Faecal Sludge Management

Operation Manual

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TABLE OF CONTENT

CHAPTER 1: BACKGROUND

1.1 CONTEXT DESCRIPTION:

Due to the lack of investment in a proper sanitation system in the Philippines - including sewage collection and treatment - close to 20% of the population (approx. 20 million) suffer from inadequate access to sanitation and 9 million rely on unsafe water sources. Additionally, a significant portion of the population is resorting to open defecation (6 million) as a negative coping mechanism, further contributing to the spread of diseases and environmental pollution. Those challenges are affecting the population unevenly with high disparities between regions and provinces.

Following the historical typhoon, 'Haiyan', that hit the Philippines in November 2013, the province of Eastern Samar (Eastern Visayas region) and notably Guiuan city have been the first affected by the typhoon. The natural disaster resulted in serious damages and losses for the already impoverished area that severely lacked proper access to sanitation.

As a response, UNICEF and the Department of Health developed a strategy to attend to the needs of the most affected and implement a recovery programme: the "Phased Approach to Total Sanitation" (PhATS), in 2015 with the support of ACTED and 11 other NGOs. The Eastern Samar province benefitted from 20,000 re-built latrines as well as a sanitation marketing approach set up in several municipalities.

1.2 SANITATION SYSTEM EVALUATION.

In order to evaluate the efficiency of the PhATS and identify remaining needs and gaps, ACTED conducted in December 2016 a post-monitoring evaluation in the four municipalities of Guiuan, Mercedes, Salcedo and Quinapondan in Eastern Samar. The evaluation focused on assessing the status and management of the latrines, the septic tank designs, sanitary behaviors at the household level as well as to evaluate the demand for a fecal sludge treatment system and its economic benefits (e.g organic fertilizer).

Details of the results are available in ACTED's Fecal Sludge Management Assessment report finalized in July 2017.

A total of 1,166 respondents (at least 5% of households in each target municipality) were reached. Most of the households interrogated did not earn an income sufficient to meet their basic needs (with an average revenue of PHP 2,000 per month)1.

Key findings show that the respondents' knowledge on fecal sludge management was very limited (13% of households) who mostly reached out for information when facing serious issues (e.g. septic tank reaching full capacity). Only 1% knew about a desludging service in place in their community although most agreed on the importance of having a sustainable desludging service accessible.

Respondents mainly considered the construction of a second septic tank as a solution to their tank reaching full capacity (69% of households), though some considered seeking a desludging service for 100-500 pesos.

[1] The respondents mainly worked in the field of agriculture (17,75%), daily labour (13,12%) and others (50% including pedicab drivers, fishermen etc.), with only 4,46% being technicians/professionals.

Lack of regulations on fecal sludge management and information to the population has been noted mostly due to technical and financial constraints faced by the municipalities.

As to the development of a human fecal sludge organic fertilizer, only 14% of the households were willing to purchase it, all of them working in the agricultural sector. Therefore, the market existed for such products but was limited.

Sludge management was not considered a priority for most respondents as they could still use their latrines. The other 13% had not found a sustainable solution and were resorting to open defecation or using their neighbors' latrines.

The status of the latrines – mainly pour-flushed- varied as half were deemed in good to very condition while 43% were in poor to bad conditions, mostly due to financial constraints.

Septic tank designs were mostly a lined pit (56%), and a water tight design (19%) which are single- chamber septic tanks and can be considered vulnerable to fecal sludge issues due to their limited capacity (especially those with shallow septic tank hole).

Open pit latrines have also been a source of concern especially when located where the ground water table is high and often overflooding, which overall raised fears of a health crisis outbreak.

Additionally, some of the latrines were in narrow access lanes, with missing manholes, making it difficult to empty as the desludging was not taken into account in the design.

Following the results of this evaluation, ACTED developed its Fecal Sludge Management project articulated in three phases.

1.3 FSM FACILITY PURPOSE AND NEED:

The proper cycle of any sanitation system starts from the HH and their proper storage and discharge of the waste water, ACTED through the same project tried to enhance the HH storage practices by promoting the designs of technical septage system which will facilitate the collection system later and protect the environment and the underground water from the contamination risks.

The second main component of the sanitation cycle is the collection and dislodging system, where its either done through piped sewerage system or through dislodging trucks services. The collection and transporting system aims for safe removal for the waste water from the HH level to the treatment or disposal facility.

The last part of the dislodging system is the treatment facility where the waste water and sludge are treated for safe discharge into the environment or reuse for several purposes. The sanitation cycle is shown in the figure below:

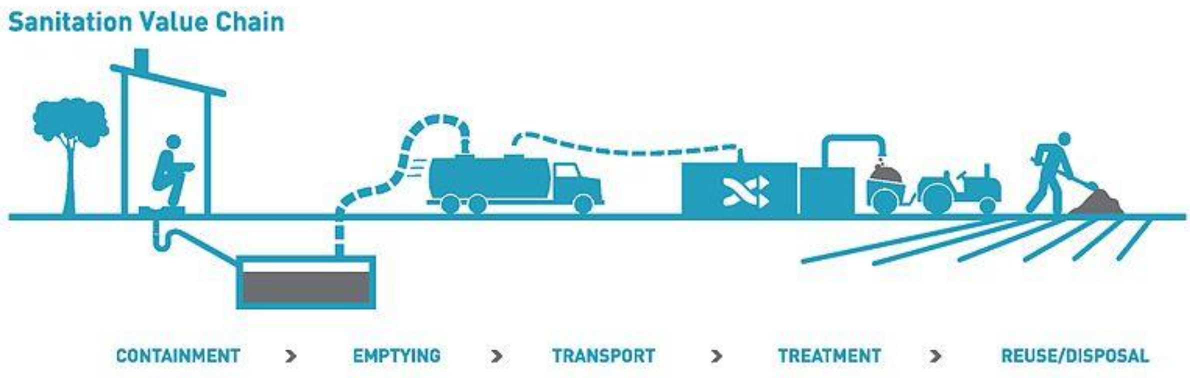
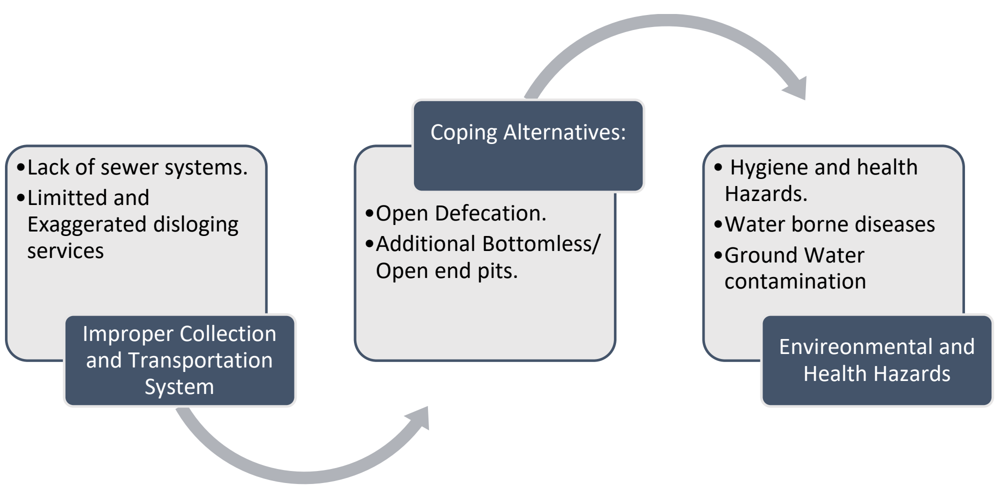


Figure 1: Sanitation Cycle[2]

In section 1.2 the sanitation system in eastern Summer was described against the sanitation cycle, noting that it misses the main components of the sanitation cycle and notably the transportation and the treatment parts.

Keeping in mind the sanitation status and considering the time period between the construction of the toilets and septic tanks right after Yolanda and the availability/affordability of proper dislodging services; the concern of adopting the pre-Yolanda sanitation practices, the concern has arisen, mainly the open defecation with its associated hygiene and health concern. However, part of the local's solutions to their full toilets with the absence of proper dislodging and is to replace it with open end/ bottom less pits, which has a major effect on the environment and underground water and raises the hygiene and health concern again. In addition to all of the above the lack of the treatment facility results into unsafe disposal of dislodged waste whenever dislodging services are used. The unsafe practices of sludge disposal and treatment affects the surface water and the water resources available and increase the chances of water contamination. The below charts describe the risks associated with the lack of proper collections and treatment system in place.



