



**TN**  
TAMIL NADU

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URBAN SANITATION

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SUPPORT PROGRAMME

**iihs**<sup>TM</sup>  
INDIAN INSTITUTE FOR  
HUMAN SETTLEMENTS

In Association With:



# Training programme on Fecal Sludge Management for Engineers in Trichy Corporation

Anaerobic digestion with co-  
composting : case study on Trichy

# Background

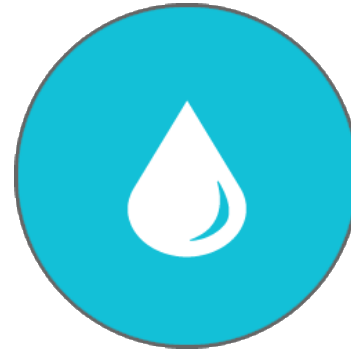
- Beneficiary population – 54,000 approx.
- Area available for FSTP – 1.6 acres
- Wards covered - 49, 45, 53, 57, & 60
- Households served - 10756 Households
- Capital cost : 3.6 crores
- O&M cost – 19 lakh per annum



# Treatment outcomes

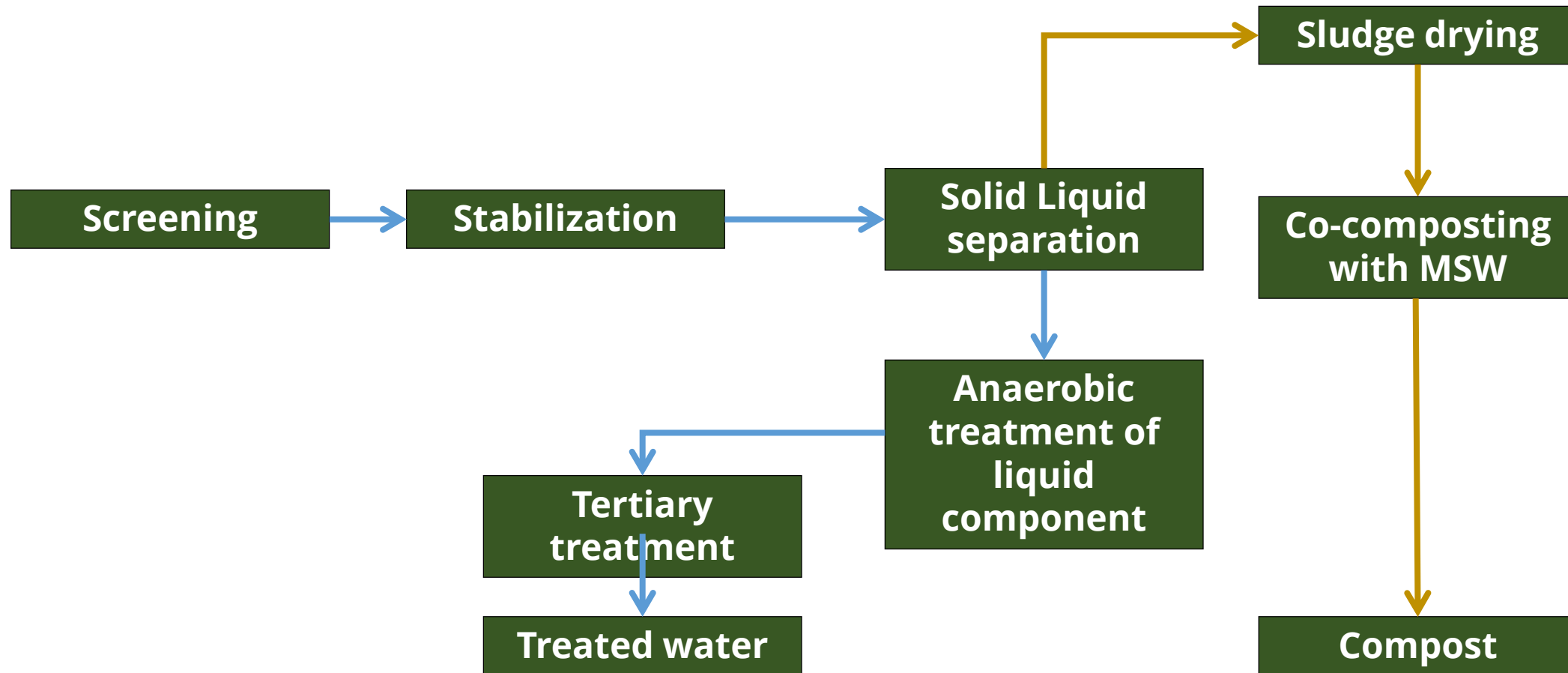


**INPUT – Fecal sludge**



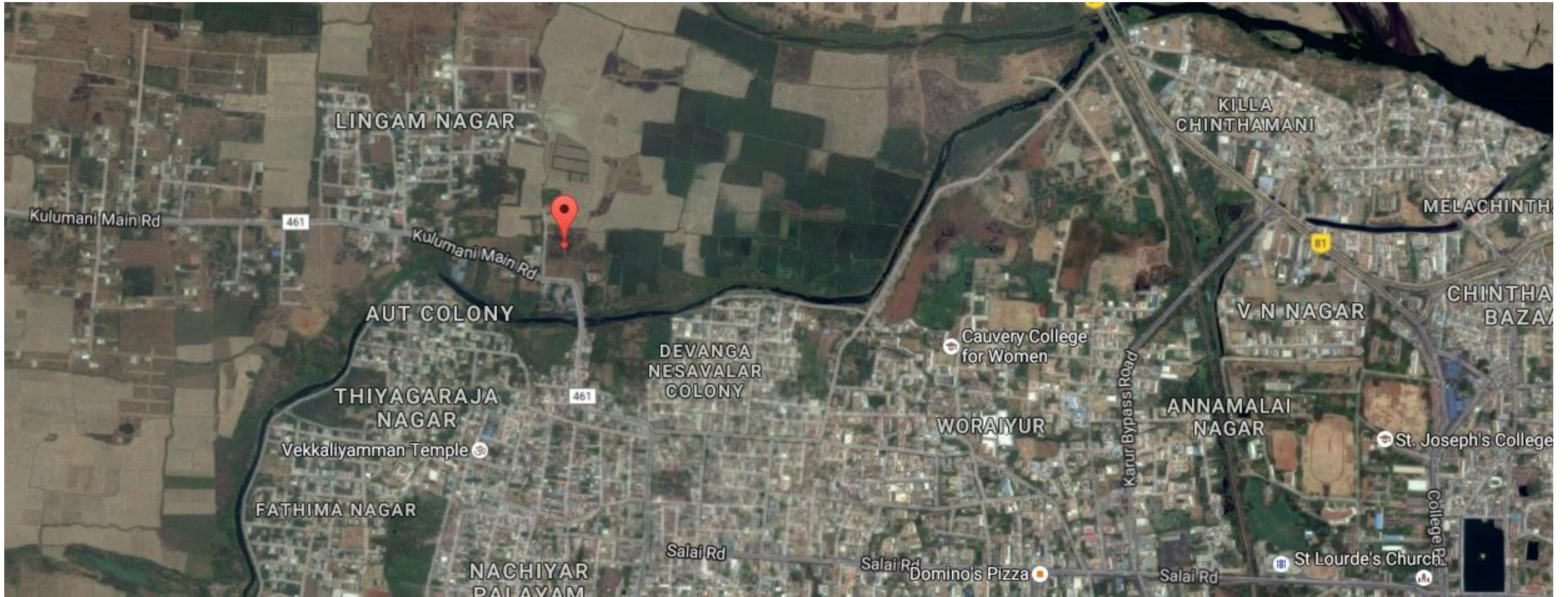
**Output – Treated water, nutrient rich compost**

