



ISO 9001:2008 CERTIFIED



# DECENTRALISED TREATMENT FACILITY (DTF) OPERATOR'S MANUAL



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## ANNEXES

Optimal functioning of a Decentralised Treatment Facility requires consistent coordination of operations of all the various Modules. It also requires observation of Health and Safety Standards. The DTF should be maintained and operated correctly in order to achieve maximum outputs.

This manual aims at equipping the DTF operators with the desired knowledge to effectively operate and maintain the facility while observing the health and safety requirements.



# HEALTH AND SAFETY



# 1. HEALTH AND SAFETY

## 1.1 PERSONAL PROTECTIVE EQUIPMENT (PPE)

### DEFINITION

According to Chapter 9 of the Occupational Safety and Health Policy Guidelines

Personal protective equipment refers to protective barriers / device or clothing that is worn by a worker in order to prevent any part of his or her body and that of the clients from coming into contact with a hazard(s) present at the place of work. Selection of PPE's will be done according to the risk assessment for specific work areas.

### General guidelines for using PPE

- » Assess the risk of the exposure to a hazard
- » Select appropriate PPE
- » Fit the PPE to the person
- » Use the right PPE for the right purpose
- » Avoid any contact between contaminated PPE and services or people outside the work area
- » Discard the PPE appropriately
- » Do not share PPEs
- » PPE should never be carried home and should be cleaned within work area.

### PPE Health and Safety



**Safety Goggles**  
to wear while operating and/or maintaining. Prevent eye contact with sludge splash and spray, gas, dust and chemicals

**Respiratory Mask**  
to wear while operating and/or maintaining, and especially when entering confined space. Prevent inhalation of dust and gas, and offer protection in oxygen-deficient atmospheres

**Protective Helmet**  
to wear while operating and/or maintaining, and especially when entering confined space or trimming trees. Protects the head from bumping or falling objects

**Rubber Gloves**  
to wear while operating and/or maintaining. Provide the first line of defence against cuts, abrasion and impact. Prevent skin contact with sludge and chemicals. Protect against electric shock, skin infection, disease or contamination

**Overall & Apron**  
to wear at any time during operational hours. Provide the first line of defence against cuts, abrasion and impact. Prevent skin contact with sludge and chemicals. Protect against adverse weather or extreme temperatures, skin infection, disease or contamination

**Harness & Safety Rope**  
to wear when entering a confined space to prevent falls or retrieve a person from a tank.

**Gumboots**  
to wear at any time during operational hours. Keeps feet and legs dry when working in wet conditions. Prevent slipping and protect against cuts, punctures, falling objects, sludge and chemical splash



## Additional Items

**First Aid Kit:** to store on-site in a dry area. Ensure it includes all basic first aid items (compress, bandages, antiseptic wipes, non-latex gloves, scissors, sterile gauze, tweezers, aspirin tablets, etc.). Check expiration dates and replace any used or out-of-date contents

**Fire Extinguisher:** to extinguish or control small fires in emergency situations. It is not intended for use on an out-of-control fire

**Fire Blanket:** to extinguish starting fire. To be placed over a fire in order to smother it.

**Bucket of Sand or Soil:** to extinguish small fires or cover spillage (sludge, oil, etc.)

**LED Flashlight:** to be used for security or maintenance purpose when visibility is limited.

**Anti-bacterial Soap:** to use for hands and body washing to avoid skin infection and prevent faecal-oral route disease transmission. Proper hand washing and hygiene are an effective barrier to stop the pathogens contained in the sludge from entering the mouth

## 1.2 SAFETY MEASURES

Use PPE as instructed

Do not smoke nor drink alcohol on-site

Keep the manhole covers closed at all time (unless in operation) to avoid falling and/or drowning hazards

Clean utensils and surfaces before food preparation and consumption

Clean working tools and monitoring equipment after each usage

Cover any skin injuries such as cuts and abrasions to prevent infection

During exhauster discharge event, prevent sludge spilling as much as possible by ensuring a tight connection into the receiving bay. In case of splash or spilling apply absorbing material (saw dust, ashes, cardboard, etc.) onto the sludge puddle to reduce contamination risks and prevent slip injuries

Keep the paths and treatment platforms clear of obstructions, to prevent trip and fall injuries and to allow swift and safe movements within the site

Control access to the site and do not leave visitors unattended

Get vaccinated (primary and booster shots) for tetanus and hepatitis A

Label sampling so that potable and non-potable water are clearly distinguished

Leave the PPE, working tools and monitoring equipment on-site and clean them regularly. Shower at work and change into clean clothes and shoes before leaving the DTF site

Wash hands with soap and water before eating or smoking and whenever hands come in contact with wastewater and sludge

In case of fire, gather at the designated fire assembly point

Do not use defective equipment, repair or replace them when necessary

## Confined Space Entry Procedure:



Working in an enclosed space, such as the DTF tanks and chambers, is dangerous because of the risks from noxious fumes, reduced oxygen levels or a risk of fire. Other dangers may include flooding/drowning or asphyxiation from other source such as dust or other contaminant.

### Before entering a confined space (DTF tanks) ensure that:

- ➔ A permit that has been prepared by the operator, is signed by the supervisor before and after the task (approval and completion of task)
- ➔ All manholes of the tank have been left open at least 24h before entering the tank, to prevent oxygen deficiency and excess of harmful gas such as hydrogen sulphide
- ➔ The person entering the tank is wearing a respirator mask, a helmet and a safety harness
- ➔ There is one person located outside the tank ready to provide assistance if needed
- ➔ The harness is attached to a safety rope held by a person outside the tank



## 1.3 EMERGENCY PROCEDURES



### In case of fire

#### KEY SKILL: Do not panic

1. Shout “FIRE”
2. Fight the fire if safe to do so
3. Call 999/911/112 or the fire brigade
4. Evacuate using acceptable route
5. Do not re-enter the site until told to do so



### First aid for someone who's unresponsive and not breathing.

#### KEY SKILL: The delivery of chest compression

1. Check breathing by tilting their head backwards and looking and feeling for breaths
2. Call 999/911/112 or your local hospital as soon as possible, or get someone else to do it
3. Push firmly downwards in the middle of the chest and then release
4. Push at regular rate until help arrives





**→ First aid for someone who's unresponsive and breathing**

**KEY SKILL:** Place the person on their side and tilt their head back

1. Check breathing by tilting their head backwards and looking and feeling for breaths
2. Move them onto their side and tilt their head back
3. Call 999/911/112 or your local hospital as soon as possible, or get someone else to do it

**→ First aid for someone who's bleeding heavily.**

**KEY SKILL:** Put pressure on the wound

1. Put pressure on the wound with whatever is available to stop or slow down the flow of blood
2. Call 999/911/112 or your local hospital as soon as possible, or get someone else to do it
3. Keep pressure on the wound until help arrives



**← First Aid for burns**

**KEY SKILL:** Cool the affected area

1. Cool the burn under cold running water for at least ten minutes
2. Loosely cover the burn with cling film or a clean plastic bag
3. Call 999/911/112 or your local hospital as soon as possible, or get someone else to do it

**→ First aid for a broken bone**

**KEY SKILL:** Immobilise the affected part

1. Encourage the person to support the injury with their hand, or use a cushion or items of clothing to prevent unnecessary movement
2. Call 999/911/112 or your local hospital as soon as possible, or get someone else to do it
3. Continues supporting the injury until help arrives





## First aid for poisoning and harmful substance

**KEY SKILL: Establish what? When? And how much?**

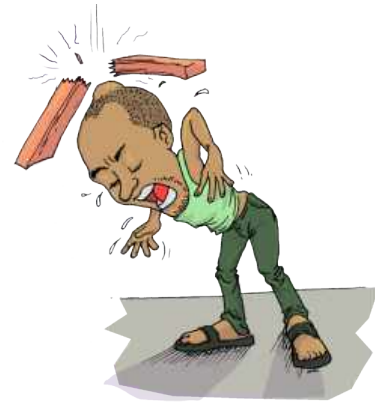
1. Establish what they have taken. When? And how much?
2. Call 999/911/112 or your local hospital as soon as possible, or get someone else to do it
3. Do not make the person vomit



## First aid for a head injury

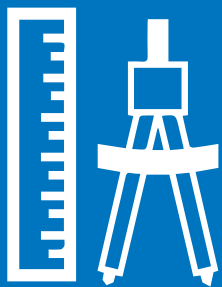
**KEY SKILL: Apply something cold**

1. Ask them to rest and apply a cold compress to the injury
2. If they become drowsy or vomit, call 999/911/112 or your local hospital



## 1.4 EMERGENCY CONTACTS

NO.	CONTACT	WHEN TO CALL	TELEPHONE NUMBER
1.	Fire and Ambulance Services	<i>In any kind of emergency</i>	
2.	Local hospital	<i>In case of physical accident</i>	
3.	Local fire station	<i>In case of fire accident</i>	
4.	Local police station	<i>In case of robbery or to report a crime</i>	
5.	Water Service Provider	<i>For any matter regarding DTF</i>	
6.	Local public health office	<i>To report any public health related issue</i>	



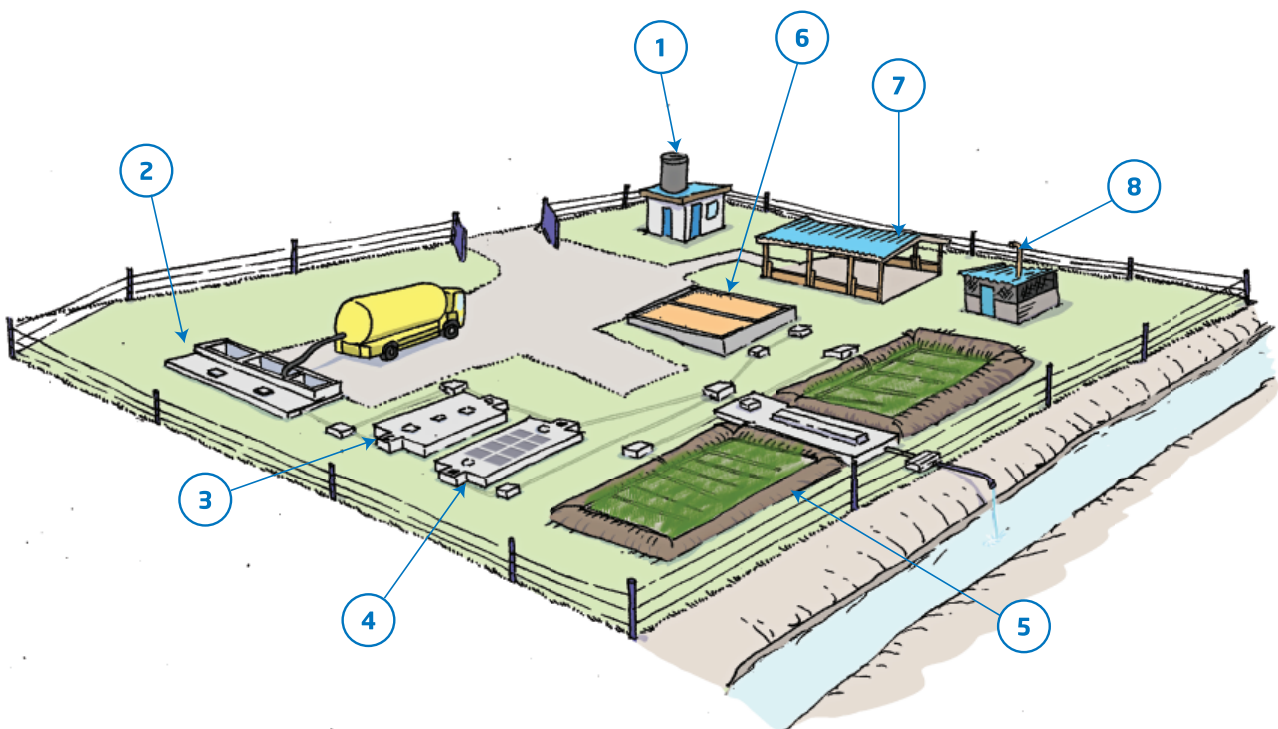
# TECHNICAL DESCRIPTION

## 2. TECHNICAL DESCRIPTION

### 2.1 DTF OVERVIEW

The generic DTF has a capacity of 22m<sup>3</sup>/day. The various modules/stages of treatment in the DTF are as follows:

1. Operator Store
2. Receiving Bay / Balancing Tank
3. Settler
4. Anaerobic Baffled Reactor
5. Vertical Flow Constructed Wetland
6. Sludge Drying Beds
7. Composting Area
8. Waste Disposal Unit



### 2.2 DTF MODULES

#### 1 Operator Store - OS

The OS is a two room building with one main office and one washroom with hand washing facility, shower and WC. The building is used as operator's office, tool and equipment store as well as guard's house. It is supplied with water (connected to service line or supplied by water bowser) and electricity (power grid or solar). Truck drivers and all visitors should report at the OS once they have entered the DTF. At this stage the operator has the duty to register the visitor once this one has been approved access.



## 2 Receiving Bay / Balancing Tank - RBBT

The RBBT is the first module of the DTF which offers preliminary treatment to the faecal sludge received. It is divided in two compartments:



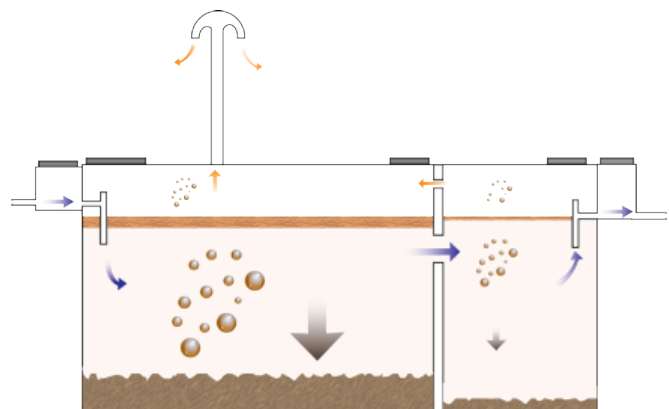
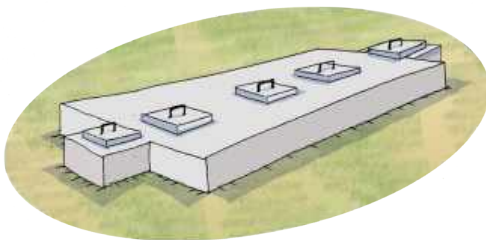
- ▶ The RB is an inlet arrangement with coarse and fine screens. The exhauster parks at the dock station and offloads its contents. The solid waste is manually removed from the screens and placed on the platforms to dry-out. Once it is dry the waste is collected in the solid waste chamber.



- ▶ The BT acts as a buffer tank. It can store up to 30 m<sup>3</sup> of faecal sludge. It also controls the discharge towards the rest of the DTF at a flow rate of 1 to 2m<sup>3</sup>/h. The opening of the valve at the outlet should be regulated to allow for this flow rate. Therefore the BT can store the faecal sludge up to 24h. In case the balancing tank exceeds its capacity, an overflow pipe has been provided to discharge surplus waste water to the next module.

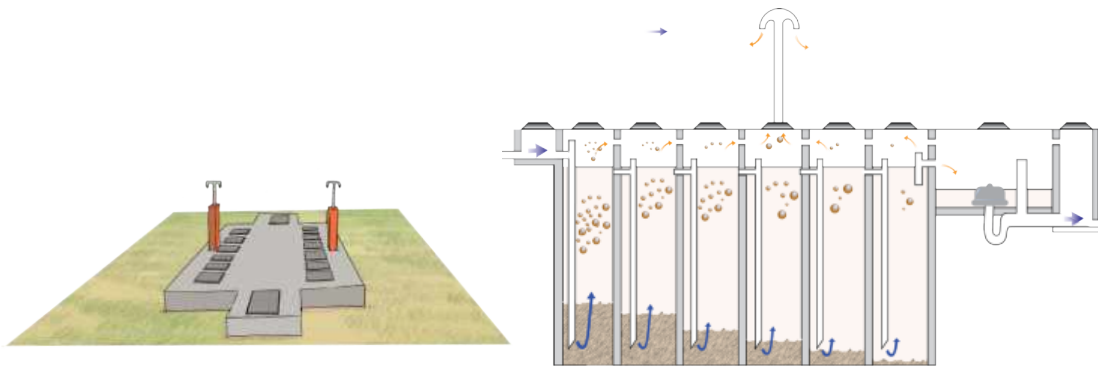
## 3 Settler - ST

The ST is the second module of the DTF treatment line. It provides mechanical primary treatment which consists mainly of sedimentation and flotation of inorganic material (biological degradation of settled solids occurs partly). The ST is split into two tanks with a length ratio of 2:1. The primary tank has a T-Piece inlet to give transitional flow to prevent - disturbance of the scum. The solids and sludge settle and accumulate at the bottom while the scum (lightweight materials including paper, fats and greases) rises to the surface. A baffle wall in between the two tanks prevents the scum and sludge layer from moving into the secondary tank. Only the liquid supernatant is to pass on to the next tank. The inlet-outlet level difference is 100mm to give the required hydraulic gradient. The volume of the ST is 65m<sup>3</sup> with a water depth of 2.5m. The minimum hydraulic retention time is 48h to allow for sufficient sedimentation of inorganic solids.