[2] *Value Chain of Excreta- WSH Program of Gates Foundation, January 2010*

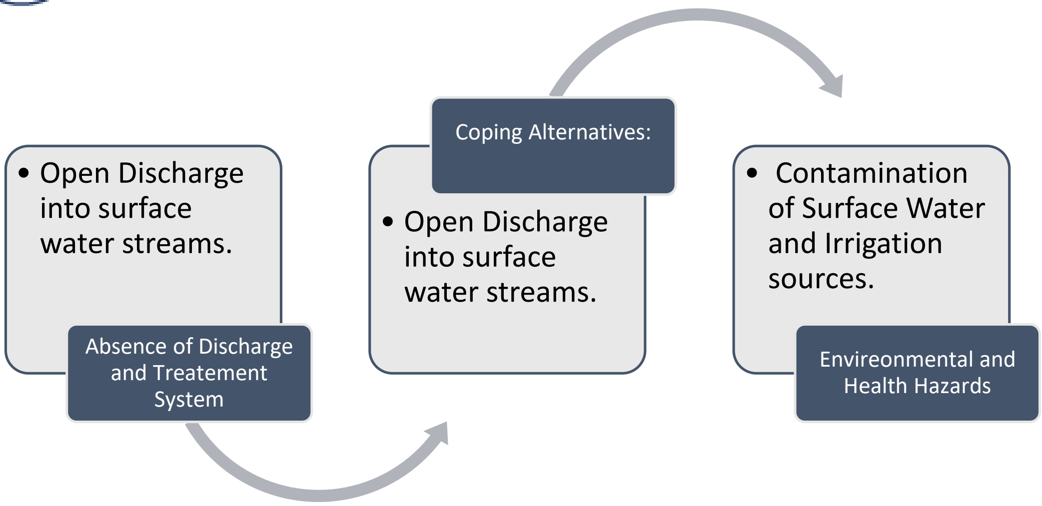


Figure 2: Problem Causes and Effects

ACTED has constructed a Faecal Sludge Management Facility introducing the necessary collection system and trying to fill the gaps eastern Summer has at the moment and which will help both the dislodging and the treatment process and will also provide sustainable livelihood opportunity to the local community besides helping the local farmers in obtaining land fertilizers with affordable cost.

CHAPTER 2: FSM SYSTEM DESCRIPTION- AND DESIGN CRITERIA:

2.1 SYSTEM COMPONENTS:

ACTED with collaboration with WASTE has designed and constructed a Faecal sludge management facility, which aims at complementing the sanitation value chain in the area, starting with the pilot that covers the municipalities of Guiuan, Salcedo, Quinapondan, and Mercedes Region VIII of Eastern Visayas, Philippines. These municipalities are among the most natural disaster-prone areas and have experienced the most devastating typhoon recorded in Philippine history. Even now, affected communities are still recovering from the damages brought by Typhoon Yolanda in 2013. The table below shows the population of target municipalities as per latest census (Philippine Statistics Authority, 2015).

Table 1: Served Districts and Population Counts

MUNICIPALITIES	POPULATION
GUIUAN	52,991
MERCEDES	6,981
SALCEDO	24,143
QUINAPONDAN	14,799
TOTAL	98,914

The current facility, which is based in Guiuan will act as a centralized treatment unit providing treatment and processing services for the collected sludge to the four municipalities. The septage management and the dislodging service through the vacuum truck and the ROM system will be available to the aforementioned municipalities as a part of the FSM system introduced by ACTED. Potential expansion of the treatment process is planned as phase II of the project, a decentralized treatment system is to be constructed at the municipal level with the its standalone collection system. Figure 3 below shows FSM geographical coverage and services:

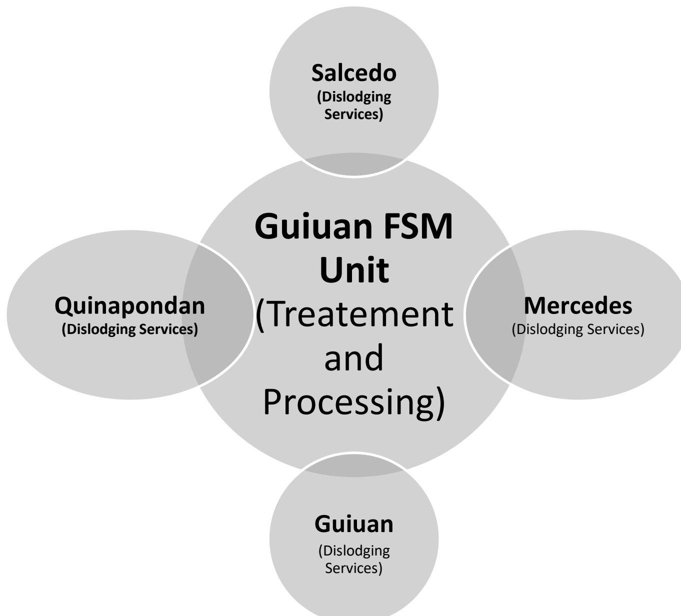


Figure 3: FSM PHASE I Geographical Coverage and Services

The constructed FSM facility comprises of three separate buildings in addition to the stabilization ponds, where both the sludge and effluent are treated either for safe disposal or re-use in the forms of organic fertilizers through both vermi-composting and co-composting process. The facility buildings are shown in Figure 4 below:

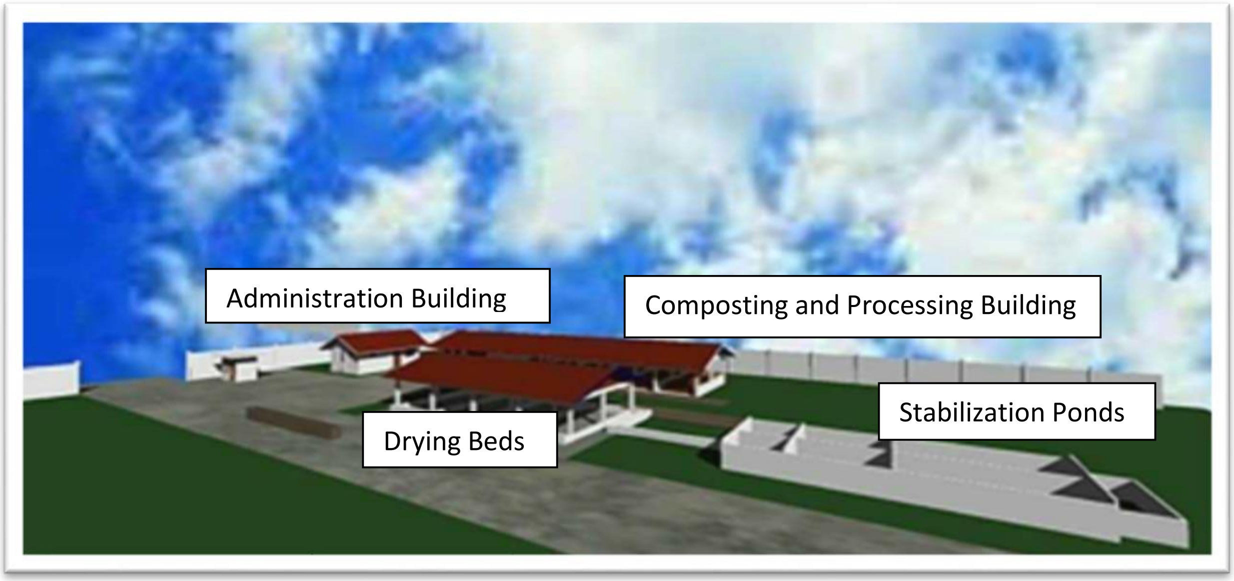


Figure 4: FSM Schematic Diagram

The reception and treatment process start at the unplanted drying beds building, where sludge and effluent are separated to be treated separately, while the dried sludge after is moved to the composting and processing building for further treatment before the final reuse in the forms of organic fertilizers.

2.2 DESIGN ASSUMPTIONS AND CRITERIA:

Main design assumptions and the criteria that were followed in the sizing, loading and unloading and the productions rates are summarized in the tables 2, 3 and 4 below:

Table 2 : Unplanted Drying Beds Design Assumptions

Sludge Loading rate	The sludge loading rate (SLR) is expressed in kg TS/ m2/year. It represents the mass of solids dried on one m2 of bed in one year. However, it is possible to indicate a range of sludge loading rates which typically vary between 100 and 200 kg TS/m2/year in tropical climates, with 100 for poorer conditions and 200 for optimal conditions.
Thickness of the sludge layer	Sludge is typically applied in a layer of 20 to 30 cm in depth, with a preference for 20 cm. It may seem a better option to apply a thicker sludge layer as more sludge can be applied to one bed; however, this will result in an increased drying time, and a reduction in the number of times the bed can be used per year. It is also important that the sidewalls of the drying beds are high enough to accommodate different loadings. For example, if a layer of 20 cm is applied with a water content of 90%, the initial height before the water is drained-off will be much greater than 20 cm. If the beds receive sludge discharged from a truck as opposed to settling tanks, the walls need to be higher than the planned 20 to 30 cm of sludge layer to allow for the increased volume of liquid.

