infiltration trenches of (2'-7"X3'-9"X108') in all kinds of soil/stony layers and stacking excavated soils at a suitable place besides the trench, etc. (Including cost of all materials, labor and transportation), complete as per instruction of Engineer-in-charge.	☐	☐	
29. **Stone Chips:** Supplying of 20 mm down well graded stone chips from the bottom of the trench (2'-7"X2'-9"X108'); all supply and laying complete including geo-tex covering as per design and as per direction of Engineer in charge.	☐	☐	
30. **Earth filling:** Earth filling to cover the infiltration trench, from the geo-textile layer (0.3m below ground) to 0.1m above the ground surface.	☐	☐	
Infiltration trenches – Material			
31. **3" dia uPVC Elbow** (D class) 5 nos, **3" PVC Tee** (D-class) 5 nos, **PVC pipe** (3" dia D class uPVC pive) total legnth of pipe is 110ft, and total pipe must be perforated **Geotextile thickness** 3mm- 51.12 Sqm **3" PVC inspection pipe** - avg length of pipe is 4ft with necessary perforation up to 2ft, and provide PVC capping 10.92 meter **4" PVC** sampling pipe with frtainer and top closer with threaded end cap.	☐	☐	
GI Wire Fencing Boundary (150FT) (5 days)			
32. **RCC Pillar:** RCC pillar 4'X4"x 7.5 ft long total 43 nos complete with supply of 19mm down graded khoa of 1st class bricks 1.0 FM clean sand, using 4 nos 6mm dia MS rod and #8 MS wire stirrups @ 125mm C/C, Casting in a metal frame as per drawing.	☐	☐	
33. **GI wire for fencing:** Supplying, fitting & fixing of GI wire fencing, length 150 ft and height 4 ft.	☐	☐	
34. **Hardware materials & Other:** Supply of hardware materials for fitting & fixing of fencing, e.g GI wire, perak, etc as per requirement and specification.	☐	☐	
Vendor representative: (Signature and date)	IOM representative: (Signature and date)	Review and approved by: (Signature and date)	

4.4. Handover

Once the construction is completed, the facility will be handed over to the WASH implementing partner (IP) in charge of the WaSH response in the area and funded by IOM. The system was designed to minimize operation and maintenance requirements. However, it's important for IOM to organize one day training with the IP to describe the treatment system, capacity, how to operate and maintain the system and monitor the volume of sludge effluent treated in different unit. IPs and IOM staff can refer directly to SOP and training tool for O&M of DEWATS in separate documents.

4.5. Workplan

The total time estimated for the construction of DEWATS is ten weeks. Several facilities can start parallelly through different trained vendors teams.

Installation of Decentralized Wastewater Treatment System (DEWATS)														
Activities	**in charge**	**#weeks**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Site identification	IOM WaSH - SMS	1	X											
Permit obtention	IOM Liaison officer	4		X	X	X	X							
Site development and slope protection	SMEP / SD	2						X	X					
ATS - sludge pits construction including rings and slabs preparation	IOM WaSH engineer	2								X	X			
Base preparation for the plastic tanks	IOM WaSH engineer	1									X			
Installation of plastic tank and fittings	IOM WaSH engineer	1										X		
Filter media cutting, packing and fitting in tanks 3&4	IOM WaSH engineer	2									X	X		
ATS - base preparation for 2000 liter tank	IOM WaSH engineer	1										X		
Infiltration trenchs – construction work	IOM WaSH engineer	2											X	
GI Wire Fencing Boundary	IOM WaSH engineer	1												X
DEWATS handover to IP	IOM WaSH NoA	1												X

Annexes

Annex 1: DEWATS design

DEWATS design

Annex 2: DEWATS BoQ

DEWATS BoQ