#### 4 Anaerobic Baffled Reactor - ABR

The ABR is the third module of the DTF treatment line. It provides biological secondary treatment consisting of biodegradation of organic material by the micro-organisms contained in the settled sludge. The ABR is divided in 2 rows of 6 successive chambers each. Three parallel down pipes are located at the inlet of each chamber, leading the incoming flow toward the bottom of the chamber. The inflow is forced to pass through the activated sludge where anaerobic bacteria are feeding from the organic material contained in the inflow to be treated. The inlet-outlet level difference is 150mm to ensure hydraulic gradient. The water depth is 1.85 m bringing the volume capacity to 22m<sup>3</sup>. The minimum hydraulic retention time is 12h to ensure biological degradation of organic material. The siphon unit located at the outlet of the ABR discharges the effluent towards the next module in intermittent doses of 1.5 to 2m<sup>3</sup> leading to an average of 12 flushes per day

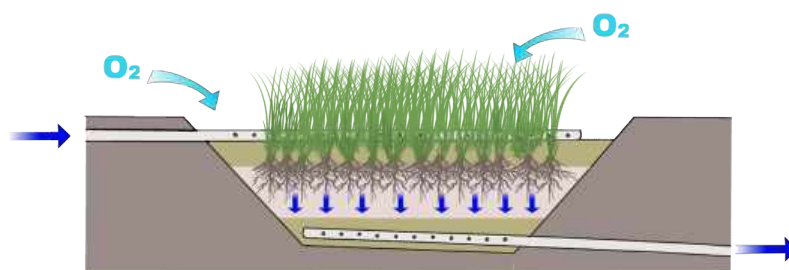


#### 5 Vertical Flow Constructed Wetland - VFCW

The VFCW is the last module of the DTF treatment line. It offers the final cleaning process that improves the effluent quality before it is discharged to the receiving environment. The VFCW is a planted filter bed that acts as:

- ▶ a filter for removing solids
- ▶ a fixed surface upon which bacteria can attach
- ▶ a base for the vegetation whose roots permeate the filter media and harbour variety of micro-organisms.

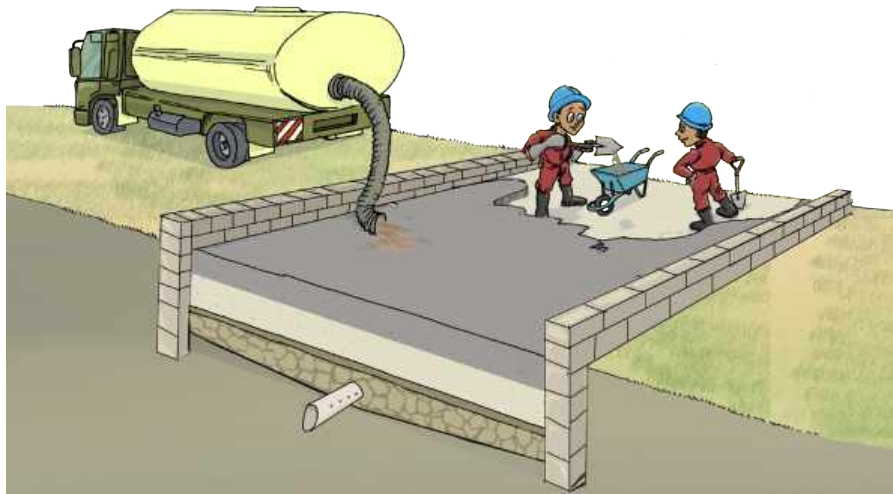
The pre-treated waste water from the ABR is loaded intermittently onto the surface of the VFCW through perforated pipe system. The water flows vertically down through the filter layer to the bottom of the bed where it is collected in a drainage pipe system. The waste water is treated by a combination of biological and physical processes. The intermittent batch loading and long resting periods enhance the oxygen transfer through the porous media and leads to high aerobic degradation activities. By forcing the organisms into a starvation phase between dosing phases, excessive biomass growth can be decreased and porosity increased. This is ensured by the intermittent load from the siphon and the alternate use of each filter bed: 1 bed is used for 15 consecutive days only. Nutrients and organic material are absorbed and degraded by the dense microbial population and pathogens are removed by natural die-off or predation by higher organisms.



## 6 Sludge Drying Beds - SDB

The SDB is a treatment module that runs parallel to the main DTF treatment line. SDBs are shallow unplanted filter beds with media consisting of sand and gravel. An underdrain pipe at the bottom of the beds collects the leachate which is conveyed to the next treatment module

Sludge from other DTF modules (Balancing tank, Settler and ABR) is discharged onto the surface for dewatering. The drying process in a SDB 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. Approximately 50 to 80% of the sludge volume drains off as leachate, which is then directed to the DTF treatment line for further treatment prior to discharge. After reaching the desired dryness, the sludge is removed from the bed manually and can be used as soil conditioner or base for organic fertiliser (compost). The thickness of dry sludge should not exceed 300mm, leaving 400mm of freeboard between the top level of the sludge and the edge of the beds.



## 7 Composting Area - CA

The CA is a treatment module that runs parallel to the main DTF treatment line. The CA is an open roofed shed that is used to shelter the collected dry sludge and organic waste, and to accommodate co-composting activities. The dry sludge comes from UDDT (dry toilets) or from the SDB. The dry sludge is mixed with organic waste at a ratio of 1:2 or 1:3 to produce compost. The compost heap are periodically watered and turned in order to provide an adequate balance between heat and oxygen supply. It takes approximately 3 months to produce a mature compost. The composting shed is equipped with a drainage channel connected to a soak away pit (for entering storm water and compost leachate) and a rain harvesting system from the two pitch roof.



## 8 Waste Disposal Unit

The Waste disposal unit includes the following elements:



- ▶ An incinerator (De Montfort model) to burn waste and reduce it. The incinerator destroys 6-7kg of solid waste per hour
- ▶ A waste store to securely accumulate waste that is to be incinerated and to stock the fuel material (wood or agro-residues) required to preheat the incinerator.
- ▶ A shelter to protect the incinerator, the operator and the waste being incinerated from the rain, the fuel and the operator's tools. Moreover, it supports the 4m high chimney.

The incinerator is made of firebricks and prefabricated metal components. It comprises primary and secondary chambers. The burning zone of the primary chamber is accessible through a front door, which lets in air, allow the operator to light the fire and also allow the removal of ashes. Once the solid waste screened at the Receiving Bay is dry, it is brought to the Waste Disposal Unit and dropped in through a loading door above the primary chamber. The secondary chamber, which is inaccessible to the operator, is separated from the primary chamber by a brick column with an opening at the bottom to induce a cross draught during operation. Additional air is drawn into the secondary chamber through a small opening in the lower section of the rear wall of the secondary chamber. This air mixes with the partially burnt flue gas from the primary chamber and causes secondary combustion. The chimney mounted above the secondary combustion chamber releases the flue gases into the atmosphere.





# DTF RULES & REGULATIONS



## 3. DTF RULES & REGULATIONS

### 3.1 Code of conduct

Waste water and faecal sludge operations is a professional occupation that requires education, training and experience. In this profession, staff involved in the operation of a DTF must be dedicated to the protection of public health and act skilfully and conscientiously. DTF Operators have a direct impact on the environment, the preservation and protection of which affects the quality of life for all residents.

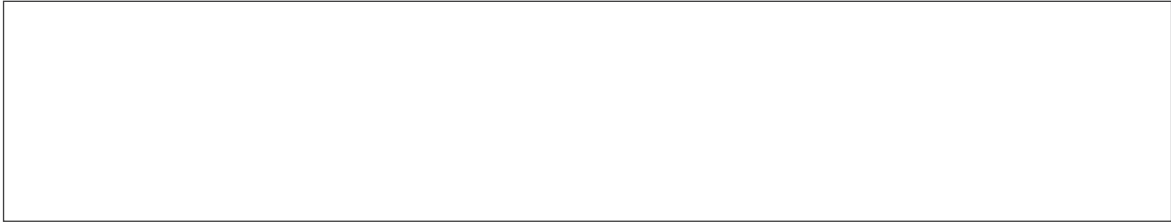


DTF Operators, in fulfilment of their professional duties, shall:

- 1. Hold paramount the health and welfare of the public.**
  - » Follow all procedures and guidelines designed to prevent pollution from occurring
  - » Strive to increase public knowledge of the faecal sludge and wastewater treatment field and its importance by leading tours of the DTF
- 2. Protect the property and the environment.**
  - » Properly and conscientiously operate and maintain the DTF
  - » Strive to maintain the aesthetic of the environment in and around the facilities
- 3. Properly and accurately complete required records**
  - » Be objective and trustful in data collection and reporting
  - » Acknowledge errors and do not distort or alter the facts
- 4. Follow and comply with the county and government rules and regulation**
  - » Be familiar with all details of the permit requirements that apply to the DTF and understand the consequences of violations caused by inaction or negligence
- 5. Follow health and safety measures and ensure best possible service**
  - » Always consider your personal safety, the safety of the fellow workers and that of any other person present at the DTF site while performing your duty
  - » Endeavour to increase your knowledge and skills through continuing education activities
- 6. Avoid unprofessional practices and act honourably, responsibly, ethically and lawfully so as to enhance the reputation of the profession**
  - » Accept personal responsibility for your professional actions
  - » Do not untruthfully criticize the Water Service Provider and/or other colleagues so as to injure professional reputation or employment

### 3.2 Site regulation

#### Operating hours:



#### Access control:



On a daily basis and from an operational point of view, access to the DTF is strictly restricted to:

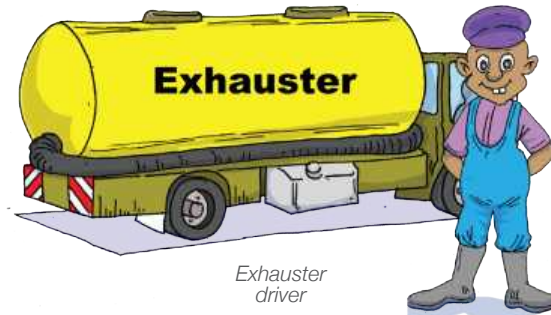
- » DTF staff who possess a professional ID card that they should be able to show to the competent authority at any time
- » Exhauster drivers that have been scheduled from the WSP office to discharge at a given date



*DTF Security Guard*



*DTF Operator*



*Exhauster driver*

In case of exceptional event such as:

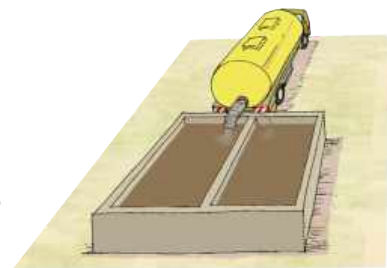
- » External service provided: collection of lab sample, desludging, etc.
- » Educational or exchange visit: schools, universities, communities, other WSP, etc.
- » Official visits: governmental authorities, county, PHO, partner institutions, etc.



*Collection of sample*



*Educational visit*



*Desludging*

Authorisation should be given from the WSP who is in charge of organising the event and communicating with the DTF staff in time. Each visitor should be registered in the visitor's book and should obtain a Visitor's badge at the gate.



### 3.3 Discharge rules

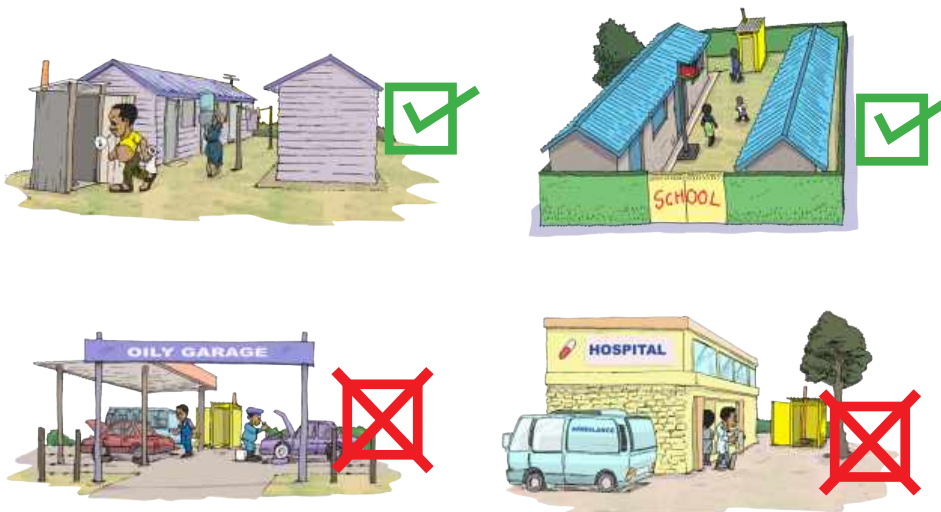
#### DTF capacity

The DTF has a design capacity of 22m<sup>3</sup> per day, which corresponds to the equivalent of approximately 3 exhausters per day



#### Approving faecal sludge for discharge

Waste from different sources can have widely different characteristics, which may impact upon the operation and the treatment efficiency of the DTF. Residential faecal sludge (from pit latrines or septic tanks) is relatively free of toxic chemicals and therefore is the most suitable for the DTF. Faecal sludge from restaurants may have significant quantities of fats, oil and grease. Since the DTF is not equipped with grease traps, this source of faecal sludge is not recommended. Faecal sludge from auto repair shops, dry cleaning establishments and hospitals may contain toxic materials that are detrimental to the treatment process by killing the living biomass responsible of the treatment. Therefore, faecal sludge from these commercial or institutional settings is to be avoided.





# START UP PERIOD



## 4. START-UP PERIOD

### 4.1 Objectives

For a newly built DTF, a transition period is necessary at the beginning before reaching the full potential of operation:



- ▶ to help the bacteria to multiply and by doing so reaching the required treatment efficiency,
- ▶ to enable reeds (from Vertical Flow Constructed Wetland) to grow and adapt to their environment,
- ▶ to define adequate operation, maintenance and monitoring procedures.

The time required for the start-up period may vary from 2 to 6 months, depending on the climatic conditions.

### 4.2 Conditions



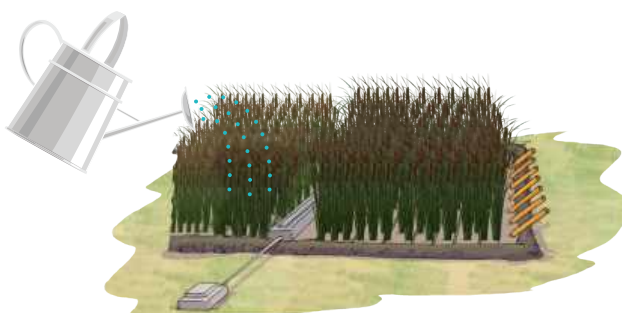
*Dry Season*

Dry and rainy season have an influence on the treatment efficiency. Therefore, in order to assess the ideal loads and retention time, it is recommended that the start-up period covers at least two seasons.



*Rainy Season*

Before the first offload, ensure all tanks, chambers and pipes are empty and clean (sediment should be removed).



Water the wetland's reeds until the DTF is fully operational to avoid the plants from wilting and dying.

### 4.3 Inoculation process

Inoculation of the DTF modules is done to activate the treatment process with fresh active bacterial material. Two procedures are possible:

#### Option 1

Discharge the faecal sludge from several exhauster trucks into the receiving bay at once, allowing it to flow into the DTF until it fills the settler and ABR modules. Considering the design of the two modules, a volume of around 90m<sup>3</sup> must be filled. Assuming that the average capacity of an exhauster truck is 8m<sup>3</sup>, the discharge of around 11 exhausters is necessary to fill the 2 settler compartments and the 12 ABR chamber. Select the first 11 exhausters to offload a fresh thick sludge from pit latrines or septic tanks (high organic load). Leave the faecal sludge to stay for a period of 14 days. During this time the level of settled sludge is measured and recorded. After 14 days and if the quality of settled sludge and supernatant is satisfying (thick blanket of sludge and clear supernatant), start the operation gradually (see next chapter).