Number of beds	The number of beds required depends on the amount of sludge arriving at the plant per unit of time, the sludge layer thickness and the allowable sludge loading rate

The technical details and characteristics that were taken into account for the design are listed in Table 3 below:

Table 3: Drying Beds Sizing Criteria

Sizing of the beds:	Production of filter layers:
Thickness of the Sludge layer =20 cm	Reduce pressure flow via Gravel-Sand – Gravel layers 10,10,20 Cm respectively.
Sludge loading rate =150 kg TS/m2/year 0.05 m2/cap	Drying bed removal efficiency: 97% SS (suspended solids) 90% COD (chemical oxygen demand) 1000% HE (helminth eggs)
Untreated sludge characteristics:	Dried sludge production:
Partly stabilized (septage or mixture of septage and public toilet)	0.125 m3 per m3 fresh FS
Sand characteristics:	Leachate:
Sand particles do not crumble	Quality fairly comparable to tropical wastewater
Sand easily available locally	Salinity too high for irrigation
Sand thoroughly washed prior to application onto the gravel base	Leachate treatment

Based on the technical details presented in Table 3 the following design for the drying beds was determined:

Table 4: Size Determination_ Loading and Unloading Cycles

2 FS truck loads/cycle (1 truck carries ~3.8 m³)	Hydraulic load on drying beds: X cm/cycle/ bed
3 dewatering cycles/month based on 10 days drying period.	Surface area of sludge drying bed= 32 m2/ bed = total of 128 m2
Volume of FS treated: 25.6 m³/cycle= 76.8m³/ month = 2.56 m³/d (Dry) and 7.2 Fresh	Number of Beds= 4

The leachate from the drying beds is collected and discharged into the facultative stabilization pond of the FSTP before final discharge into a nearby stream or for the use purposes either for irrigation or in the co-composting and vermi-composting purposes. The dried FS is removed from the drying beds once it can be removed by spade (after 10 days) to Composting building.

2.3 FSM LOCATION SELECTION AND CONSIDERATION

The selected site is large enough to accommodate waste for the operational life of the facility and Its located in an area that will not contaminate any nearby water sources.

The following environmental considerations were taken into account to develop in the selection of the FSM location:

- The base of the FSM is located above the high groundwater table and avoid all contact with groundwater. Sole-source aquifer and areas of groundwater recharge similarly were avoided.
- Its located in such a way that will minimize fugitive emissions and odor impacts.
- Wetlands and habitat areas, which are important to the propagation of rare and endangered species, were avoided.
- The FSM location were selected to avoid populated areas of conflicting land use, such as parks and scenic.
- Unique archaeological, historical, and paleontological interest were avoided.

2.4 OUTCOMES AND FINAL PRODUCTS:

2.4.1 USE OF FAECAL SLUDGE AS A SOIL CONDITIONER

Using treated sludge and septage by Co-composting or Vermicomposting as a soil amendment has many benefits over using chemical fertilizers alone (Strauss, 2000). Organic matter in FS can increase soil water holding capacity, build structure, reduce erosion and provide a source of slowly released nutrients. Treated FS shall be disposed by landfilling and spread on land. The sludge may be applied to agricultural land, forestland, lahar areas, coconut, bamboo and rubber plantations, etc. as organic fertilizer and/or soil conditioner to facilitate nutrient transport and increase water retention. If applied to land where food crops will be grown, special precautions must be taken to prevent contamination. The amount of nitrogen, phosphorus, potassium, pathogens, essential trace elements and heavy metals shall be within the allowable/acceptable limits set by the DA Bureau of Soils and Water Management. In cases where the operator intends to sell its treated sludge, product registration shall be secured from DA.

The below table shows the specifications of fertilizers and compost that shall be ensured prior the usage

Table 5: Specification of Fertilizers and Compost/ Soil Conditioner

	Plain Organic Fertilizer	Compost/Soil Conditioner	Fortified Organic Fertilizer
Total NPK	5-7%	3-4%	8% minimum
C: N	12:1	12:1	12:1
Moisture content	≤35%	≤35%	≤35%
Organic Matter	≥20%	≥20%	≥20%

Where; NPK - nitrogen, phosphorous, potassium / C: N – carbon nitrogen ratio

Table 6: Test for Pathogens for Organic Fertilizer/Soil Conditioner

Faecal Streptococci	< 5×10^2/g compost
Total Coliforms	< 5×10^2/g compost
Salmonella	0
Infective Parasitic	0

Table 7: Allowable Levels of Heavy Metals in Organic Fertilizer/Compost Soil Conditioner

Heavy Metals	mg/kg dry weight
Zn	1000
Pb	750
Cu	300
Cr	150
Ni	50
Hg	5
Cd	5

Soil samples from each field used for land application of sludge shall be collected on a yearly basis not more than 90 days prior to the initial application for that year, and analyzed by accredited laboratories of the Department of Agriculture Fertilizer and Pesticide Authority (DAFPA) using standard methods on the following parameters:

- Soil acidity, measured as pH
- Buffer pH Texture
- Calcium
- Magnesium
- Potassium
- Phosphorus
- Organic matter

2.4.2 USE OF LIQUID STREAMS

Liquid streams from treatment processes can be used for agricultural and horticultural irrigation, or other forms of water reclamation (e.g. non-recreational water features, industrial processes), depending on the quantity produced.

Sanitary landfills are often used for the disposal of treated septage or sludge. However, under no circumstances may untreated sludge or raw septage be placed in a sanitary landfill. All septage or sludge must be treated or stabilized prior to land filling.

Testing for nematode eggs is a relatively simple procedure to check if the septage or sludge has been treated to a level that is safe for disposal on agricultural land. This should become an integral component of any program that reuses the treated product as a soils amendment for agricultural purposes.

Treatment of domestic sludge and septage shall undergo best applicable and cost-effective processes, including, but not limited to, the treatment options described in the sections below.

CHAPTER 3: OPERATION PRACTICES:

3.1 DISLODGING AND TRANSPORTATION PLAN

3.1.1 GEOGRAPHICAL COVERAGE & PRIORITIZATION PLAN.

At the initial stage of the project the FSM facility will cover 4 municipalities. The vacuum truck and the ROM system on the tricycle provided by ACTED will act as the main dislodging assets to cover Guian where the facility is based and three other municipalities, namely; Salcedo, Mercedes and Quinapondan municipalities. However, the at the start up phase the facility and the dislodging services will run only in Guian for the period of 3 months for the optimization of the cost by minimizing trip lengths considering that the facility is located there. The dislodging capacity of the vacuum truck is 3000 liters per trip (3 m3 per trip) while the tricycle and holding tank capacity equals to 800 liters (0.8m3 per trip). Total capacity of the dislodging assets equals 3.8 m3 per full trip.

The anticipated total number of Leaching pits, septic tanks and concrete tanks is around 8600 pits with an average volume of 0.64 m3 per pit.

The project aims at dislodging all the septic tanks and pits in 4 years span which will require around 11 pits to be emptied every day with an average 200 working days per year. Knowing that the dislodging services capacity is 3.8 m3 in total and the average pit size is around 0.64 m3, it can be concluded that each the vacuum truck and the ROM system will have to discharge its full load twice a day in the facility to achieve 4 years target.

3.1.2 TRIP GENERATION (COLLECTION OF FAECAL SLUDGE)

Effective sludge removal relies on trained personnel, functional equipment, and procedures for conducting the work safely and with minimal impact to the environment.

When emptying the FS from onsite systems, a number of tasks are performed in accomplishing the job. Ideally, a typical job requires the operators to:

- Interact with customers prior to removing FS to arrange logistics and inform them of procedures, the operator who comes to collect the FS needs to be knowledgeable about the onsite system, and to be able to communicate why sludge removal is necessary and beneficial to the client and their community. The operator is also the only person who will be able to observe the onsite storage system both when it is full, and when it is empty. They should use this opportunity to assess how well it is functioning, identify repair needs and issues related to proper operation that might increase the life span of the system.
- Determining the accessibility of pit latrines in terms of:
- Width of the road
- Vacuum truck are to be used, roads need to be wide enough to accommodate the truck emptying equipment.
- Access to the site

- Does neighbouring property need to be accessed to reach the system;
- Are there any weather-related concerns regarding site access, such as stream crossings, or roads which are impassable during heavy rain event.
- Appropriate tools of the trade; The sludge emptying process requires that the operator has access to a number of tools and that the equipment is properly used and maintained. Such as shovels, screwdrivers, long handle shovels and buckets, hooks to remove non-biodegradable solids, and safety equipment
- evaluate the condition of the system post-collection;
- close and secure the system once the FS removal has been completed;
- clean up after the process is completed
- perform the final inspection and report any issues with the system to the customers after the service is completed.

The following steps are recommended for the operation of vacuum trucks:

- Park the truck as close to the system as possible. The maximum distance is determined by the length of hose and elevation rise from the bottom of the pit or septic tank to the vacuum truck tank inlet. This should typically be no more than 25 meters in linear distance and 4 meters in elevation gain. Further distances or elevation differences may require intermediate pumps.
- Inform the occupant of the pending service and note any concerns or issues.
- Inspect the site for possible hazards, such as clearing the area of people, or identifying high groundwater that could cause a tank to 'float' if emptied.
- Secure the truck using wheel chocks.
- Lay out and connect the hoses from the truck to the tank or pit to be emptied.
- Open the tank or pit by removing the access ports or covers over the storage system.
- Engage the vacuum equipment by using a power take-off from the truck's transmission.
- Increase the vacuum to the proper level with the valve closed by watching the vacuum gauge, then lowering the end of the hose into the storage system and open the valve sufficiently such that the FS is drawn out of the tank or pit. Closing the valve periodically re-builds the vacuum to enable the removal of further FS.
- Continue this process until the job is complete.
- Break up FS that has agglomerated into a solid mass, either by making use of a long handle shovel and adding water when necessary to reduce the viscosity of the FS; or by reversing the direction of the flow and forcing the contents of the vacuum truck tank back through the hose and into the sanitation system in order to use the high-pressure stream to break up the sludge. The direction of the flow is then returned to normal and the contents removed. It is essential to ensure that the hose is in sound condition, and that the hose connections are locked into place prior to using this method;
- Operators should remove between 90% and 95% of the contents. It is recommended that this is verified by management through periodic spot checks.
- Identify any abnormal conditions, such as high concentration of non-biodegradable materials, oils and grease. The color and odor of the FS can provide clues as to how the occupants are using the system, and if excessive chemicals are being discharged down the drain.
- Inspect the system once empty. In the case of a septic tank, the following checks should be carried out by the operator:

- Listen for water running back from the discharge pipe, which **could** indicate plugged leach lines (if present);
- Check to make sure that inlet and outlet tees are properly in place. Frequently, these structures break off and can sometimes be found at the bottom of the tank;
- Inspect the tank for cracks or damage; d. Verify that the tank is properly vented;
- Ensure that the tank lids are properly attached when the pumping is complete and that they are properly secured; Prepare a written report indicating:
  a. How much waste was removed;
  b. The condition of the tank or pit;
  c. Any recommendations for repairs or maintenance;
  d. Any recommendations for proper use of the system.

- Secure the tank lid and pack away the hoses;
- Clean up any spillage using proper sorbent materials;
- Inform the client that the work is complete, and give them the final report. In some instances, payment is received immediately for the service however, payment is often made directly to the service provider through some type of billing system. During this final interview, the operator informs the client of the findings and any recommendations;
- Remove the wheel chocks and drive the truck to the next site or to the nearest approved disposal site.

3.1.3 TRANSPORT OF FAECAL SLUDGE

Vacuum trucks will be utilized in removing and desludging FS from onsite sanitation systems to treatment plant. Vacuum trucks are available in a wide variety of sizes and models to accommodate different needs. Vacuum pumps are sized based on lift elevation, pumping distance, volume of sludge to be removed, and volume of the tank.

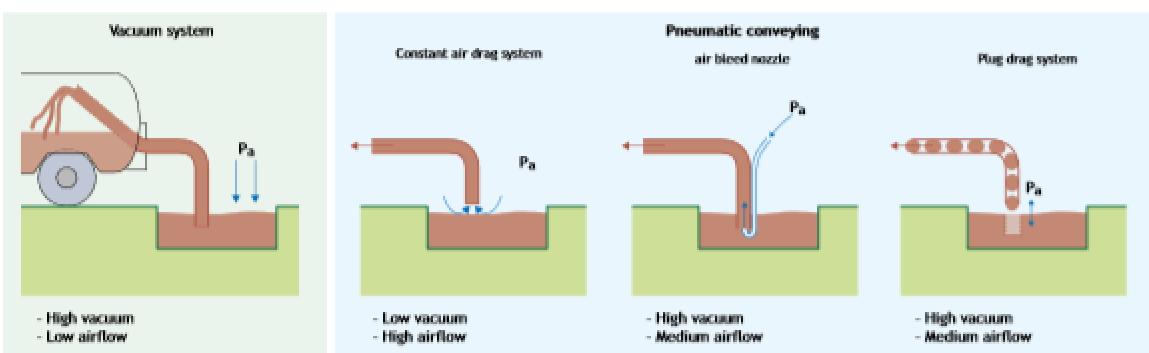


Figure 5: Four types of vacuum sludge removal techniques

The following factors influenced the selection of a vacuum truck, including:

- typical volume of the tanks or vaults that will be serviced;
- road widths and weight constraints;
- distance to the treatment plant;
- availability;

- budget;
- skill level of the operators.

3.1.4 DELIVERY OF FAECAL SLUDGE TO THE TREATMENT PLANT

Independent of the delivery method of FS to the treatment plant, operators should adhere to the following safety guidelines:

- Check in with facility guard or operator.
- Carefully following instructions regarding the sampling of FS. The FSTPs have designated sites for residential septage, and others for commercial sludge. Plant operators may request samples of the FS prior to allowing discharge if it is suspected that the FS may contain materials hazardous to the plant.
- Position the truck in the designated location for sludge removal, park and take the truck out of gear, apply the parking brake, and chock the wheels.
- Remove the hose and make the connections.
- Engage the power take-off or other mechanism for unloading the tank and complete the offloading process.
- Ensure sufficient water is available for washing the solids as some transfer stations have screens to remove non-biodegradable solids.
- Store any screened non-biodegradable solids in a safe location to drain and dry prior to containment and/or proper disposal either through incineration landfilling.
- Use proper lifting techniques when discharging drums into a transfer station such as standing on a stable surface, and ensure all protective equipment is worn.
- Clean up any spillage in the area around the inlet after completing the discharge of FS into the transfer station and re-seal the inlet.
- Use personal protective equipment such as gloves and hard hats, and do not smoke during the entire collection and discharge operation.
- Replace hoses and equipment, following adequate hygiene practices (e.g. hand washing), and completing the required paperwork.

3.2 PHYSICAL TREATMENT MECHANISMS: FILTRATION, RECEPTION BOX SCREENING AND EVAPORATION

Filtration is a commonly applied mechanism for liquid – solids separation in FSM. Several filtration media (e.g. membrane, granular) and types (e.g. slow, rapid, gravity driven or pressurised) are applied to water, wastewater and treated sludge (biosolids) processing. However, in this FSM the selected type of filtration starts with the screening at the reception box until the water filtration in the unplanted drying beds. This process uses filter media to trap solids on the surface of the filter bed, while the liquid percolates through the filter bed and is collected in a drain, or evaporates from the solids. In filter drying beds, slow filtration is occurring with filtration rates of 0.1-0.4 m/h, which requires less operations and maintenance than faster rates.

The parameters that have the greatest impact on slow filtration efficiency are the characteristics of the influent, the type of filtration media, and the filter loading rate. For example, higher suspended solids concentrations in the influent can increase filter clogging, floc strength can impact the solids retained at te surface and the overall performance, and particle size distribution can affect performance as smaller particles are not as effectively removed by filtration.

Given the high content of coarse wastes such as plastics, tissues and paper in the FS discharged by collection and transport trucks, a preliminary screening is needed for most treatment technologies. In Guiuan FSTP a reception box with manual screen is installed as the screening is another important physical mechanism in FSM. Bar screens at the influent of a FSTP are imperative to remove municipal waste and large solid objects from the FS, thereby preventing clogging and pump failures, and enhancing the value of treatment end products. Bar screens installed in a vertical and inclined positions against the incoming flow make a physical barrier that retains coarse solids. The distance between the bars are set such that the liquid and small solid particles can flow through while the larger solids are trapped.

The velocity of the flow of FS through the bars influences the screen performance. A low velocity allows an increased removal of solids, but involves a greater solids deposition in the channel leading up to it, which should be avoided. Therefore, the flow velocity should reach, at a minimum, the self-cleansing velocity (greater than 0.3 m/s for wastewater). The flow should also not exceed 1 m/s in order to avoid coarse wastes being pulled through the bars due to the strength of the flow. The bars create a head loss that depends on the quantity and type of solid wastes retained. The flow velocity shall be insured by the vacuum truck and tricycle operators as well as it is maintained after through the slope of the channels to the drying beds gates.

In addition to filtration, dewatering in drying beds is also occurring through evaporation. The energy required for evaporation to occur is provided by solar energy (with losses due to convection). Thus, evaporation is strongly influenced by climate, and the available heat and moisture content of air are especially important. The surface from where the evaporation is occurring can also influence the evaporation rate. Important parameters are depth and total area of the drying bed which in this case are 32 m2 per bed at 0.2-meter depth. The larger the total mass of an object, the more energy that can be stored, increasing the heat requirement for evaporation. Wind speed also has an effect on the rate of evaporation, as it increases the replacement of saturated air with dry air.