#### Option 2

If the required volume of thick faecal sludge is not available, prepare the equivalent of 1.8m<sup>3</sup> cow dung (approx. 30 wheelbarrow). The cow dung is mixed with water in 1:1 ratio (i.e. mix 1 bucket of water to 1 bucket of cow dung) and stirred to form a slurry. Filter the slurry by passing it through a 15mm sieve (to remove all unwanted matter, such as fibre, wood, polythene, etc.). Pour the slurry in the 2 settler compartments and the 6 first chambers of the ABR to form a layer with a thickness of 300mm. Start the operation the next day.



## 4.4 Gradual inflow



It is recommended to start operations with less than the full daily inflow (wastewater/sludge) capacity and to increase the daily quantity steadily over the first three months. This helps the bacteria to multiply and accumulate in the active sludge layer (Settler and ABR) and the biofilm (VFCW) without being flushed out.

- ▶ First month of operation: start with one exhauster (or  $8\text{m}^3$  per day)



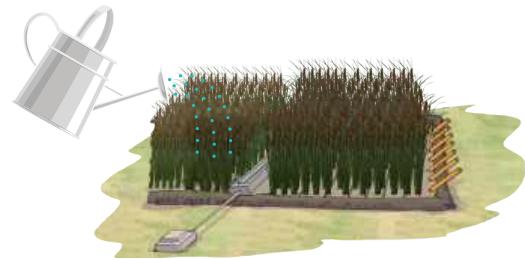
- ▶ Second month: increase to two exhauster (or  $20\text{m}^3$  per day  $15\text{m}^3$  per day)



- ▶ From the third month: increase to the full capacity which is three exhauster (or  $22\text{m}^3$  per day)



During the first two months, the reeds from the VFCW need to be irrigated with fresh water to compensate from the lower volume of effluent and to enable the young plants to acclimate gradually to their new environment.



## 4.5 Monitoring

During the first 6 months of the DTF operation, basic parameters (Temperature, pH, BOD, COD, Suspended Solid, TNb, TP, pathogens) should be measured on a monthly basis (see monitoring chapter).





# OPERATION & MAINTENANCE



## 5. OPERATION & MAINTENANCE

### 5.1 List of equipment



### 5.2 O&M procedures

#### 5.2.1 Receiving Bay



**General remark:** before entering or operating in the receiving bay, open all covers (if any) for at least 1 hour, lift both screens to facilitate movement inside the module, and don't forget your respirator and helmet



Time interval	Task
Daily	<ul style="list-style-type: none"> <li>Rake the solid waste from the two screens after each exhauster offload and spread it on top of the drying platform. When the solid waste is dry, shift it into the solid waste chamber.</li> <li>Clean the receiving bay with water to avoid odours and remove silt and sludge residue</li> </ul> <p><b>Remarks</b> Cover the openings of the receiving bay at night and during rain event to prevent rain water to enter the system.</p>
Weekly	<ul style="list-style-type: none"> <li>Remove (for incineration or disposal) the solid waste from the chamber</li> </ul> <p><b>Remarks</b> The solid waste chamber should have the possibility to be covered in case of rain event</p>
Annually	<ul style="list-style-type: none"> <li>Clean the metal parts (screens and covers) and apply from time to time one coat of water paint and two coats of quality gloss paint to avoid corrosion</li> <li>Apply a coat of paint on the external PVC pipe to protect them from weathering. Replace them when necessary</li> </ul>



Raking off the solid waste



Storage of the dry waste in the solid waste chambers



Incineration of the solid waste

## 5.2.2 Balancing tank



**General remark:** when opening the manhole's cover, don't forget your respirator, don't face the manhole directly and wait at least 1 hour before operating in the tank (removal of floating material, scum or sludge)



Time interval	Task
Daily	<ul style="list-style-type: none"> <li>Inspect the outlet chamber to check for blockages and control the valve opening</li> </ul>
Weekly	<ul style="list-style-type: none"> <li>Inspect and remove the floating material that might have gone through the screens</li> </ul> <p><b>Remarks</b> The floating material found in the tank should be disposed the same way as the solid waste</p>
Monthly	<ul style="list-style-type: none"> <li>Remove the grit and settled sludge manually when it has accumulated (&gt;5 cm) and dispose the material in the sludge drying beds</li> </ul> <p><b>Remarks</b> Before entering the tank, ensure it is empty, leave the manholes open for at least 3h and don't forget your respirator and helmet</p>



Control of the flow rate



Removal of floating materials



Removal of grit and settled sludge

### 5.2.3 Settler

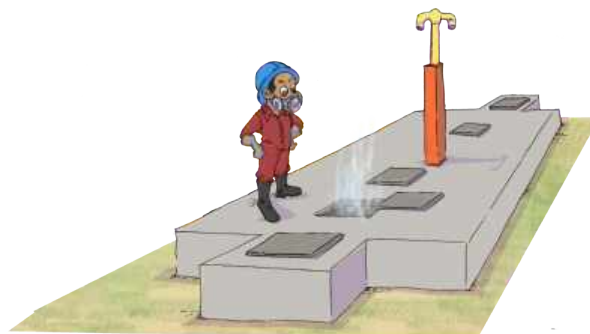
#### General remark:



When opening the manhole's cover, don't forget your respirator, don't face the manhole directly and wait at least 1 hour before operating in the tank (removal of floating material, scum or sludge)



Avoid as much as possible to enter the tanks due to presence of toxic gases and insufficient oxygen. In specific cases (cleaning, repairs, etc.) strictly follow the confined space entry procedures (see chapter 1.2 safety measures)



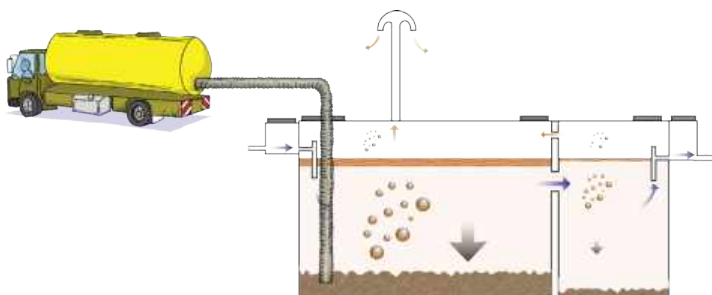
Time interval	Task
Daily	<ul style="list-style-type: none"> <li>Inspect the inlet and outlet chamber daily to check for any blockages</li> </ul>
Weekly	<ul style="list-style-type: none"> <li>Inspect and remove the floating material from both tanks</li> </ul> <p><b>Remarks</b> The floating material found in the tank should be disposed the same way as the solid waste</p>
Monthly	<ul style="list-style-type: none"> <li>Remove the scum with a skimmer and ensure the scum thickness does not exceed 5cm</li> </ul> <p><b>Remarks</b> The scum is disposed in the sludge drying beds</p>
Semi Annually	<ul style="list-style-type: none"> <li>Inspect and monitor the level of sludge (with the sludge judge) in both tanks</li> <li>Remove the sludge with a vacuum pump when the layer has reached a thickness of 60 cm</li> </ul> <p><b>Remarks</b> Leave a minimum of 10 cm layer of sludge to ensure active biomass The sludge is disposed in the sludge drying beds</p>



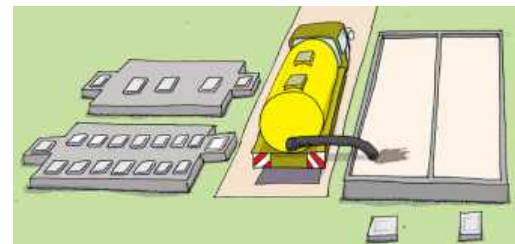
Removal of floating materials



Monitoring of sludge level



Desludging



Disposal of sludge in the sludge drying bed

## 5.2.4 Anaerobic Baffled Reactor



When opening the manhole's cover, don't forget your respirator, don't face the manhole directly and wait at least 1 hour before operating in the tank (removal of floating material, scum or sludge)



Avoid as much as possible to enter the tanks due to presence of toxic gases and insufficient oxygen. In specific cases (cleaning, repairs, etc.) strictly follow the confined space entry procedures (see chapter 1.2 safety measures)



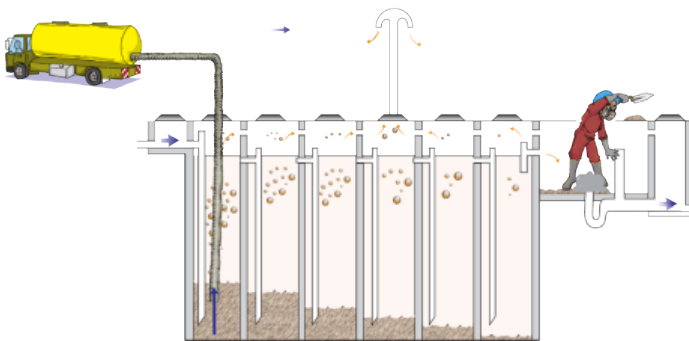
Time interval	Task
Daily	<ul style="list-style-type: none"> <li>Inspect the inlet and outlet chamber daily to check for any blockages</li> </ul>
Weekly	<ul style="list-style-type: none"> <li>Inspect and remove the floating material from all 12 chambers</li> <li>Remove manually any settled sludge from the siphon chamber</li> </ul> <p><b>Remarks</b>  <i>The floating material found in the tank should be disposed the same way as the solid waste</i>  <i>To operate in the siphon chamber, wait that the chamber is almost empty (when the flush has just occurred) to enter the chamber and don't forget your respirator and helmet</i>  <i>The sludge collected is disposed in the sludge drying beds</i></p>
Monthly	<ul style="list-style-type: none"> <li>Remove the scum with a skimmer and ensure the scum thickness does not exceed 5 cm</li> </ul> <p><b>Remarks</b>  <i>The scum is disposed in the sludge drying beds</i></p>
Semi Annually	<ul style="list-style-type: none"> <li>Inspect and monitor the level of sludge (with the sludge judge) in all 12 chambers</li> <li>Remove the sludge when the layer has reached a thickness of 150 cm</li> </ul> <p><b>Remarks</b>  <i>Leave a minimum of 30 cm (50 cm in the first four chamber) layer of sludge to ensure active biomass</i>  <i>The sludge is disposed in the sludge drying beds</i></p>



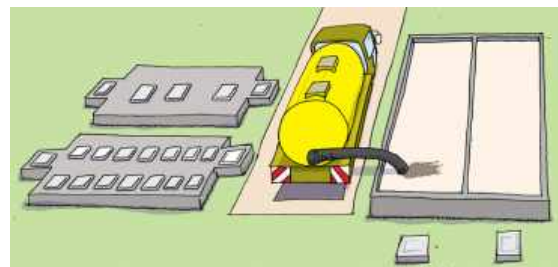
Removal of floating materials



Monitoring of sludge level



Desludging

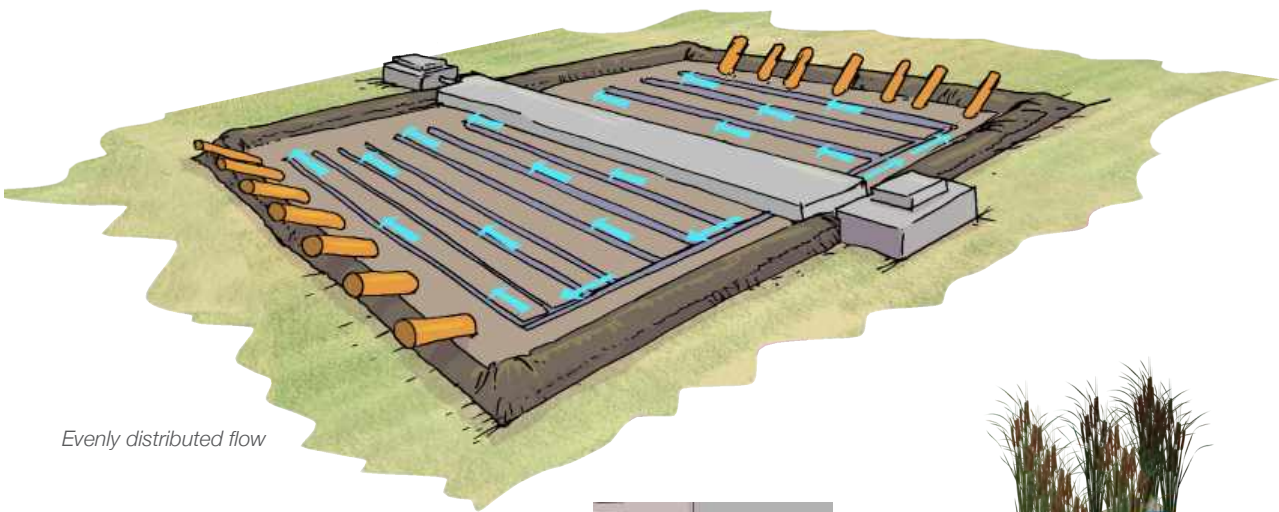


Disposal of sludge in the sludge drying bed

### 5.2.5 Vertical Flow Constructed Wetland

Time interval	Task
Daily	<ul style="list-style-type: none"> <li>Inspect of the feeding pipes to ensure flow is evenly distributed</li> <li>Inspect the surface of the basin to ensure water level is below the surface (no saturation)</li> <li>Ensure moderate growth of aquatic plants (reeds)</li> <li>Inspect the embankments of the beds to ensure their stability</li> </ul>

<b>Weekly</b>	<ul style="list-style-type: none"> <li>Inspect the central drainage channel to ensure that the flow is evenly drained, that there is no leakages in the basin (same volume coming in and out) and that no filter media is being washed out</li> <li>Inspect the condition of the ball cock valves and the saddle clamps in the distribution chamber (no leakage)</li> </ul>
<b>Every 2 weeks</b>	<ul style="list-style-type: none"> <li>Interchange the use of each wetland</li> </ul>
<b>Monthly</b>	<ul style="list-style-type: none"> <li>Remove regularly the weeds and other plants that might interfere with reeds growth</li> <li>Remove the plant litter when it entirely covers the surface of the wetland</li> </ul>
<b>Semi Annually</b>	<ul style="list-style-type: none"> <li>Harvest the aquatic plants (reeds) when vegetation become too dense</li> </ul>
<b>Every 5 years</b>	<ul style="list-style-type: none"> <li>Replace or wash the filter media when it is clogged or when efficiency is reduced</li> </ul> <p><b>Remarks</b> The washing is done by spreading the filter media on the ground outside the wetland, washing it with a high pressure hose and letting it dry for 1 day</p>



Evenly distributed flow



Filter media being washed out

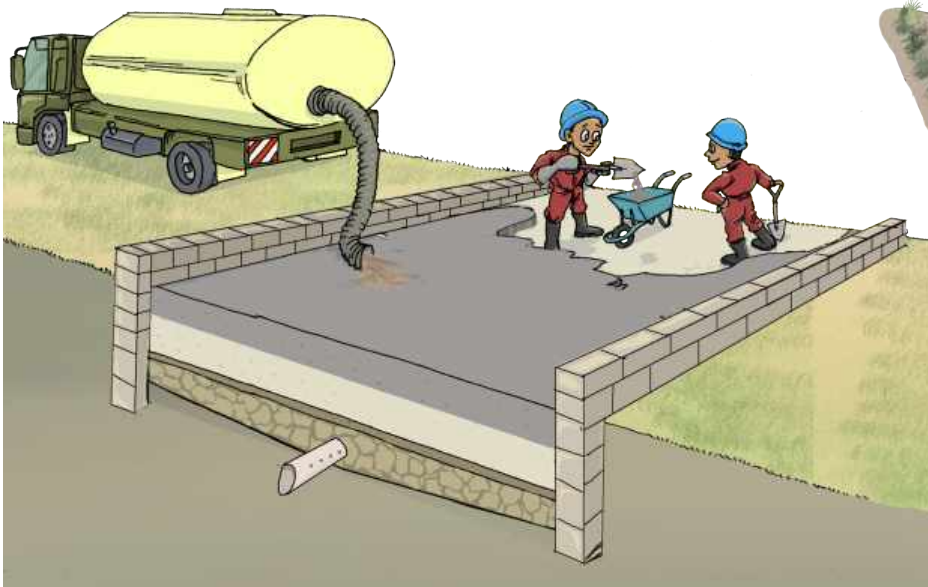


Weeding of the surface of the basins

## 5.2.6 Sludge Drying Beds

<b>Time interval</b>	<b>Task</b>
<b>At every sludge discharge</b>	<ul style="list-style-type: none"> <li>Ensure that before allowing the discharge of an exhauster in a bed, the sludge level allows a minimum of 40 cm freeboard</li> <li>Ensure that the sludge is distributed evenly across the whole bed surface</li> <li>Ensure that under dry condition the water contained in the sludge is being drained (no clogging in the filter media)</li> <li>Remove and dispose of the solid waste that might have been discharged along with the sludge</li> </ul>