3.3 DRYING BEDS CONCEPT, MECHANISM AND PRODUCTIVITY:

Unplanted sludge drying beds are shallow filters filled with sand and gravel with an under-drain at the bottom to collect leachate. Sludge is discharged onto the surface for dewatering. The drying process in a drying bed is based on drainage of liquid through the sand and gravel to the bottom of the bed, and evaporation of water from the surface of the sludge to the air. The design as well as the operation of the drying bed is fairly straightforward, provided the sludge loading rate is well selected and the inlet points for depositing the sludge onto the bed are properly designed. Depending on the faecal sludge (FS) characteristics, a variable fraction of approximately 50-80% of the sludge volume drains off as a liquid (or leachate), which is then collected and treated in the stabilization ponds prior to discharge. After reaching the desired dryness (10 days cycle per bed), the sludge is removed from the bed manually using shovels and wheel barrows. Further processing for stabilization and pathogen reduction is conducted through either the co-composting process or vermi composting that follows the drying process. When the drying beds were considered the installation of a drying bed, the ease of operation and low cost were considered against the relatively large footprint and odour potential.

This FS treatment plant (FSTP) consists of 4 drying beds in one location each bed is 2 X 8 meters with special entry gate. Sludge is deposited on each of these drying beds where it remains for 10 days considering the climate in Guiuan area until the desired moisture content is achieved. It is subsequently manually removed further treatment and fertilizers generation and reuse.

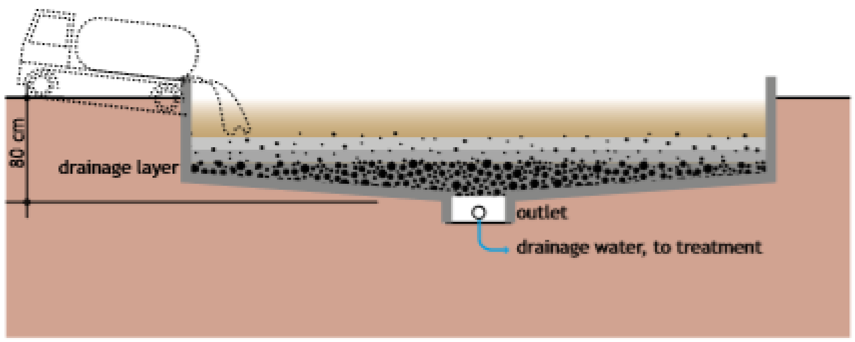


Figure 6: Schematic overview of an unplanted sludge drying bed

The drying process is based on two principles. The first principle is percolation of the leachate through sand and gravel. Where two gravel layers where installed the bottom one of 20 Cm depth and the top of 10 Cm while in between 10 cm sand layer was maintained. This process is significant with sludge that contains large volumes of free water as in Guiuan and the nearby municipalities case. The second process, evaporation, removes the bound water fraction and this process takes place over a 10 days period. The moist removal efficiency varies between 50 to 80% by volume due to drainage, and 20 to 50% due to evaporation in the drying beds with FS depending on the time of the year. This range is typical for sludge with a significant amount of free water, but there is more evaporation and less percolation with sludge that has more bound water.

3.4 EFFLUENT TREATMENT PROCESSES:

Waste stabilization ponds were used for the co-treatment of wastewater with the effluent following solid-liquid separation of FS in unplanted drying beds.

Design and Principles of the three types of ponds constituting Waste Stabilization ponds

WSPs consist of three ponds having different depths and retention times. A combination of three types of ponds in series is implemented as follows:

- Anaerobic pond that is 2.5 meters deep are used for settling of suspended solids and subsequent anaerobic digestion. The effluent flows to the facultative pond. The retention time for the Anaerobic pond is 5 days with anticipated 77% efficiency in BoD removal and 95 % efficiency in E-Coli removal.
- Facultative pond that is 1.5-meter-deep allow for remaining suspended solids to settle. In the top layer of the pond dissolved organic pollution is aerobically digested, while anaerobic conditions are

prevalent at the bottom. The retention time for the Facultative pond is 5 days with anticipated 68% efficiency in BoD removal and 95 % efficiency in E-Coli removal.

- Maturation pond that is 1.5 m deep allow for pathogen reduction and stabilisation. The ponds are mainly aerobic. Oxygen is supplied through algae and diffusion from the air. Pathogen reduction occurs via UV rays from the sun. The retention time for the Anaerobic pond is 7 days with anticipated 74% efficiency in BoD removal and 96 % efficiency in E-Coli removal.
-

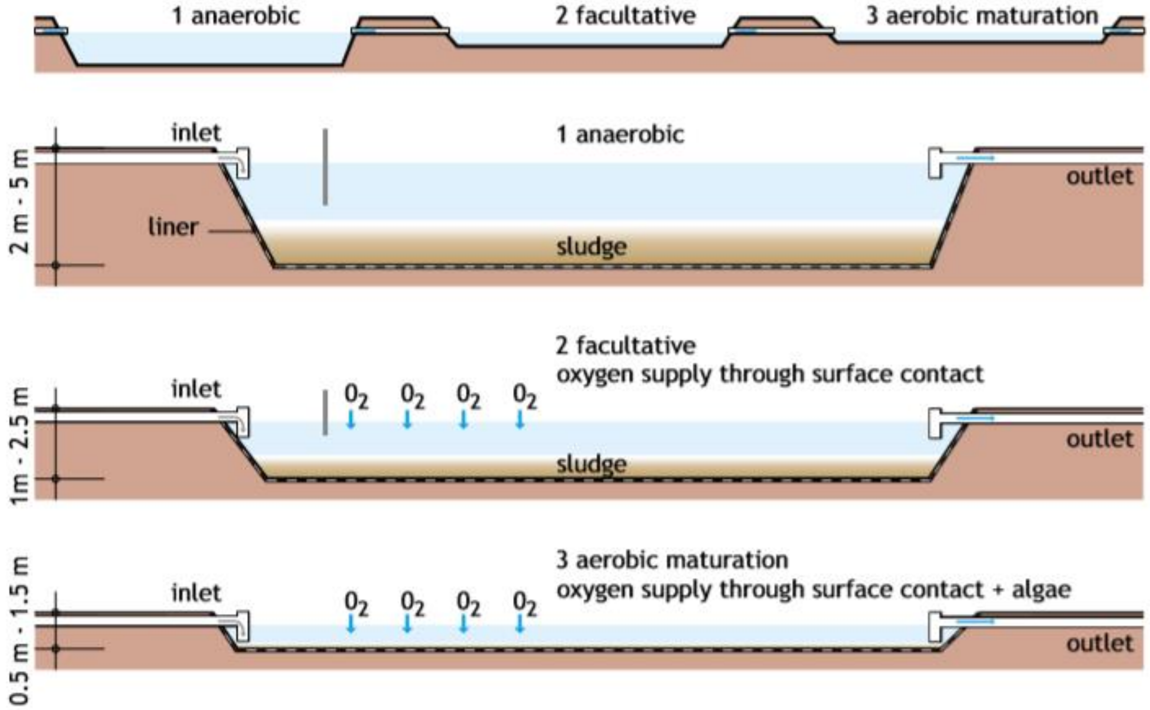


Figure 7: Stabilization Pond Treatment Process

3.5 BIOLOGICAL TREATMENT MECHANISMS: CO- COMPOSTING AND VERMI-COMPOSTING TECHNIQUES, STANDARDS, OPERATION PROCEDURES AND PRODUCTIVITY:

In FSM, biology is essential in the achievement of treatment objectives through transformation of organic matter and nutrients. Biology is also important in understanding mechanisms of pathogen reduction. Pathogens of concern such as Helminth eggs, while mechanisms of inactivation are covered in the following section.

Biological treatment harnesses the metabolism and growth rate of microorganisms in naturally occurring processes, and employs them in controlled situations to optimize the desired outcomes. Treatment systems usually rely on complex populations of microorganisms. As the microbes grow, they are dynamically altering the system, by modifying forms of organic matter, and releasing and binding up nutrients.

The biodegradable organic matter in FS varies depending on the source, but usually needs to be stabilized prior to final end-use or disposal. Stabilization involves the degradation of putrefiable, readily degradable material, leaving behind more stable, less degradable organics. This is important in order to reduce the oxygen demand, produce stable and predictable characteristics, reduce odors, and allow for easy storage and manipulation.

Composting and vermicomposting are the best and most efficient methods to produce organic fertilizer from human excreta. Faeces contain less nutrient than urine, the humus produced from faeces actually contains higher concentrations of phosphorous and potassium. Once the pathogens are destroyed through dehydration, the resulting inoffensive material can be applied to the soil to increase the amount of available nutrients, to increase the organic matter content and to improve the water-holding capacity.

3.5.1 CO-COMPOSTING OF FAECAL SLUDGE

Composting is a biological process that involves microorganisms that decompose organic matter under controlled predominantly aerobic conditions. The resulting endproduct is stabilised organic matter that can be used as a soil conditioner. It also contains nutrients which can have a benefit as a long-term organic fertiliser. The open composting system is to be used, open systems are lower in capital and operating costs but typically require more space ACTED has constructed 6 beds for the co- composting purposes each bed 6 X 4 meters; 4 beds out of the six will be used for the co-composting mixing while the additional two will serve as the final drying stage prior moving to the processing and packaging building.

In an open composting system, raw organic matter is piled up into heaps (called windrows) and left for aerobic decomposition. In Guiuan FSM each heap is meant to have 2 meters diameter and 2 meters height.

To ensure an optimal composting process, the following parameters need to be controlled:

- A carbon to nitrogen ratio (C: N) between 20-30:1 to ensure biological availability; as the organisms degrading organic matter need carbon as a source of energy and nitrogen for building cell structure. High nitrogen enhances ammonia loss due to volatilization. Higher C:N ratio hinders optimal growth of the microbial populations due to insufficient nitrogen. The compost heap will remain cool and degradation will proceed slowly. High carbon in the final compost product can create problems as microbial activity in the soil may use any available soil nitrogen to make use of still available carbon, thereby “robbing” the soil of nitrogen and thus hindering its availability for plants. During composting carbon is converted to CO and the C:N ratio decreases to a ratio of around 10:1 when the compost is stabilized.
- An oxygen concentration of 5-10% to ensure aerobic microbiological decomposition and oxidation. Aeration can be ensured by either providing passive ventilation structures (air tunnels) or can be enhanced by blowing or sucking air through the waste heap (called active or forced aeration). With forced aeration external energy is required. In Guiuan FSTP open system is used where the heaps are manually turned, although the main objective of this turning is to ensure that material on the outside of the heap is moved to the centre where it will be subject to high temperatures.
- A moisture content between 40 and 60 % by weight to ensure adequate moisture for biodegradation, and that piles are not saturated creating anaerobic conditions. Turning removes water vapour and thus the turning frequency depends primarily on the moisture content of the

material, as high moisture content reduces the availability of air in the pore space. If compost heaps become too dry, water must be added to ensure continuous biological activity.

- A particle diameter of less than five centimetres for static piles. Smaller particles degrade more rapidly as they provide more surface area for microbial decomposition. But on the other hand with smaller particles size aeration through the pile is hindered if structural strength cannot be maintained. Thus, particles size influences pore structure and aeration as well as surface area for degradation.
- In a properly operated composting heap the temperature rises rapidly to 60-70°C as heat is released when carbon bonds are broken down in an exothermic process. Pathogen die-off is highest during this time of high temperature. After approximately 30 days, the temperature drops down to 50°C. During the maturation phase the temperature is around 40°C, and the process ends once ambient temperature is reached. The whole composting process (including maturation) takes a minimum of six to eight weeks. While in the Guiuan FSM and according the weather condition in the area the co-composting process will take 90 days for the inactivation of all helminth eggs.

Optimal composting conditions with appropriate C:N ratio and moisture content can be achieved by mixing different waste streams together. For example, mixing of FS and Municipal Solid Waste (MSW) for co-composting can be advantageous as excreta and urine are relatively high in nitrogen and moisture, whereas municipal waste can be relatively high in carbon and low in moisture. Concentrations of high lignin materials should be limited as they are resistant to biological degradation. Corn stalks and straw made of a tough form of cellulose are also more resistant to degradation. Although all these materials can be used a higher initial C:N ratio to compensate for lower bioavailability must be considered. A moisture content between 40 and 60% is considered ideal which corresponds to the feel of a damp sponge. Higher moisture content limits air supply, creates anaerobic conditions and results in odor emissions.

Co-composting of FS with MSW is best implemented with sludge that has undergone dewatering (drying beds). Although untreated FS can also be used and sprayed over the compost heaps, its high water content will only allow the use of very little volume before the compost heap is too wet and is therefore not practical. Organic MSW usually already has a moisture of 40-60% so typically not much additional moisture can be added before the system gets too wet.

The organic fraction of the MSW and dried FS to be mixed in a ratio of 1:2 to 1:10; (The optimal selected in Guiuan FSTP is 1:2) and composted using an open windrow system (aeration by manual turning). During a composting cycle, the following activities are to be carried out: turning, watering, temperature measurement, weighing and sampling (followed by laboratory analysis). The matured compost to be sieved, packed in 20 liters bags and stored prior to reuse. The compost to be tested for its impact on the germination capacity of selected vegetables, the germination capacity acceptable range is between 70-100%.

With regard to helminth eggs, an optimum composting period of at least 2 months is necessary to produce compost that complied with the WHO guidelines of 1 Ascaris egg/gTS, thus exposing the helminth eggs for 90 days to temperatures over 45˚C, which the duration set for the co-composting process in Guiuan FSTP. Note that if these conditions are not met, pathogen reduction will not be adequate to meet the WHO guidelines. In that case, one possibility is extended storage prior to end-use.

Table 8: Design criteria and assumptions used for the Co-composting plant in Guiuan FSTP

Co-Composting	
Dried sludge per batch	1.28 m3/batch
Number of batches per year	2 batches/month
Bio-gradable solid waste/ dried sludge	5:5
Bio-gradable solid waste required	6.4 m3/batch
Inactivation time	3 months
Co-composting interval	0.5 month
Co-composting heap	7.68 m3/batch
Height	2 m
Length = Width (walled area)	1.96 m
Number of heaps	6
Area required for composting	92 m2
Redundancy	50%
Width	8.26 m
Length	17 m
Loss during composting process	50%
Co-compost per year	92.16 m3/year
Volume 1 bag of compost	20 Liters

The main advantage of co-composting is formed by the thermophilic conditions and the resulting pathogen inactivation. The output of co-composting is a good soil conditioner which provides potential for income generation depending on the demand for compost.

3.5.2 VERMICOMPOSTING

Earthworms are a member of the oligochaetes sub-class and they appear to be very effective in organic waste reduction. Interestingly, the earthworms seemed to function in synergy with bacterial communities within the filter. Worms cannot survive in fresh faeces and need some kind of support in the form of layers of soil and vermi-compost. Vermicomposting is not a reliable method to ensure adequate pathogen removal. However, when carried out under proper conditions the technology of vermicomposting can lead to a complete removal of coliforms. Permissible levels for reuse in agriculture are achieved after 60 days, starting from the initial earthworm inoculation, faecal coliforms, Salmonella spp., and helminth ova were reduced to <1000 MPN/g, <3 MPN/g, and <1 viable ova/g on a dry weight basis, respectively.

With vermicomposting, worms breakdown larger organic particles, stimulate microbial activity, and increase the rate of mineralization, thereby converting FS into humic like substances with a finer structure than normal compost. Vermicomposting should be operated at a maximum temperature of 35˚C in order to maintain the viability of worms. This temperature is not high enough to ensure pathogen inactivation, so, vermicomposting is combined with another approach such as storage.

In general, the advantages and constraints for vermicomposting are similar to the points for co-composting. However, vermicomposting cannot be carried out at the thermophilic temperatures of co-composting. Therefore, if adequate pathogen reduction is not achieved during treatment, further treatment steps are required. Constraints are that the technology is still in development; the worms can be quite susceptible to toxic components (or higher concentrations in general), and the time span until matured compost is reached can be longer than for thermal composting. The production of worms can be beneficial provided there is a market for them.

Table 9: Vermi-composting Processing Summary

Worm reactor	
Description	Quantity
Sludge per day	160 kg/day
Worms eat	2 kg/kg sludge
Worms needed	80 kg worms
Worms/Surface	2 kg worms/ m2
Surface needed	40 m2
Number of Beds	4
Length / Width ratio	6
Width	1.3 m
Length	8 m
Volume reduction	90%
Vermi-cast production	16 kg/day
Vermi-cast production	3200 kg/year

CHAPTER4: ADMINISTRATION PERSONNEL AND DATA LOGGING:

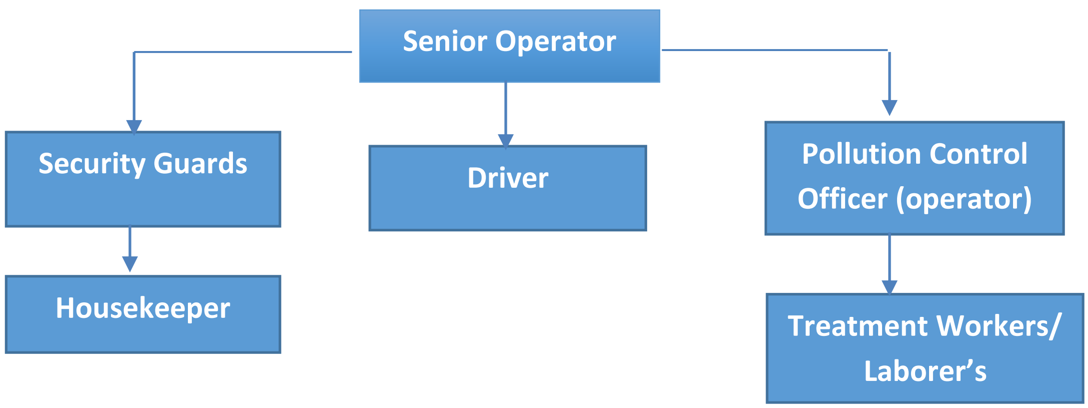
4.1 STAFFING, ORGANIZATIONAL STRUCTURE, ROLES AND RESPONSIBILITIES

Septage is biologically active material that must be handled with care. Operators must always employ good hygienic practices when handling or working with septage.