<b>Once the sludge is dry and has reached its maximum level</b>	<ul style="list-style-type: none"> <li>Remove the dry sludge manually (with a shovel and a wheelbarrow) trying not to disturb the sand layer too much</li> </ul> <p><b>Remarks</b> The dry sludge can be used as soil conditioner (for non- edible crops) or can be processed further with organic waste to produce compost (fertiliser)</p>
<b>Weekly</b>	<ul style="list-style-type: none"> <li>Remove the weeds, plant's roots and leaves (from surrounding trees)</li> </ul>
<b>Monthly</b>	<ul style="list-style-type: none"> <li>Inspect the outlet chamber of each bed to ensure that there is no clogging or breakage of the underdrain pipe, that there is no leakage at the bed liner level and that no filter media is being washed out</li> </ul>
<b>Semi Annually</b>	<ul style="list-style-type: none"> <li>Top-up (after 10-20 drying sequences) the sand layer</li> </ul>
<b>Every 5 years</b>	<ul style="list-style-type: none"> <li>Replace or wash the filter media when it is clogged or when efficiency is reduced</li> </ul> <p><b>Remarks</b> The washing is done by spreading the filter media on the ground outside the wetland, washing it with a high pressure hose and letting it dry for 1 day</p>



Filter media being washed Discharge of the fresh sludge (manual removal of the dry sludge)



Weeding of the surface of the beds



Filter media being washed out

## 5.2.7 Composting shed



**General remark:** for co-composting related activities, refer to the “**Operating and maintaining a co-composting facility**” manual



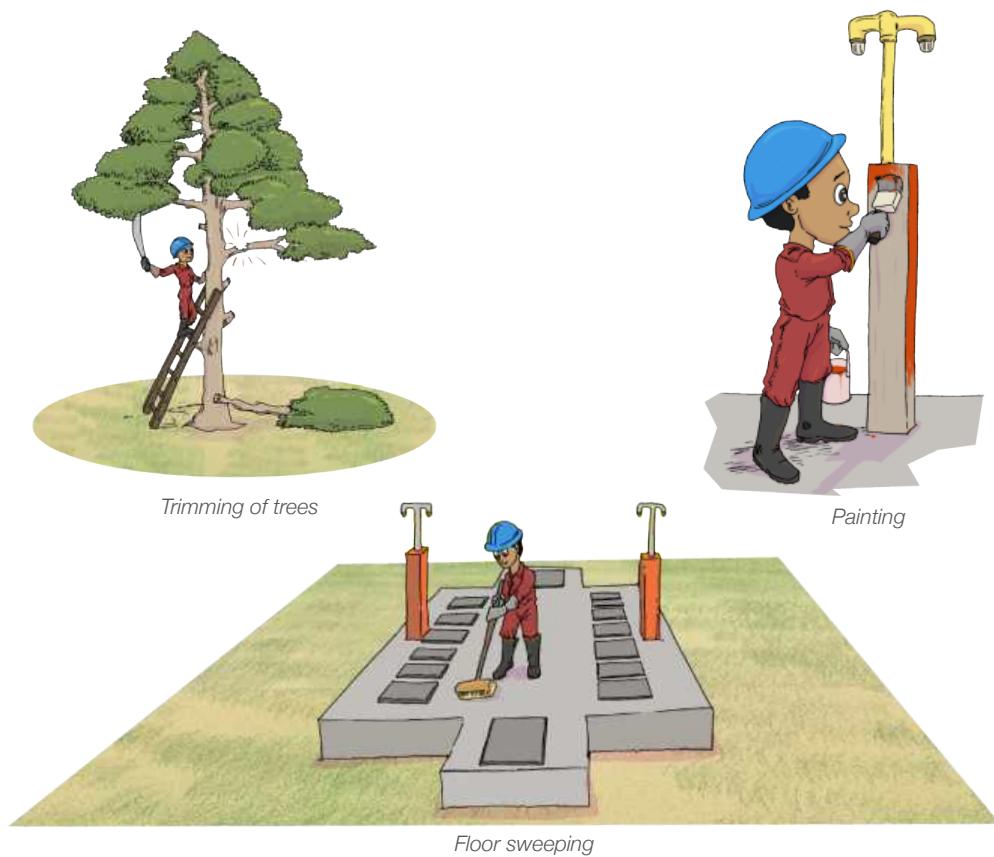
Time interval	Task
<b>Daily</b>	<ul style="list-style-type: none"> <li>• Ensure that the platform is clean and that the drainage channel is clear</li> <li>• Inspect the soak away pit to ensure that there is no clogging</li> </ul>
<b>Monthly</b>	<ul style="list-style-type: none"> <li>• Inspect the roof, check for breakages in the roof sheets and clean the translucent PVC roof sheets to allow the light in</li> <li>• Inspect and clean the gutter to avoid blockages and clogging</li> </ul>
<b>After every rain event</b>	<ul style="list-style-type: none"> <li>• Check the water content of the rain harvesting cistern and empty when almost full</li> </ul>



*Repair of shed's roof*

## 5.2.8 General

Time interval	Task
<b>Daily</b>	<ul style="list-style-type: none"> <li>• Sweep the concrete surface: suspended slab and platforms of all modules</li> <li>• Inspect the soil moisture condition around the modules to identify any leakages from the pipes or from the modules themselves</li> <li>• Keep the operator store clean and tidy: clean the floor and the windows</li> </ul>
<b>Weekly</b>	<ul style="list-style-type: none"> <li>• Inspect around the DTF modules and remove the plants and roots which might interfere and damage the infrastructure</li> <li>• Keep the lawn green and healthy: grass cutting, watering, repairing, etc.</li> <li>• Remove the weeds</li> <li>• Water the ornamental plants</li> </ul>
<b>Monthly</b>	<ul style="list-style-type: none"> <li>• Check on the structural condition of each treatment module: cracks, settlement of structure, caving of the suspended slab, etc.</li> <li>• Control the corrosion on the metal parts: scrap rust, paint metal surfaces, repair corroded concrete reinforcement</li> <li>• Trim the trees</li> </ul>
<b>Semi annually</b>	<ul style="list-style-type: none"> <li>• Clean the external walls and slab of the module either with a high pressure hose or with a brush and some water</li> </ul>



Trimming of trees

Painting

Floor sweeping

### 5.2.9 Waste Disposal Unit

The burning cycle contains three phases:

**Preheating period:** The primary chamber is loaded, lit and the temperature is brought to approximately 600°C in 20 to 30 minutes by burning fuel material, i.e., firewood, coconut shells, etc., which is supplemented by kerosene or diesel fuel as may be necessary.

#### PHASE 1

#### PHASE 2

**Solid waste disposal:** Once the temperature in the primary chamber has reached 600°C, the solid waste is loaded at a rate that maintains a constant and good, but not fierce, fire in the grate (approximately 6 kg/hr of solid waste).

#### PHASE 3

**Burn down/close down period:** 8 to 10 minutes after the entire solid waste has been loaded, an additional 1 kg to 2 kg of fuel material (wood or agro-residues) is added to ensure that complete burning occurs.



The operator must be on-site while the incinerator is functioning.

The incinerator should not be used to destroy:  
Waste containing broken thermometers or batteries  
PVC plastic bags (one can easily distinguish between PVC and polypropylene since PVC sinks in water, while polypropylene floats.)  
Wet waste

The operator must inspect regularly the incinerator (metallic and masonry parts) and the Waste Disposal Unit structure (metallic or concrete parts) to check for any repair or replacement needed.



Incinerator

### 5.3 Troubleshooting

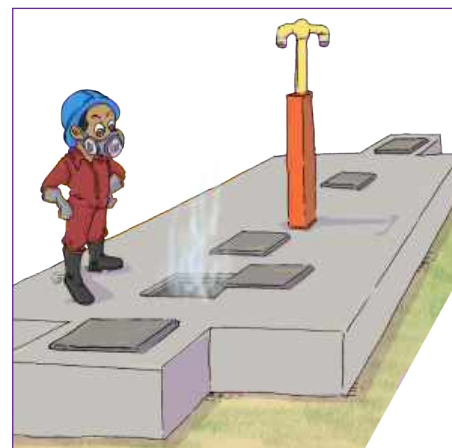
#### REMINDER



✓ When opening the manhole's cover, don't forget your respirator, don't face the manhole directly and wait at least 1 hour before operating in the tank (removal of floating material, scum or sludge).



✓ When entering a tank, make sure it has been emptied and that the confined space entry procedures (see chapter 1.2 Safety measures) are respected.



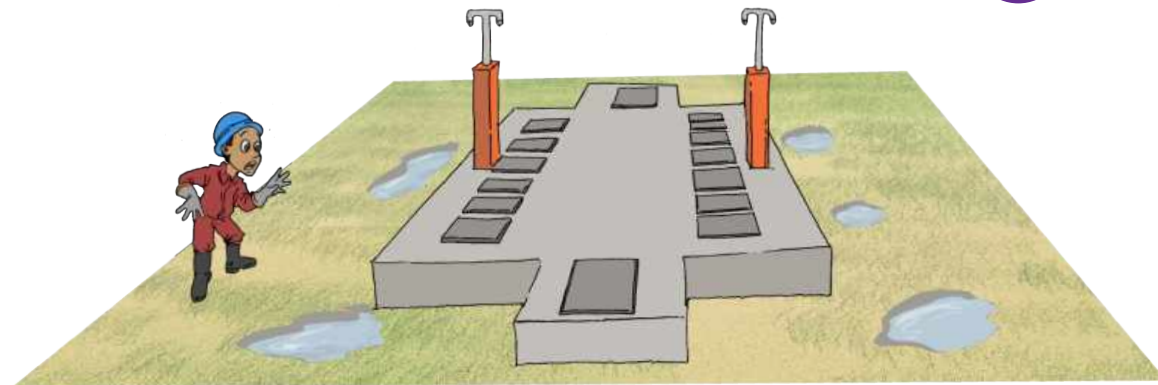
#### If the solid waste starts to smell and attract flies:

- » Ensure that the drying process on the platform is complete before shifting the solid waste in the solid waste chamber
- » Cover the solid waste chamber (iron sheet or plastic liner) during the night and in case of rain event
- » Cover the solid waste with a layer of ashes
- » Get rid (landfill disposal or incineration) of the collected solid waste regularly (at least once a week)



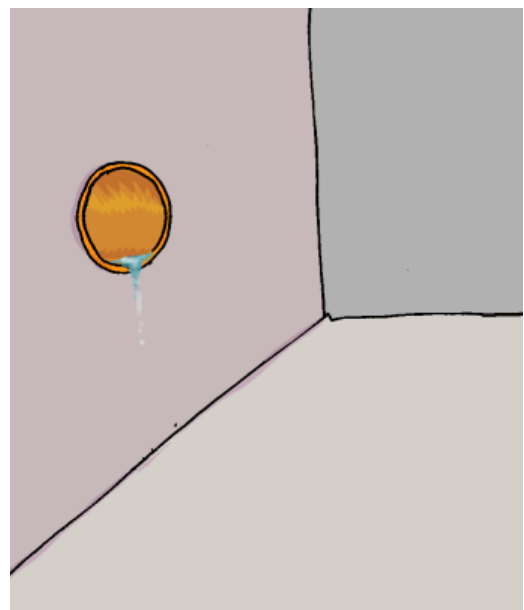
**If you notice any unusual soggy area around the modules or above the pipelines:**

- » Stop the incoming flow by closing the balancing tank valve (and prevent the exhauster from offloading)
- » Check at the water level of the modules next to the soggy area . If the water level of one of the module is below the outlet level, the leakage is located within the tank
- » Test the water tightness of the nearby pipes by carrying out a water flow test from one chamber to another. If the volume of the water introduced in the first chamber is reduced in the next chamber, the leakage is located in the pipe in between
- » When the leakage has been identified, organise for the necessary repairs: replace the pipe or repair the cracks in the tank with bituminous waterproof coating (Colaskote or equivalent)



**If there is no water flow in one of the module:**

- » Stop the incoming flow by closing the balancing tank valve (and prevent the exhauster from offloading)
- » Determine if the leakage come from the prior module or the incoming pipeline and when the leakage has been identified, organise for the necessary repairs (see previous troubleshooting bullet point)



**If there is an overflow in one of the module:**

- » Stop the incoming flow by closing the balancing tank valve (and prevent the exhauster from offloading)
- » Inspect the outlet chamber of the module and the inlet chamber of the next module to check for blockages.
- » When the blockage has been identified, remove manually the clogging material, dispose it with the rest of the solid waste and clean the chamber and pipes thoroughly



**If you notice some unusual smell coming from the Settler or the ABR:**

- » Measure the flow rate in one of the inspection chamber to check if the flow rate is between 1 to 2m<sup>3</sup>/h and adjust the control valve of the balancing tank accordingly
- » Inspect the inside of the tanks and remove any floating material.
- » Check at the level of scum and sludge and remove if they are exceeding the recommended level

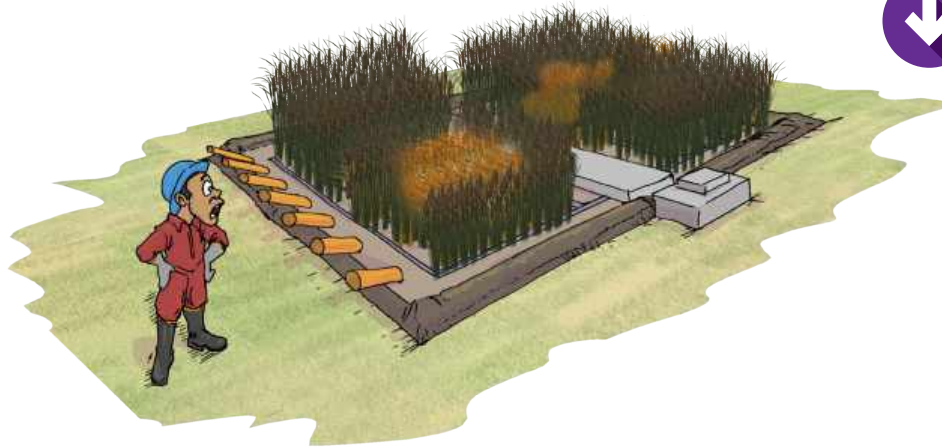
**If you notice some unusual smell coming from the VFCW:**

- » Ensure that the siphon is functioning properly. If it is not the case, remove the sludge that has settled at the bottom of the siphon chamber. As a last resort, unscrew the bell and the vent pipe and clean the inside of the siphon with a high pressure hose
- » Ensure that the bed has not been in use for more than 15 days. If it is the case, close the valve and switch to the other bed
- » Check visually if one of the bed is saturated (water level above the surface).
- » Remove the plant litter that might clog the surface of the beds
- » Remove weeds and other plants that might interfere with reed growth
- » Harvest some of the reeds if vegetation has become too dense
- » As a last resort, replace or wash the filter media and check for clogging at the underdrain pipes level



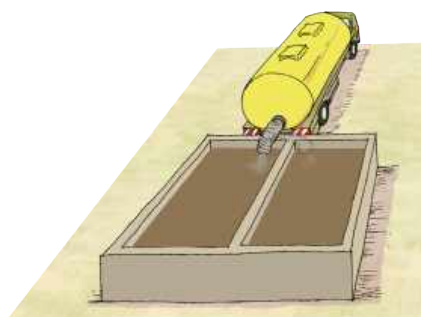
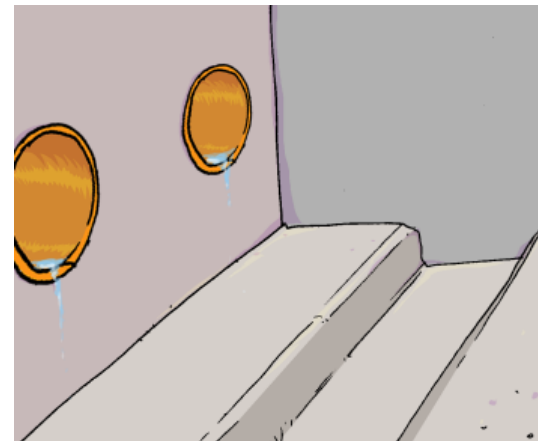
### If part of the reeds has withered:

- » It is a sign that the flow is not evenly distributed. Identify the dead zones by inspecting the feeding pipes at the surface of the beds
- » If the dead zones are caused by clogging, remove the clogging material and clean the inside of the pipe with a high pressure hose
- » If the dead zones are caused by the fact that the surface is not flat, rectify the level of the feeding pipes to ensure even distribution



### If there is no water flowing in the drainage channel of the VFCW:

- » Check for leakages at the valve level in the inlet chamber and repair if necessary
- » If the valve are not leaking, remove the filter media and identify the leakage in the PE liner. Repair with appropriate equipment: PE liner patch welded with hot wedge welding machine