Operating the septage pumping equipment is a dangerous job. The operator is not responsible for their own personal safety, but for safety on the road during transport.
All service providers and personnel directly involved in the operations are required to undergo training on health, safety, and hygiene from DOH or DOH-recognized academic institutions, or professional organizations.

The organizational Chart for Guiuan FSTP is presented in the diagram below with detailed Roles and Responsibilities in the section below:

4.1.2 ORGANIZATIONAL STRUCTURE



4.1.2 ROLES & RESPONSIBILITIES:

A. Senior Operator

- Position is full-time
- Responsible for all the decision-making inside the facility.
- Management of all the internal and external transactions of the facility.
- Monitor employee work schedules, working hours and overtime
- Balance workloads among employees.
- Conduct hiring and training of new employees.
- Strictly implement rules and regulations inside the facility.
- Responsible for gathering all the data about the septage history, quality and volume before it is discharged.

B. Pollution Control Officer

- A part time position
- Supervise the operation of the facility.
- Evaluate work assigned to operators.
- Inspect areas of facilities for cleanliness and proper maintenance.

- Supervise and perform on-site maintenance.
- Initiate repairs inside the facility.
- Assist in monitoring the employee work schedules

C. Drivers

- Part-time
- In charge in desludging services
- Operates the vacuum trucks and the ROM for collection
- In charge for transferring the collected sludge to the Treatment Facility

D. Treatment Workers/Laborers

- A part time position
- Assist in the collection of dislodging services along with the driver
- Assist in treating the dislodge along with the PCO (Pollution Control Officer)
- Performed other duties as instructed by the Supervisor

E. Security guard

- A full time position.
- Handle safety and security inside the premises.
- Perform other duties as instructed by the supervisor.

F. Housekeeper

- A part time position
- Handle cleanliness inside the premises.
- Perform other duties as instructed by the supervisor.

4.2 DATA LOGGING PRACTICES

To ensure proper documentation of the collection and treatment processes and in order to be able to keep a record of all O&M related aspects the following documentation process shall remain in place:

- Operator's log book

The operators log book is perhaps the most important record for a FSTP. This log book provides a means of communication between operators of the plant and a written record of important events. Typical entries include the names of people on duty, weather conditions, any equipment malfunctions, operating problems, important phone messages, security information and actions taken in response to unusual circumstances.

- Reception monitoring reports

Reception monitoring reports record the amount of FS received at the plant each day, the discharge fees collected, and any issues reported by drivers or employees. Maintenance of accurate reception monitoring reports is critical as it minimizes fraud and assists in guaranteeing that the collected FS was delivered to the FSTP and not discharged elsewhere.

❖ Treatment unit operation sheets

Treatment unit operation sheets are used to record the quantity of FS loaded into each treatment unit, the operational activities performed (e.g. load of FS or extraction of end products), the operational variable applied (e.g. mixing ratio of fresh to stabilized sludge, addition of lime), the quantity of end products and wastes extracted, and the consumables required. The number of employees required and the relevant skills needed to perform all the activities should also be recorded, together with any difficulties encountered and potential solutions. These sheets therefore provide historical records of the maintenance carried out on each piece of equipment, the failures experienced and the solutions implemented, together with the budget and HR involved. Distinction should be made between preventative and reactive maintenance, and recommendations for optimizing the planning process made.

❖ Manifest form- Annex 1

The Manifest form shall include all of the following:

- Name of the client, complete address, and contact numbers;
- Date and time of collection;
- Source of sludge and septage (whether it is residential, commercial, or institutional);
- Estimated volume of sludge and septage collected (in cubic meters);
- Identity of transporter/hauler including the name of the operator, company, address, storage capacity of vehicle, plate number, body number, and name of driver;
- Destination (treatment/disposal facility) of collected sludge and septage, (the manifest form must be signed by the receiving facility, including the name and address of the facility);
- Date and time when the sludge and septage is received by the treatment/disposal facility; and

Other applicable conditions:

- The form shall be signed by the treatment facility operator and indicate, that it is a treatment plant, and not a disposal facility.

The service providers (including collection and transport and the treatment and disposal facilities) are required to retain copies of the manifest forms for a minimum of 3 years.

CHAPTER 5: PRECLUSIONS AND PREVENTIVE MAINTENANCE MEASURES.

5.1 MAIN PROCESSING HAZARD IDENTIFICATION AND PROTECTION MEASURES:

Main Hazards and risks associated with the with the FS collection and treatment process are summarized in the points below:

- Septage is an infectious material. It can cause disease if ingested or when it comes in contact with broken skin. Always wash hands immediately with soap after contacting septage or tools and equipment that may have contacted septage, and always before eating or drinking.
- Septage workers should be immunized for tetanus, hepatitis A, and hepatitis B.
- Never smoke while operating septage equipment. Septic tanks may generate methane, an explosive gas. Smoking also promotes the hand to mouth route of infection.
- Use caution around the septic tank. Never enter a septic tank. Every year people are killed because they enter tanks, which are confined spaces that may contain toxic gas or too little oxygen. Use caution when walking around septic tanks. Septic tanks may cave in or break when excessive weight is place on the lid or manhole cover.
- Always secure septic tank lids with screws or locks. Keep children safe by securing septic tank lids.
- Personal protective equipment – All employees are responsible for maintaining their personal protective equipment in good condition. This protective equipment includes among others,
    - Gloves
    - Boots
    - Hard hat and face mask
- Disinfecting and spill control equipment – Operators should be trained on identifying spills and proper methods of disinfecting pavement and equipment in the event of a spill. In Asia, septic tanks are often located in the home. Should spills occur while desludging septic tanks in homes, special care to clean and disinfect surfaces is important in maintaining good customer relations and avoiding complaints. Examples, of disinfecting methods and safety measures are:
    - Bleach solution – Typically one cup of bleach to 2 litters of water is a good solution for disinfecting surfaces.
    - Lime – only use outside. Sprinkle over spilled area, wait 15 minutes, then wash with water.
    - Safety cones – set up safety cones around spilled areas until properly disinfected.
- When using the lime stabilization method for treating septage, follow the recommendations below:
    - Avoid contact with skin or eyes to avoid severe burns.
    - Keep bags of hydrated lime dry. A wet bag can start a fire.
    - Do not put water on a fire involving hydrate lime. The water will react with the hydrated lime and cause it to release more heat.
- The following safety equipment should be used when handling quicklime:
    - Safety goggles;
    - Half-mask respirator with cartridge;
    - Shoulder-length, fully coated neoprene gloves;
    - Emergency eyewash, in case lime gets on the face or in the eyes; and
    - Carbon dioxide fire extinguisher, in the event of a fire.

Detailed consideration per each process is described below, in particular for the dislodging process starting with the collection, transport and the discharge to the FSTP:

- <u>Collection</u>

Collection should be done in coordination with the Barangay Captain or his/her duly authorized representative who shall sign the manifest form (see Annex F: Manifest Form).

Preferably, collection should be done when traffic is light in the area. All collection vehicles should have traffic cones or an early warning device. Traffic cones should be placed behind and in front of the vehicle during operation. It is the responsibility of the collection operator to check the safety equipment daily before proceeding to a collection site. Any safety equipment deficiencies should be reported to the supervisor.

After the desludging operation, the operator should clean and disinfect any spills with a bleach solution or by spreading lime on the spillage. It is the collection operator's responsibility to verify that sufficient disinfectant (bleach or lime) is on the truck before it goes to a collection site.

Desludging workers must wear appropriate personal protective equipment, including rubber gloves, rubber boots, a face mask, and eye protection. After pumping, operators must wash their hands with soap.

Only operators with a valid ESC and sanitary permit are authorized to collect and transport domestic sludge and septage. Only drivers with Land Transportation Office (LTO) License Restriction Code #3 can operate the desludging tanker/truck.