1 week later ↓



### If the sludge disposed on the sludge drying beds stays wet for an unusual period of time:

- » Check the outlet chamber for any clogging
- » Remove the sludge and check for solid waste, weeds, roots or leaves that might clog the surface of the bed
- » If no apparent clogging of the bed surface, replace or wash the upper part of the filter media (10 cm of the sand layer)
- » As a last resort, replace or wash the entire filter media (sand + gravel) and check for clogging at the underdrain pipe level





# MONITORING OF THE EFFLUENT QUALITY

## 6. MONITORING OF THE EFFLUENT QUALITY

### 6.1 List of equipment



### 6.2 Monitoring parameters

#### 6.2.1 Visual inspection, on-site measurement and analysis



Parameters	Description
<b>Level of sludge and scum</b>	Biological reaction regulates the level of sludge and scum. However with time, both sludge and scum layers start to accumulate at the bottom and at the surface respectively. An ideal level of scum and sludge should be maintained in order to keep the balance between biological treatment (from the bacteria located in the sludge) and volume capacity of the treatment modules
<b>Turbidity</b>	Turbidity is the cloudiness of a fluid caused by the presence of particles like micro-organisms and suspended sediment. High turbidity can be an indication of high sediment load or high algal concentration
<b>Odour</b>	Odour is a sensory response to the chemical contained in the water. It can be used as an indicator for water quality



<b>pH</b>	pH has a profound effect on the rate of microbial growth. Acidic conditions (low pH) or basic conditions (high pH) alter the structure of enzyme responsible of microorganism growth
<b>Dissolved Oxygen (DO)</b>	Dissolved oxygen is defined as the relative measure of oxygen dissolved in water available to sustain life, including living bacteria. DO is an indicator of the health of a water body and its capacity to support a balanced aquatic ecosystem of plants and animal. Wastewater effluent that is not efficiently treated may contain inorganic pollutants that will deplete the dissolved oxygen and may lead to the death of marine organisms.
<b>Temperature</b>	Temperature measurement in wastewater treatment provides an important back up to pH, turbidity and DO measurement. The efficiency of activated sludge treatment process and the biological activity is greatly influenced by temperature

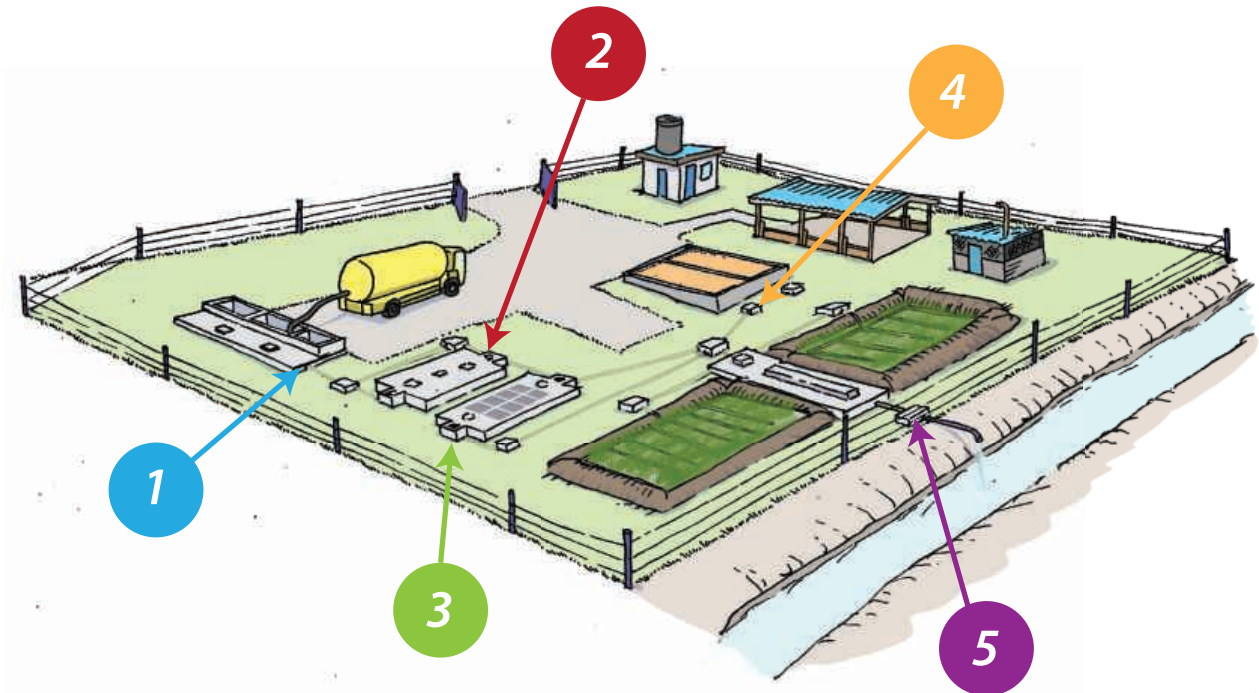
## 6.2.2 Measurement and analysis in laboratory



<b>Parameters</b>	<b>Description</b>
<b>Total Suspended Solid (TSS)</b>	<ul style="list-style-type: none"> <li>Measure of the dry the dry weight of particles trapped by a filter. Suspended solid can lead to the development of sludge deposits and anaerobic conditions when untreated wastewater is discharged in the aquatic environment.</li> </ul>
<b>Total Dissolved Solid (TDS)</b>	<ul style="list-style-type: none"> <li>Measure of the combined content of all inorganic and organic substances that are small enough to pass through a sieve. These substances are primarily minerals, salts and organic matter that can be a general indicator of water quality.</li> </ul>
<b>Biodegradable organics (BOD<sub>5</sub> and COD)</b>	Composed principally of proteins, carbohydrates and fats, biodegradable organics are measured most commonly in terms of BOD (biochemical oxygen demand) and COD (chemical oxygen demand). These parameters monitor the available oxygen which has a direct impact on aquatic life. If biodegradable organics are discharged untreated to the environment, their biological stabilisation can lead to the depletion of natural oxygen resources and to the development of septic conditions.
<b>Nutrients (NH<sub>4</sub>, NO<sub>3</sub>, NO<sub>2</sub>, Total Phosphorus)</b>	Both nitrogen and phosphorus, along with carbon are essential nutrients for growth. When discharged to the aquatic environment, these nutrients can lead to the growth of undesirable aquatic life and increase the risk of eutrophication of water bodies.
<b>Pathogens (E.Coli and Total Coliforms)</b>	<ul style="list-style-type: none"> <li>Communicable diseases can be transmitted by pathogenic organisms that may be present in wastewater.</li> </ul>

### 6.3 Location for sample collection

Samples are taken in five distinctive locations of the DTF:



- 1 In the outlet chamber of the Balancing Tank
- 2 In the outlet chamber of the Settler
- 3 In the outlet chamber of the ABR
- 4 In the last outlet chamber of the Sludge Drying Beds
- 5 In the outlet chamber of the Vertical Flow Constructed Wetland

### 6.4 Monitoring procedures



#### SAFETY CONSIDERATION

- Always prohibit eating, drinking or smoking near samples and sampling locations
- Keep sparks, flames and excessive heat sources away from samples and sampling locations

## 6.4.1 On-site measurement and analysis:

### Level of Sludge and Scum

Procedures: the sludge and scum level is to be measured in both tanks of the settler and in the 12 chambers of the ABR. Gently insert the sludge measurement tube vertically into the tank or chamber to be measured. Once the bottom of the tank is reached, screw the tube left and right to ensure it is sealed with the sludge. Plug the top of the tube with one hand and remove the tube carefully. Read and record the level of the sludge and the scum and release the content of the tube in the area of collection.



### Analysis:

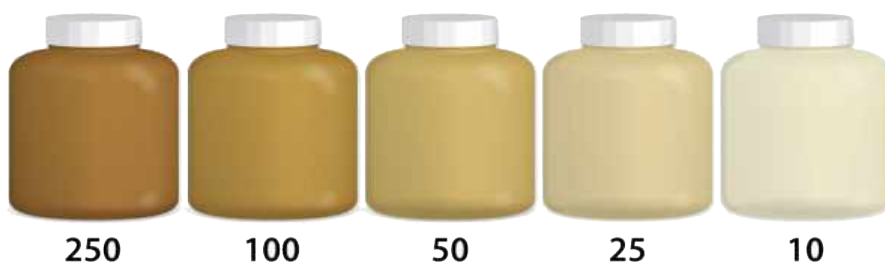
Settler tanks	Remedial actions
Scum layer > 5 cm	Remove the scum layer entirely
Sludge layer > 60 cm	Remove the sludge layer and leave a minimum of 10cm sludge layer at the bottom
ABR chambers	Remedial actions
Scum layer > 5 cm	Remove the scum layer entirely
Sludge layer > 100 cm	Remove the sludge layer and leave a minimum of 30cm sludge layer at the bottom (50cm in the first 4 chambers)

### Turbidity

Collect effluent samples with the sampling rod and pour the liquid into a clean glass jar. Estimate visually the turbidity of each sample by comparing the colour of it to the turbidity colour chart. Turbidity is measured in a unit called NTU (Nephelometric Turbidity Units).

## Turbidity (NTU)

### Water Samples:





**Analysis:** according to the Kenyan Water Quality regulations, no turbidity limits are defined for effluent discharge into the environment. The turbidity values will be used for internal monitoring purposes. However it is recommended that the final effluent discharged into the environment (sample nr. 5) does not exceed **50 NTU**.

**Tips:** Try to take turbidity readings in the same light each time. Analyse individual samples as soon as possible after collection and preferably at the sample point, to avoid disturbance. If the sample stands for any length of time, shake your sample well before taking measurement.

## Odour

The odour intensity is stated according to a predetermined rating system.



Odour intensity measurement	Odour strength
+	Barely perceptible
++	Slight
+++	Moderate
++++	Strong
+++++	Very strong

Half score is used when the observer is undecided

Offensive odour description	Potential compound responsible
Pungent, Irritating	Ammonia (NH <sub>3</sub> ), Ozone (O <sub>3</sub> ), Sulphur dioxide (SO <sub>2</sub> )
Rotten eggs	Hydrogen Sulphide (H <sub>2</sub> S)
Vinegar	Acetic Acid (CH <sub>3</sub> COOH)
Acrid	Formaldehyde (HCHO)
Fishy	Methylamine (CH <sub>3</sub> NH <sub>2</sub> )

## DO (Dissolved oxygen)

For each sample location, collect a 250 ml sample with the sampling rod and measure the DO with the DO meter probe.

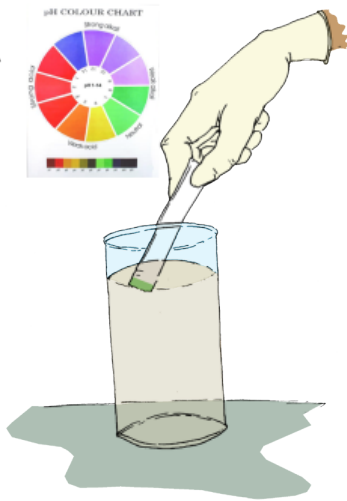
**Analysis:** Since the DTF is mainly using anaerobic treatment, the DO value is expected to be quite low until the VFCW (aerobic treatment). The minimum DO value that the final effluent (VFCW outlet) should reach before being released into the environment is **1.5 mg/L**.

**Tips:** Analyse individual samples as soon as possible after collection and preferably at the sample point, to avoid disturbance. The sample should not be agitated to avoid changes in gaseous content.



## pH

Measure the pH with the pH test strip using the same 250 ml sample. Dip a pH test strip into the sample for several seconds (no need to stir the strip), remove the pH strip, hold it and wait for the colour indicator on the end of the strip to finish changing colour. Take a reading of the pH by comparing the colour indicator on the test strip to the chart that came with the pH test kit. Once the reading and recording is done, dispose of the used strip (it cannot be used again).



**Analysis:** Most microorganisms do well within a pH range of **6.5 to 8.5**. Therefore it is important to control the pH of the wastewater at each stage of the treatment to prevent extreme pH to cause significant microbial destruction.

**Tips:** Analyse individual samples as soon as possible after collection and preferably at the sample point, to avoid disturbance.

## Temperature

Measure the temperature using the same 250ml sample collected for the DO measurement. The optimum efficiency is obtained at a temperature ranging from 10 to 40°C. The temperature of wastewater is a function of seasonal changes therefore it is important to pair wastewater with ambient temperature measurements. The ambient temperature is measured with the thermometer. The wastewater temperature can be measured either with the thermometer or the DO meter probe.

**Tips:** Analyse individual samples as soon as possible after collection and preferably at the sample point, to avoid disturbance.



### 6.4.2 Measurement and analysis in an external laboratory:

For each sample location, collect a 1000 ml sample in a clean plastic container (free of contaminants). Each sample will be sent to the laboratory to be analysed for the following parameters: TSS, TDS, BOD<sub>5</sub>, COD, total Nitrogen, E. Coli/Coliforms. Fill sample containers without pre-rinsing with sample (as it can bias results high when certain components adhere to the sides of the container). When filling the sample, leave an air space equivalent to approximately 1% of the container volume to allow for thermal expansion during shipment and use a thermo box for transport. If immediate analysis is not possible, refrigerate all the samples to be sent to the laboratory (<4°C but above freezing). Deliver samples to laboratory as soon as practicable after collection, typically within 2 days. Ensure that samples are accompanied by a complete chain-of- custody record including a sample analysis request.



According to the sixth schedule of the Kenyan Water Quality Regulation document (2006), the guided value for the aforementioned parameters are as follows:

Parameter	Guide value
BOD <sub>5</sub>	30 (mg/L) max
COD	50 (mg/L) max
TSS	30 (mg/L) max
TDS	1200 (mg/L) max
NH <sub>4</sub>	100 (mg/L) max
NO <sub>3</sub>	100 (mg/L) max
NO <sub>2</sub>	100 (mg/L) max
E.Coli	Nil/100 ml
<b>Total coliform</b>	1000/100 ml

#### Chain-of-Custody Procedures

Properly designed and executed chain-of-custody forms will ensure sample integrity from collection to data reporting. This includes the ability to trace possession and handling of the sample from the time of collection through to analysis and final disposition.

- » Use labels to prevent sample misidentification. Label should include: sample number, location, name of collector, date and time of collection.
- » Use sample seals to detect unauthorized tampering with samples up to time of analysis. Use self-adhesive paper seals or plastic shrink seals.
- » Fill out the chain-of-custody and analysis request form (provided by the laboratory) to accompany each sample or group of samples.

## 6.5 Monitoring routine schedule

Parameter	Guided value	Sample location	Sample Frequency	Measurement type
Sludge level	60cm max for Settler 100cm max for ABR	Settler and ABR tanks	1/month	On-site: visual inspection through sludge judge
Scum level	5cm max			
Turbidity	50NTU max (at the effluent)	1,2,3,4 and 5	1/month	On-site: visual, sensorial, DO meter, pH test strip and thermometer measurement on a 250mL sample
Odour	-			
Dissolved oxygen (DO)	1.5mg/l max (at the effluent)			
pH	Between 6.5 and 8.5			
Temperature	Between 10 to 40°C			
TSS	30mg/L max (at the effluent)			
TDS	1200 mg/L max (at the effluent)	1,2,3,4 and 5	4/year	Laboratory: send a 1000mL sample
BOD <sub>5</sub>	30 mg/L max (at the effluent)			
COD	50 mg/L max (at the effluent)			
NH <sub>4</sub>	100 mg/l			
NO <sub>3</sub>	100 mg/l			
NO <sub>2</sub>	100 mg/l			
E. Coli	Nil/100 ml			
Total coliform	1000/100 ml			

# RECORD KEEPING





# 7. RECORD KEEPING

## 7.1 Operator's logbook

The operator's logbook is intended for the operator to report its time schedule and to keep an on-site daily record of operation, maintenance and monitoring activities. The logbook is also used to report any events that is considered out of the ordinary, such as emergency response, injury, etc. Finally, the operator's logbook is a communication tool that is used to report instructions from the supervisor and/or recommendations from the operator him/herself.



The operator's logbook is to be filled every day by the operator and should be filed in a way that the supervisor or anyone from the WSP should be able to easily access the information.