- <u>Transportation of Sludge and Septage</u>

The driver and service providers are responsible for safe operation of the vehicle and equipment at all times. Traffic rules must be followed at all times. All accidents and citations shall be reviewed and investigated by management to ensure adequately trained and competent drivers are employed for sludge and septage transportation. Additional requirements are:

- Drivers inspect all trucks prior to transport on public roads to ensure that septage will not leak, spill, or run out of the tank;
- All vehicles used to transport septage shall be equipped, at all times, with spill control or absorbent materials and disinfectant materials, such as lime or chlorine bleach;
- No discharge of septage or sludge shall be allowed in manholes, drainage areas, canals, creeks, rivers or other receiving bodies of water or land; and
- Manifest forms must be properly filled out.
- The collection vehicle and tank should be maintained to prevent excessive odors or public health hazards. To prevent these, the following needs to be done:
- The collection tank must be inspected frequently to ensure its water tightness;
- All piping, valves, and connections should be accessible for cleaning;
- All inlet and outlet connections should be maintained such that no material will leak, spill, or run out of the tank during transfer or transportation; and
- Discharge outlets should be maintained to control the flow of discharge without spraying or flooding the receiving area.
- The discharge pipe must protrude from the end of the tank at least 6 inches.
- The end of the discharge pipe must have a screwed-on end cap installed.

5.2 PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment (PPE) is equipment worn in order to minimize exposure to hazardous conditions, and includes:

- Hardhats to provide head protection from falling items.
- Eye protection such as safety glasses, goggles or face shields to protect against chemical or dust exposure.
- Gloves for hand protection from chemicals or abrasion, made from rubber latex or another materials dependent upon the specific hazard.
- Breathing safety devices such as respirators, dust masks or self-contained breathing apparatus (SCBA), should certain tasks require them;
- Other protective clothing including foot protection, and coveralls.

5.3 PREVENTIVE MAINTENANCE MEASURES:

- Corrosion control – scraping rust, painting metal surfaces, and repairing corroded concrete.
- Sludge and coarse solids extraction from the basins and canals.
- Repacking and exercising valves (i.e. locating and maintaining fully operational valves)
- Oiling and greasing mechanical equipment such as pumps, centrifuges or emptying trucks;
- Housekeeping activities including pickingup of refuse and vegetation control.

ANNEXES

Manifest Form

Sludge / septage origin

Name (Household unit owner)

Address

Date and time of collection

Source and volume of sludge/septage

Source	Check one	Volume (cubic metre)
Residential		
Commercial / industrial		
Institutional		
Wastewater treatment plant		

Commercial / industrial waste must be sampled and tested before it is offloaded at the treatment facility to ensure that the material will not contaminate the treatment process. Contamination can be caused by grease, oil, metals and chemicals.

Description of commercial / industrial waste:

Excavator / transporter

Operator / company	
Address	
Type of vehicle	
Plate number	
Name of driver	
Signature	
Driver's license number	
Name of other personnel	

Approved by authorised representative

(Name and signature)

Annex 1: Manifest Form

Septic Tank Application Form *(Name and Address of Municipality or LGU)*	
1. APPLICANT DATA Name: Address: Telephone:______________________________ Fax:	
2. TYPE OF APPLICATION (check where applicable)	**3. SEWAGE FLOW**

ACTED

Residential: ___ Commercial:	Number of bedrooms: ____ Number of people in residence:_____

4. SEPTIC TANK DESIGN INFORMATION:

Septic tank material: Concrete (poured in place)___ Concrete (precast):____ Hollow blocks_____

Plastic:_____ Fiberglass:____ Other:_______

Size: Total Volume (liters) :_________ Number of compartments:__________

Name and Manufacturer:____

Note: Use of steel, wood or other materials that may degrade in the soil is prohibited.

5. PLOT PLAN OR SKETCH. *Please show North arrow, building locations, septic tank locations, streets, driveways, cut banks, water lines and any other feature of the property that may affect the septic tank installation.*

Setback Table

Septic tanks must adhere to the following setbacks:

Wells: 25 meters Lake: 25 meters

Stream/river: 25 meters

Flood plain: 25 meters

Water lines: 3 meters

Structures: 1 meter

Property lines: 1 meter

Cut banks: 1 meter

FOR OFFICIAL USE ONLY

Approved by: ___________

Issue Date:_____________

Final Inspection:_________

Comments:_____________

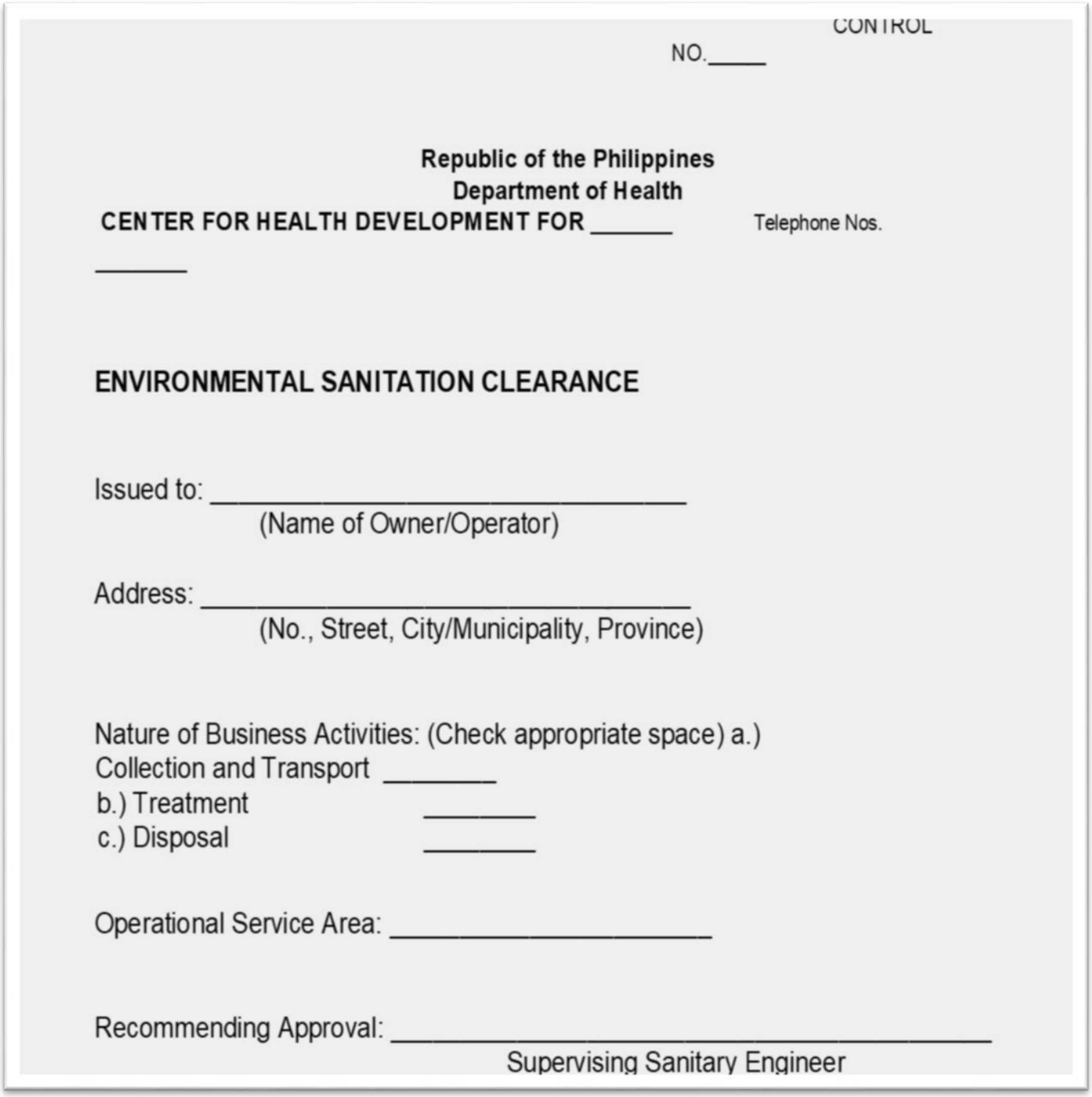
____

____

____

6. CERTIFICATION: I hereby certify that the above information is true and correct and that the proposed work will be done to meet the requirements of the building offi cial, health offi cer or sanitary inspector:
Applicant name:__________________________________ Date:_____________________________

Annex2: Septic Tank Application Form



CONTROL NO._____

Republic of the Philippines
Department of Health
CENTER FOR HEALTH DEVELOPMENT FOR ______ _______

Telephone Nos.

ENVIRONMENTAL SANITATION CLEARANCE

Issued to: ___________________________________
(Name of Owner/Operator)

Address: ____________________________________
(No., Street, City/Municipality, Province)

Nature of Business Activities: (Check appropriate space) a.) Collection and Transport ________
b.) Treatment ________
c.) Disposal ________

Operational Service Area: _______________________

Recommending Approval: ____
Supervising Sanitary Engineer

Annex 3:Environmental Sanitation Clearance from CHD