OPERATORS LOGBOOK	
Date: <u>26/9/2016</u>	Time of arrival: <u>8:15am</u>
Operator's name: <u>Charles Kamau</u>	Time of departure: <u>8:45am</u>
<small>Exceptional absence and replacement during the day: Indicate timeframe, reasons, name and signature of the substitute</small> <u>Berferspeles es duciisciis ipicipi untiur as acieniet odite liqui niatia sequisi optae sin cores aut eatemporum.</u>	
<small>Exceptional events to be reported (disaster response, injury, communication with regulatory officials, etc.):</small> <u>m fugiant occatio et harum fugiasi odis nonet vendent del ilit laccus minveli cilicid quia velita autecerum,</u>	
<small>Specific instructions from plant superintendent (if applicable):</small> <u>Ruptati doluptassi dit, verspe comnitia vit is eati res maiorporum quossequis volupta tum exerentiās mi,</u>	
<small>Operation, Maintenance and Monitoring tasks undertaken: Indicate if any breakdown or other malfunctions</small> <u>Mus aut officid elictem porecto tatibea nusandu ciaspe non nosant.</u> <ul style="list-style-type: none"> <li>• <u>Luptae am, aborissin re, volupta volestemped mo te lanis um fugiant</u></li> <li>• <u>Occatio et harum fugiasi odis nonet vendent del ilit laccus minveli cilicid quia velita autecerum, omnimusamusa</u></li> <li>• <u>Poria corestistia parumque repella volorBer ibusam quatur a qui rempos</u></li> </ul>	
<small>Recommendations from operator:</small> <u>Ibustrum vitasperem sequodiam as idvelita autecerum, omnimusamusa poria corestistia</u>	
<small>Signature of operator:</small> <u>Charles Kamau</u>	

**→ To be filled daily by the Operator**

**Signature of the operator mandatory**

## 7.2 Manifest form

The manifest form is used to compile information regarding the origin of the sludge that is being discharged into the DTF (source, volume and special characteristics). It is a prerequisite for the sludge load to be discharged into the DTF. The manifest form is a key monitoring tool to identify the number of people served by the DTF.



The blank form is given to the exhauster driver from the DTF operator or the WSP office. When the driver is intending to discharge the content of his/her truck, he or she must submit the form duly filled (as indicated below). to the operator. Once the load is approved, the form is signed by the operator and remains at the operator office for data collection.



To be filled and submit by the driver to the operator prior to discharge

### MANIFEST FORM

#### ORIGIN OF THE SLUDGE:

Date of collection: 26/09/2016

Name (of plot owner or institution): St Andrews primary school

Area: Manyani

SafiSan toilets: Yes  No

Source	Check	Volume (m3)	Number of users	Last emptying date
Residential	<input checked="" type="checkbox"/>	4	4	unknown
Institutional *	<input checked="" type="checkbox"/>	6	150	15-Jan
Commercial/Industrial **				

\* Description of the institution or commercial/industrial waste (if applicable):

Septic tank of a primary school

Name and signature of the exhauster driver:

Patrick Kariuki

Date: 26/09/2016

Ref no.: 16-0001

To be filled by operator

Approved by authorized authority:

(Name and Signature)

Charles Kamau



To be filled and signed by the operator once the truck load has been approved



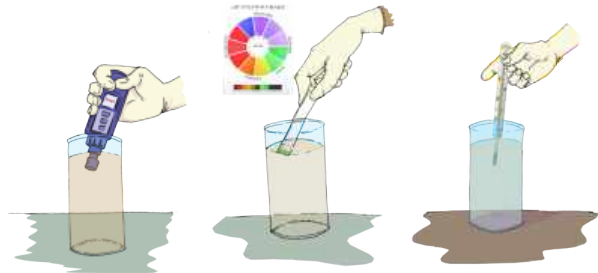
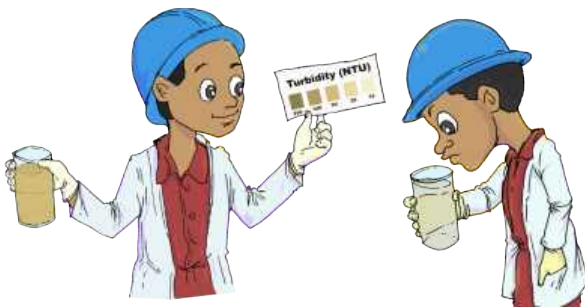


## 7.5 Monitoring of effluent quality logbook

Monitoring of effluent quality logbook comprises of:

- » The on-site measurements form: to be completed each time samples are taken and analysed on-site (monthly)
- » The laboratory measurements form: to be completed each time the results from the sampling are received from the laboratory (quarterly)

Both on-site and laboratory measurements forms are to be filled by the operator or the person in charge of sampling. The objective of the logbook is to monitor the performance of the DTF module by module. It will enable to take quick, adequate and precise remedial actions in case of a malfunction.



### ON-SITE MEASUREMENTS

Name of collector: .....Charles Kamau.....  
Date of collection: .....11.05.2017.....

Sampling points	Initial state		After desludging/removal of scum	
	Level of sludge (cm)	Level of scum (cm)	Level of sludge (cm)	Level of scum (cm)
Settler tank 1	35	5	0	0
Settler tank 2	20	0	0	0
ABR chamber 1	70	5	30	0
ABR chamber 2	90	5	30	0
ABR chamber 3	75	5	30	0
ABR chamber 4	50	3	50	0
ABR chamber 5	60	0	60	0
ABR chamber 6	20	0	20	0

Time of collection: .....8:50 AM..... (8:00 Hour recommended)

Weather condition: .....sunny..... Ambient temperature: .....28°C.....

Sampling points	Turbidity (NTU)	Odour (+)	pH	Temperature (°C)	Dissolved oxygen (mg/L)
1	250	++++	6.5	20	1.2
2	100	+++	6.5	21	1
3	50	+++	7	22	0.9
4	50	+++	7	21	0.9
5	25	++	7	18	1.6

Time of collection: .....13:00 Hour recommended.....

Weather condition: .....sunny..... Ambient temperature: .....28°C.....

Sampling points	Turbidity (NTU)	Odour (+)	pH	Temperature (°C)	Dissolved oxygen (mg/L)
1					
2					
3					
4					
5					

Time of collection: .....18:00 Hour recommended.....

Weather condition: .....sunny..... Ambient temperature: .....28°C.....

Sampling points	Turbidity (NTU)	Odour (+)	pH	Temperature (°C)	Dissolved oxygen (mg/L)
1	250	++++	6	22	1
2	100	+++	6.3	23	0.8
3	50	+++	7.1	22	0.9
4	50	+++	6.9	22	1.2
5	25	++	7	20	1.5

Name and signature of the person responsible of sampling: .....Charles Kamau.....

### LABORATORY MEASUREMENTS

Name of collector: .....Charles Kamau.....

Date of collection: .....18.01.2017..... Time of collection: .....10:30 AM.....

Weather condition: .....cloudy..... Temperature: .....20°C.....

General field observations at the sampling points: .....Nothing to report.....

Date of sending: .....18.01.2017..... Time of sending: .....12:00 PM.....

#### Physico-Chemical parameter analysis

Sampling points	Sample ID	TSS (mg/l)	TDS (mg/l)	BOD5 (mg/l)	COD (mg/l)	NH4 (mg/l)	NO3 (mg/l)	NO2 (mg/l)
1	BT-001	1150	1117	275	785	470	1012	822
2								
3	BT-002	566	7089	463	814	470	3001	762
4								
5	BT-003	87	1005	52	71	124	98	64

#### Bacteriological quality test

Sampling point	Sample ID	Total coliform count	E.Coli count
1	BT-001	690	1778
2			
3	BT-002	422	234
4			
5	BT-003	NIL	NIL

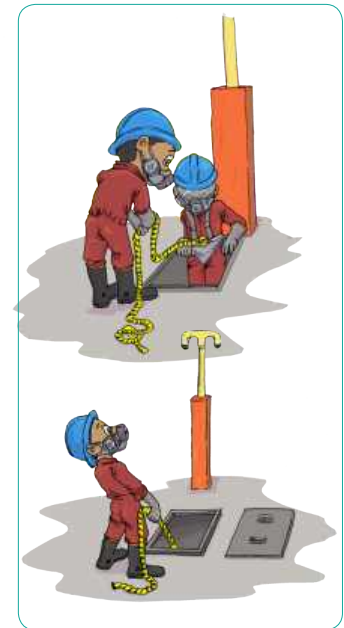
Name and signature of the person responsible of sampling: .....Charles Kamau.....



## 7.7 Confined space entry permit

Working in an enclosed space such as the DTF tanks and chambers is dangerous because of the risks from noxious fumes, reduced oxygen levels or risks of fire. Other dangers may include flooding/drowning or asphyxiation from other source such as dust or other contaminant.

Before entering a confined space (DTF tanks), a confined space entry permit must be prepared by the operator. The supervisor must approve by signing the form before and after the task has been completed. This form will ensure that all safety measures are respected prior to entry into the tank and that the name of the entrants and attendants are recorded.



### CONFINED SPACE ENTRY PERMIT

PERMIT VALID FOR 1 SHIFT ONLY, ALL PERMIT COPIES MUST REMAIN AT THE SITE UNTIL SHIFT OR JOB IS COMPLETED

Date: 25.03.2017 Permit No: 2017/01 WSP: NAWASCO

Confined Space Locations: Settler primary tank and ABR chambre no. 2

Purpose of entry: Repairs for water tightness

Time in: 09:30 am Time out: 02:00 pm

Permit Canceled Time: \_\_\_\_\_

Reason Permit Canceled: \_\_\_\_\_

Supervisor on-site (Name and signature): Robert Mutua

Authorized Entrants	Authorized Attendants
<u>John Kemboi</u>	<u>Charles Kamau</u> <u>Robert Mutua</u>

Minimum requirements to review prior to entry	YES	NO	N/A
Manholes of the tank have been left open 24H prior to entry	<input checked="" type="checkbox"/>		
Respiratory mask	<input checked="" type="checkbox"/>		
Harness and safety rope	<input checked="" type="checkbox"/>		
Standby safety personel	<input checked="" type="checkbox"/>		



To be filled by  
the Operator

### PERMIT AUTHORIZATION

I certify that all actions and conditions necessary for safe entry have been performed

WSP: NAWASCO

Technical manager or above: Henry Ogalo  
(Name and signature)

Date and Location: 24.03.2017, Nakuru



To be filled by  
the Supervisor

# **ANNEXES**



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# OPERATORS LOGBOOK

Date: \_\_\_\_\_

Time of arrival: \_\_\_\_\_

Operator's name: \_\_\_\_\_

Time of departure: \_\_\_\_\_

Exceptional absence and replacement during the day:  
*Indicate timeframe, reasons, name and signature of the substitute*

Exceptional events to be reported (disaster response, injury, communication with regulatory officials, etc.):

Specific instructions from plant superintendent (if applicable):

**Operation, Maintenance and Monitoring tasks undertaken:**  
*Indicate if any breakdown or other malfunctions*

**Recommendations from operator:**

**Signature of operator:**

## MANIFEST FORM

### ORIGIN OF THE SLUDGE:

Date of collection: \_\_\_\_\_

Name (of plot owner or institution): \_\_\_\_\_

Area: \_\_\_\_\_

SafiSan toilets:                      Yes                                       No

Source	Check	Volume (m3)	Number of users	Last emptying date
Residential				
Institutional *				
Commercial/Industrial **				

*\* Description of the institution or commercial/industrial waste (if applicable):*

Name and signature of the exhauster driver: \_\_\_\_\_ Date: \_\_\_\_\_

Ref no.: \_\_\_\_\_ **To be filled by operator**  
Approved by authorized authority:  
(Name and Signature)

## MANIFEST FORM

### ORIGIN OF THE SLUDGE:

Date of collection: \_\_\_\_\_

Name (of plot owner or institution): \_\_\_\_\_

Area: \_\_\_\_\_

SafiSan toilets:                      Yes                                       No

Source	Check	Volume (m3)	Number of users	Last emptying date
Residential				
Institutional *				
Commercial/Industrial **				

*\* Description of the institution or commercial/industrial waste (if applicable):*

Name and signature of the exhauster driver: \_\_\_\_\_ Date: \_\_\_\_\_

Ref no.: \_\_\_\_\_ **To be filled by operator**  
Approved by authorized authority:  
(Name and Signature)





## ON-SITE MEASUREMENTS

Name of collector: .....

Date of collection: .....

Sampling points	Initial state		After desludging/removal of scum	
	Level of sludge (cm)	Level of scum (cm)	Level of sludge (cm)	Level of scum (cm)
Settler tank 1				
Settler tank 2				
ABR chamber 1				
ABR chamber 2				
ABR chamber 3				
ABR chamber 4				
ABR chamber 5				
ABR chamber 6				

Time of collection:..... (8:00 Hour recommended)

Weather condition:..... Ambient temperature:.....

Sampling points	Turbidity (NTU)	Odour (+)	pH	Temperature (°C)	Dissolved oxygen (mg/L)
1					
2					
3					
4					
5					

Time of collection:..... (13:00 Hour recommended)

Weather condition:..... Ambient temperature:.....

Sampling points	Turbidity (NTU)	Odour (+)	pH	Temperature (°C)	Dissolved oxygen (mg/L)
1					
2					
3					
4					
5					

Time of collection:..... (18:00 Hour recommended)

Weather condition:..... Ambient temperature:.....

Sampling points	Turbidity (NTU)	Odour (+)	pH	Temperature (°C)	Dissolved oxygen (mg/L)
1					
2					
3					
4					
5					

Name and signature of the person responsible of sampling:

# LABORATORY MEASUREMENTS

Name of collector: .....

Date of collection: .....

Time of collection: .....

Weather condition: .....

Temperature: .....

General field observations at the sampling points:

Date of sending: .....

Time of sending: .....

## Physico-Chemical parameter analysis

Sampling points	Sample ID	TSS (mg/l)	TDS (mg/l)	BOD5 (mg/l)	COD (mg/l)	NH4 (mg/l)	NO3 (mg/l)	NO2 (mg/l)
1								
2								
3								
4								
5								

## Bacteriological quality test

Sampling point	Sample ID	Total coliform count	<i>E.Coli</i> count
1			
2			
3			
4			
5			

Name and signature of the person responsible of sampling:



# CONFINED SPACE ENTRY PERMIT

PERMIT VALID FOR 1 SHIFT ONLY, ALL PERMIT COPIES MUST REMAIN AT THE SITE UNTIL SHIFT OR JOB IS COMPLETED

Date: \_\_\_\_\_

Permit No: \_\_\_\_\_

Confined Space Locations: \_\_\_\_\_

Purpose of entry: \_\_\_\_\_

Time in: \_\_\_\_\_

Time out: \_\_\_\_\_

*Permit Canceled Time:* \_\_\_\_\_

*Reason Permit Canceled:* \_\_\_\_\_

Supervisor on-site (Name and signature): \_\_\_\_\_

Authorized Entrants	Authorized Attendants

Minimum requirements to review prior to entry	YES	NO	N/A
Manholes of the tank have been left open 24H prior to entry			
Respiratory mask			
Harness and safety rope			
Standby safety personel			

## PERMIT AUTHORIZATION

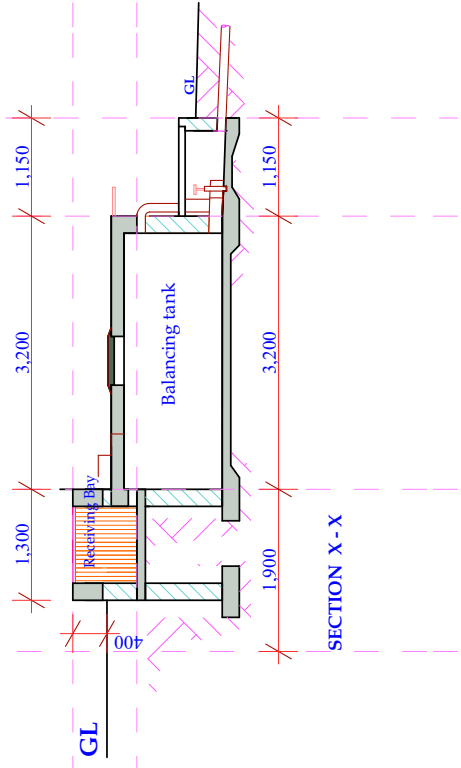
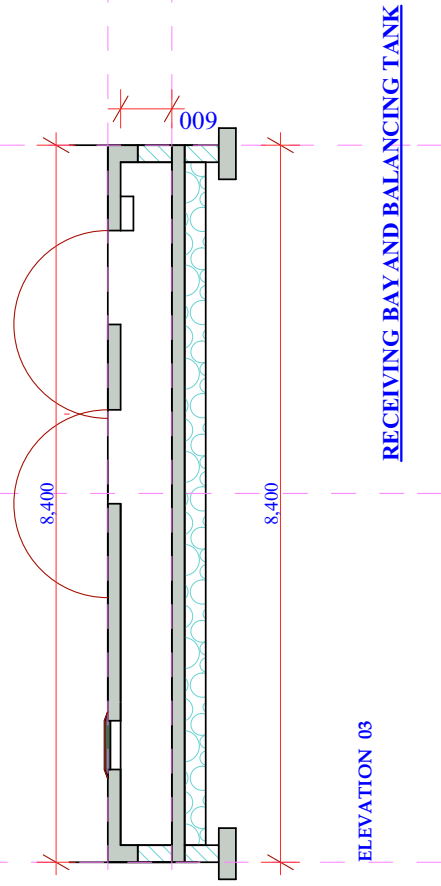
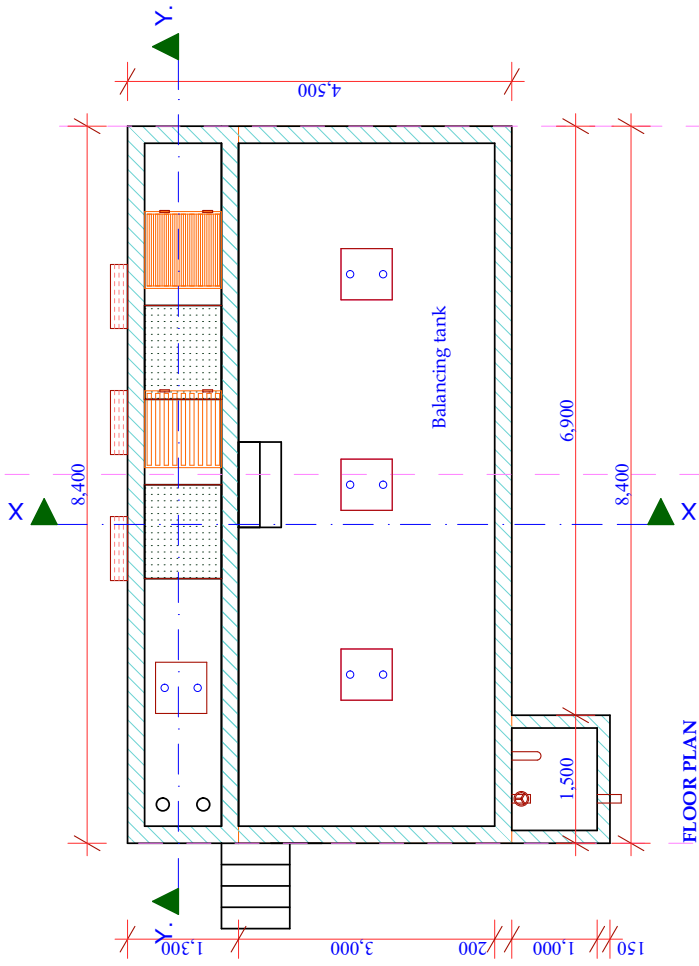
I certify that all actions and conditions necessary for safe entry have been performed

WSP:

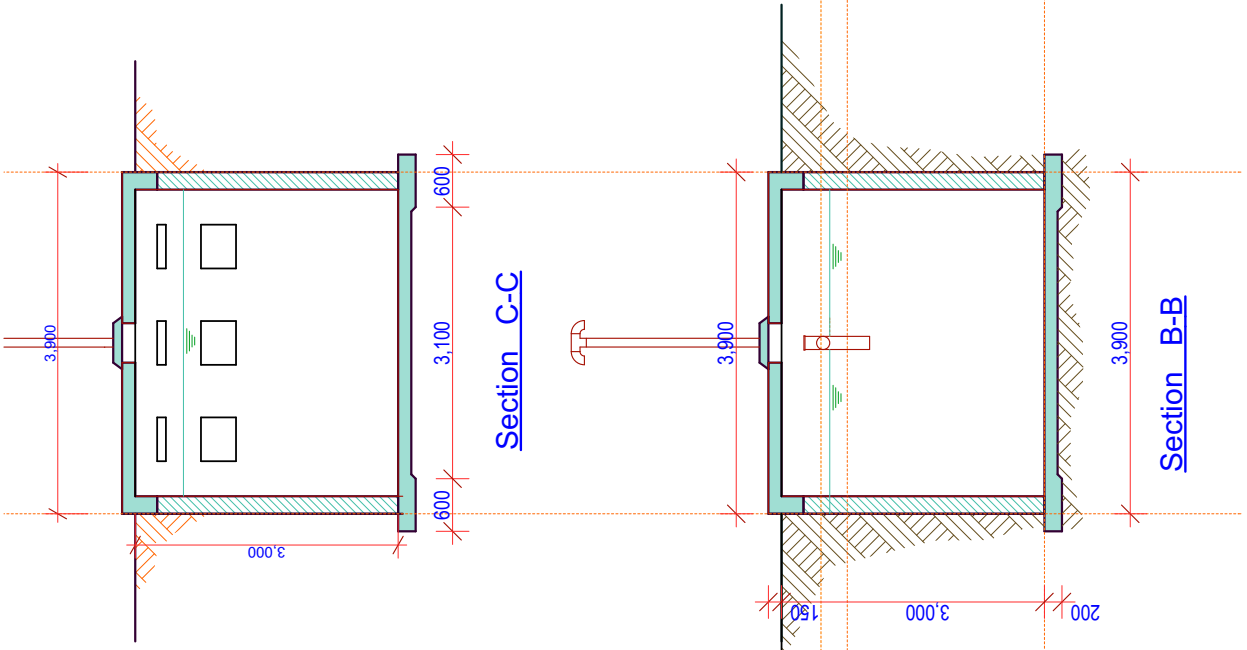
Technical manager or above:  
(Name and signature)

Date and Location:

# SITE BLUEPRINTS

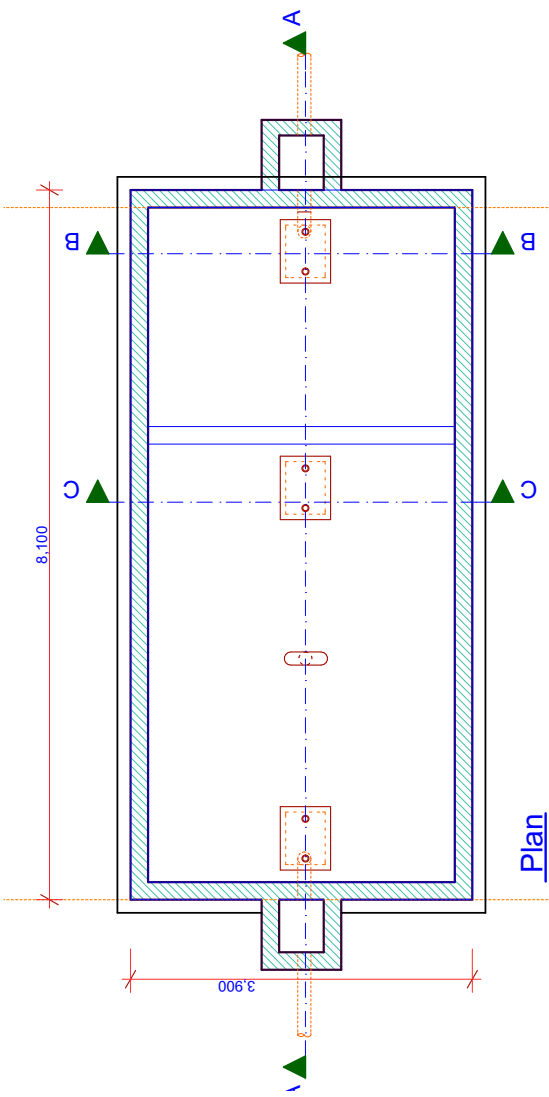




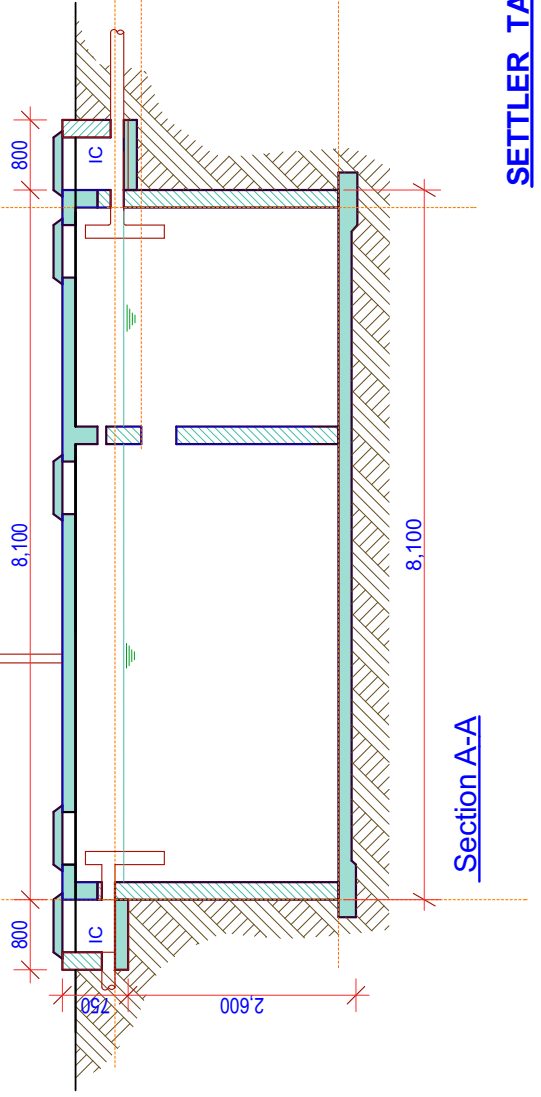


Section C-C

Section B-B



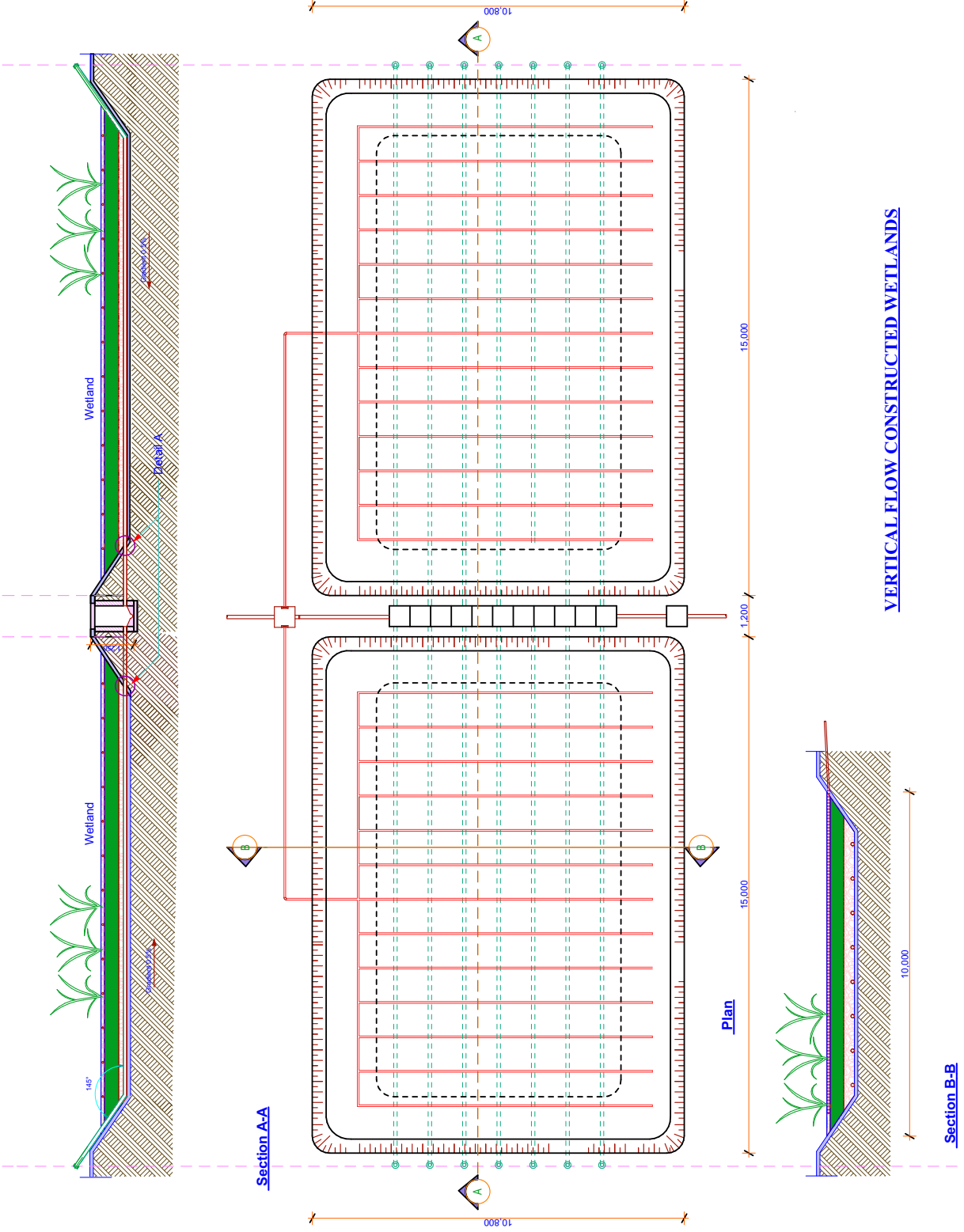
Plan

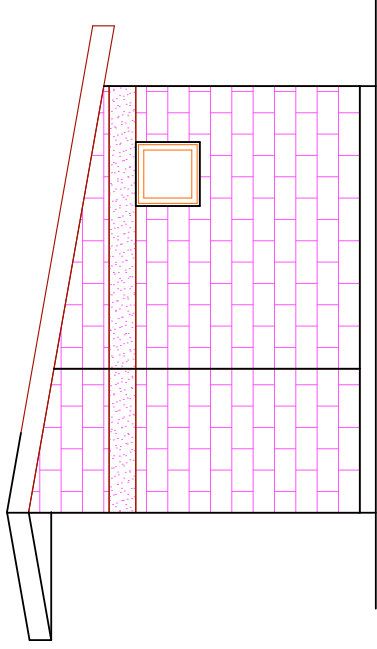


Section A-A

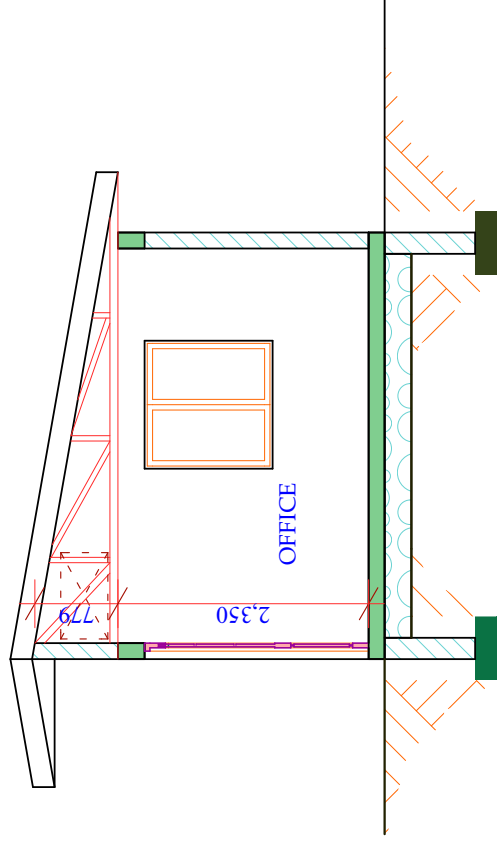
**SETTLER TANK**



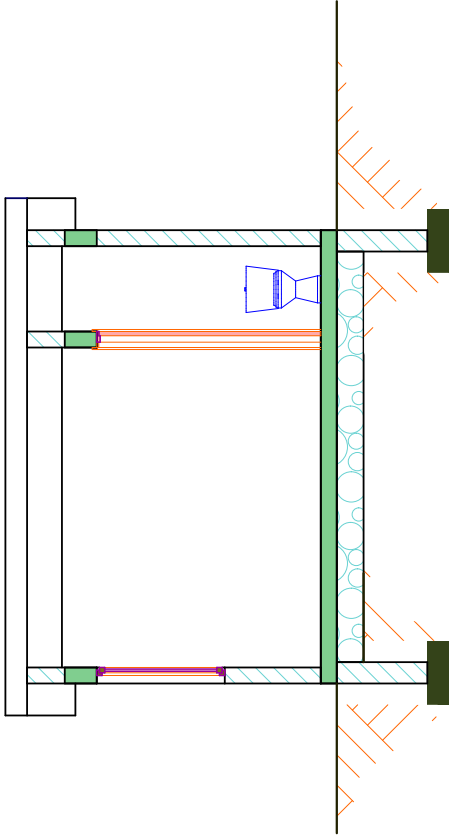




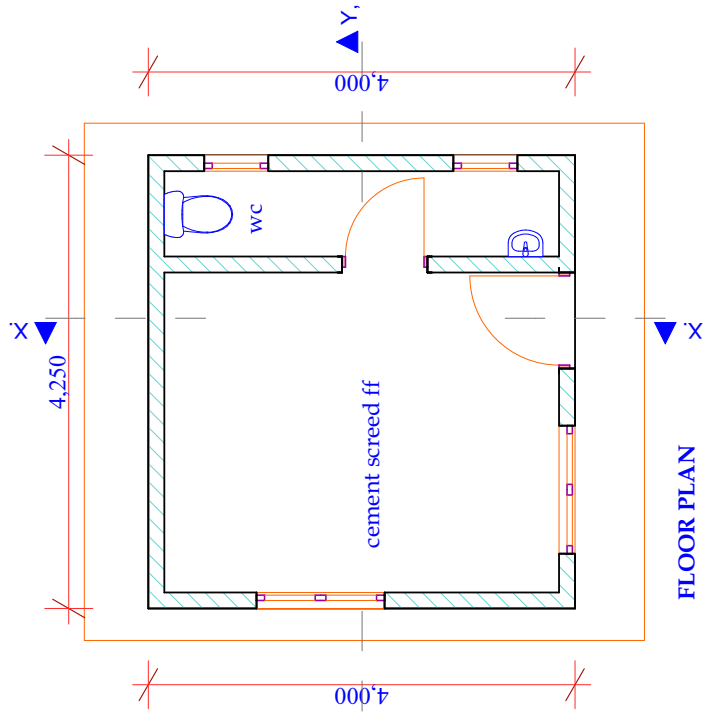
ELEVATION E1



SECTION X - X

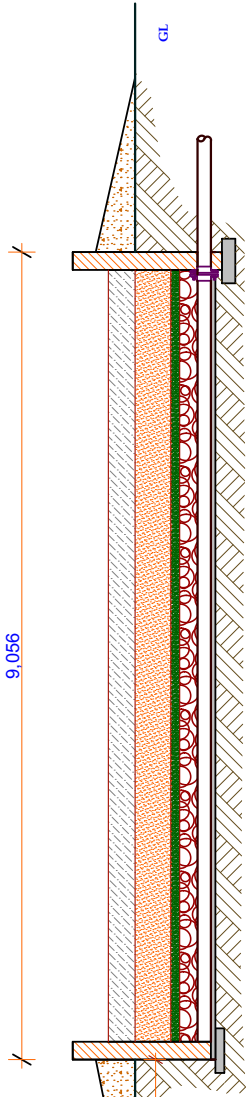


SECTION Y - Y

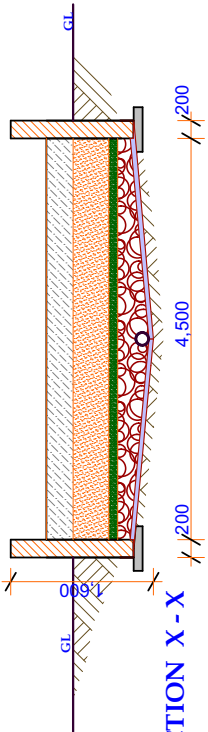


FLOOR PLAN

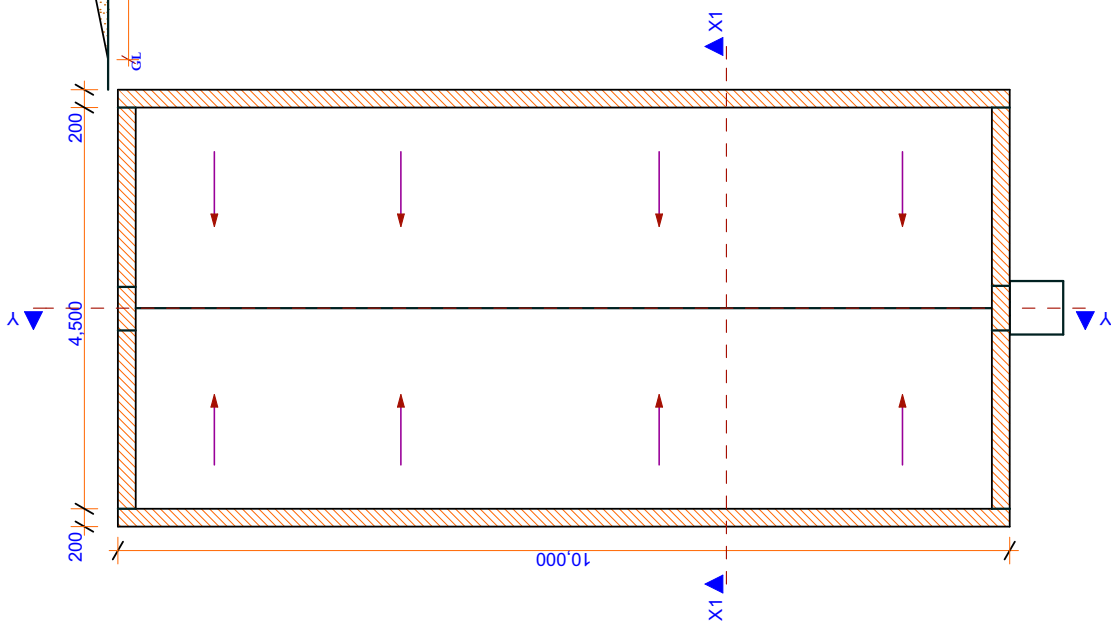
OFFICE



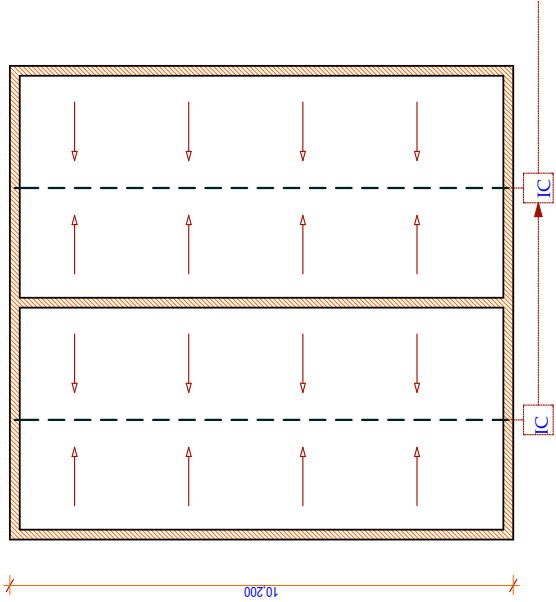
SECTION Y - Y



SECTION X - X

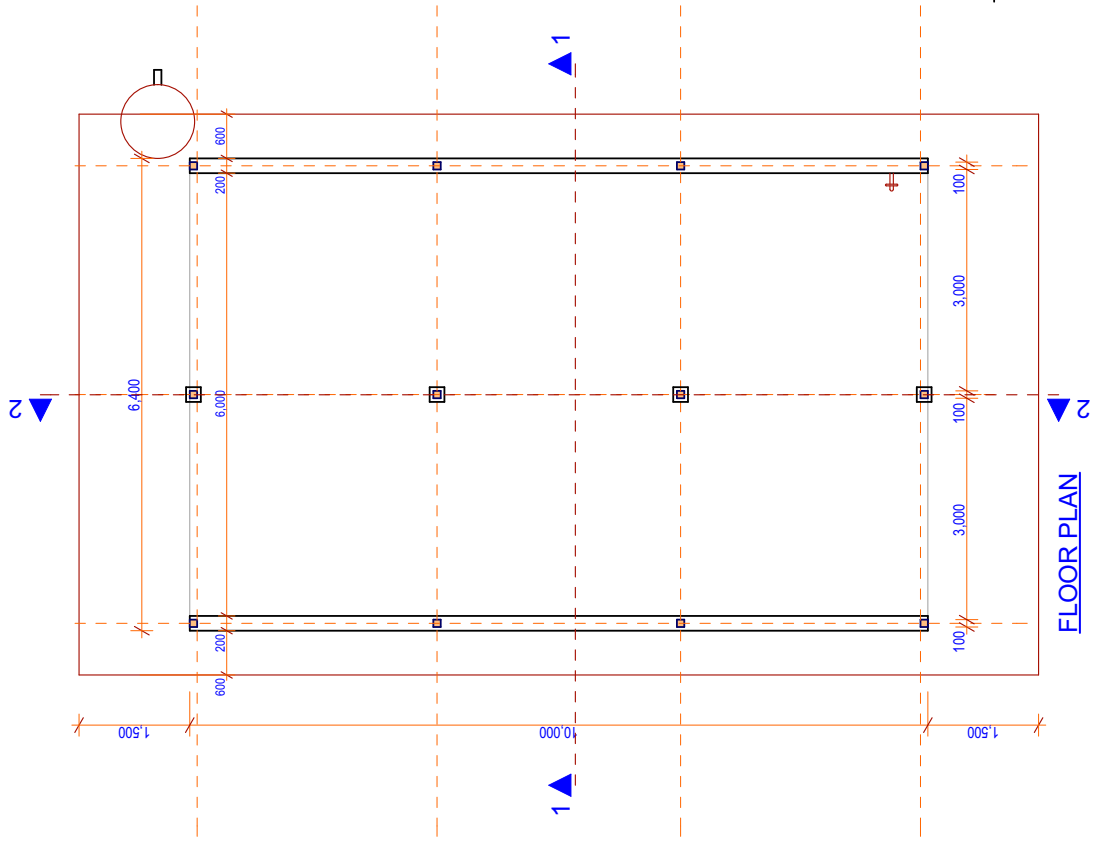


SINGLE UNIT LAYOUT PLAN

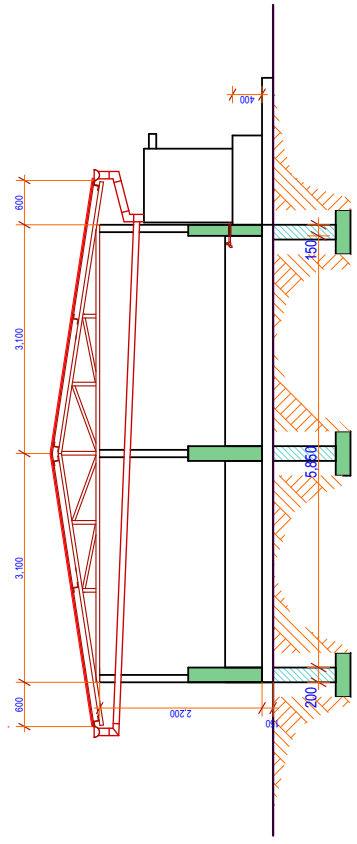


DOUBLE UNIT LAYOUT PLAN

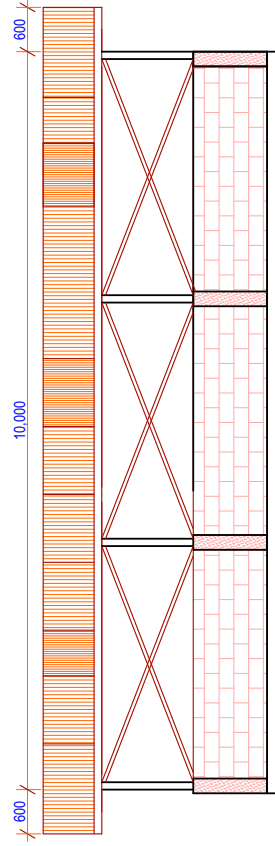
**SLUDGE DRYING REED BED**



FLOOR PLAN

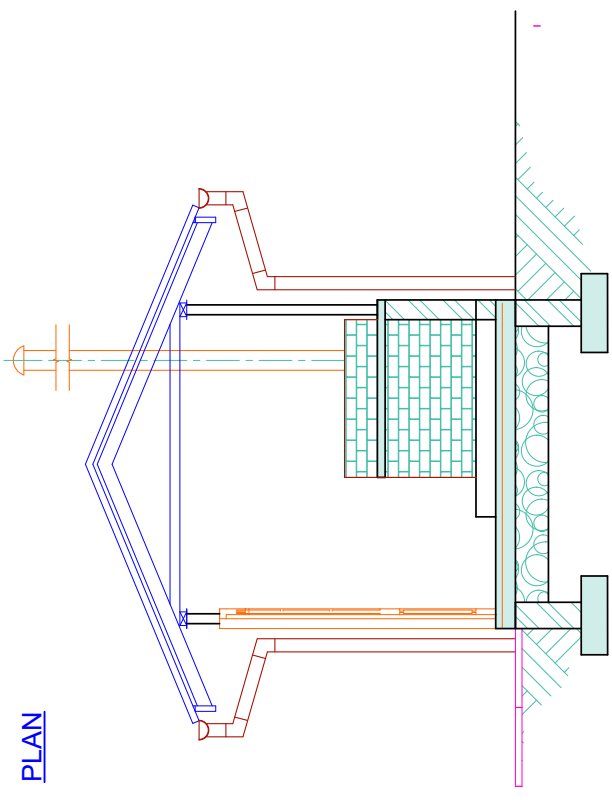
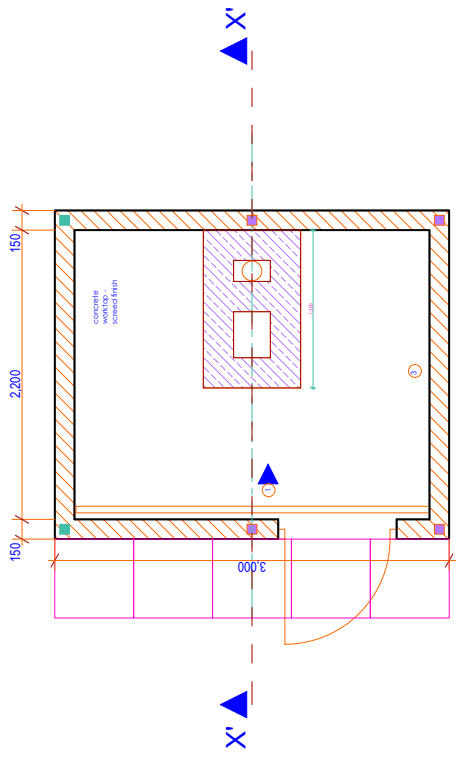
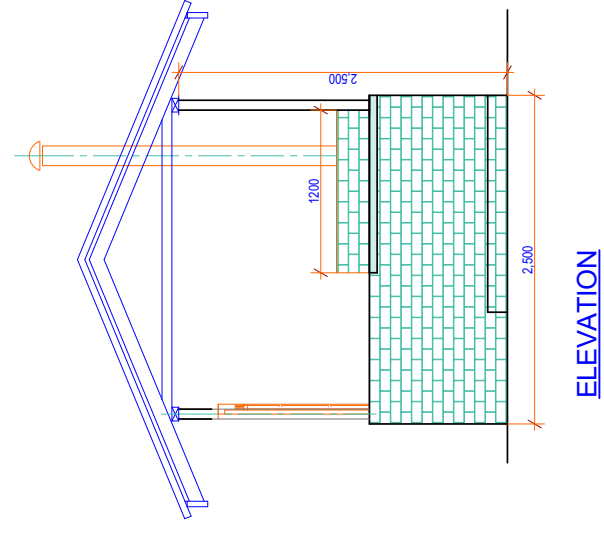
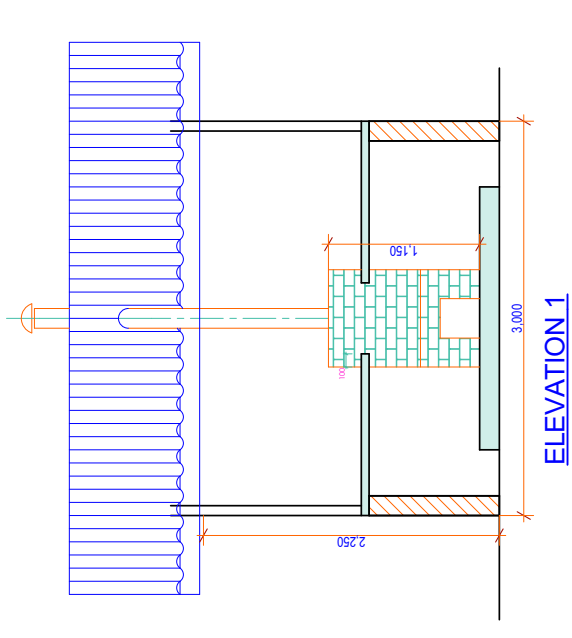


SECTION 01



SECTION 02

COMPOSTING BED



**INCINERATOR SHED**



ISO 9001:2008 CERTIFIED

### WATER SECTOR TRUST FUND

CIC Plaza, First Floor, Mara Road  
PO Box 49699 - 00100  
Nairobi, Kenya  
**T.** +254 (020) 272 9017/18/19  
**E.** info@waterfund.go.ke  
**I.** www.waterfund.go.ke

**Facebook:** www.facebook.com/kewstf

**Twitter:** https://twitter.com/wstf\_ke

**Youtube:** www.youtube.com/channel/  
UCwjdTibVD-5PJrwHhbxVg



Supported by



www.waterfund.go.ke

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