# Treatment Concept





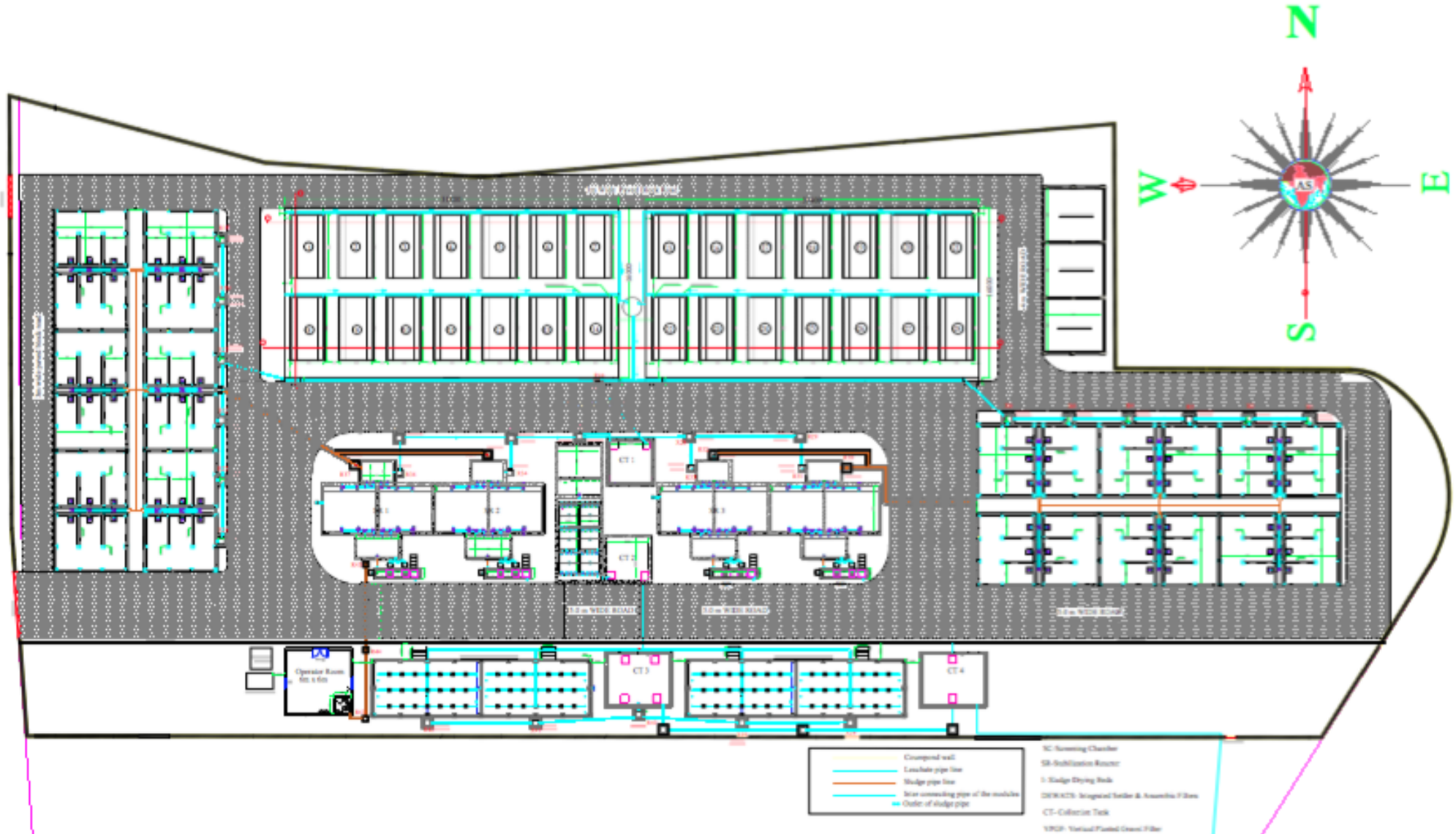
# Tiruchirappalli Location



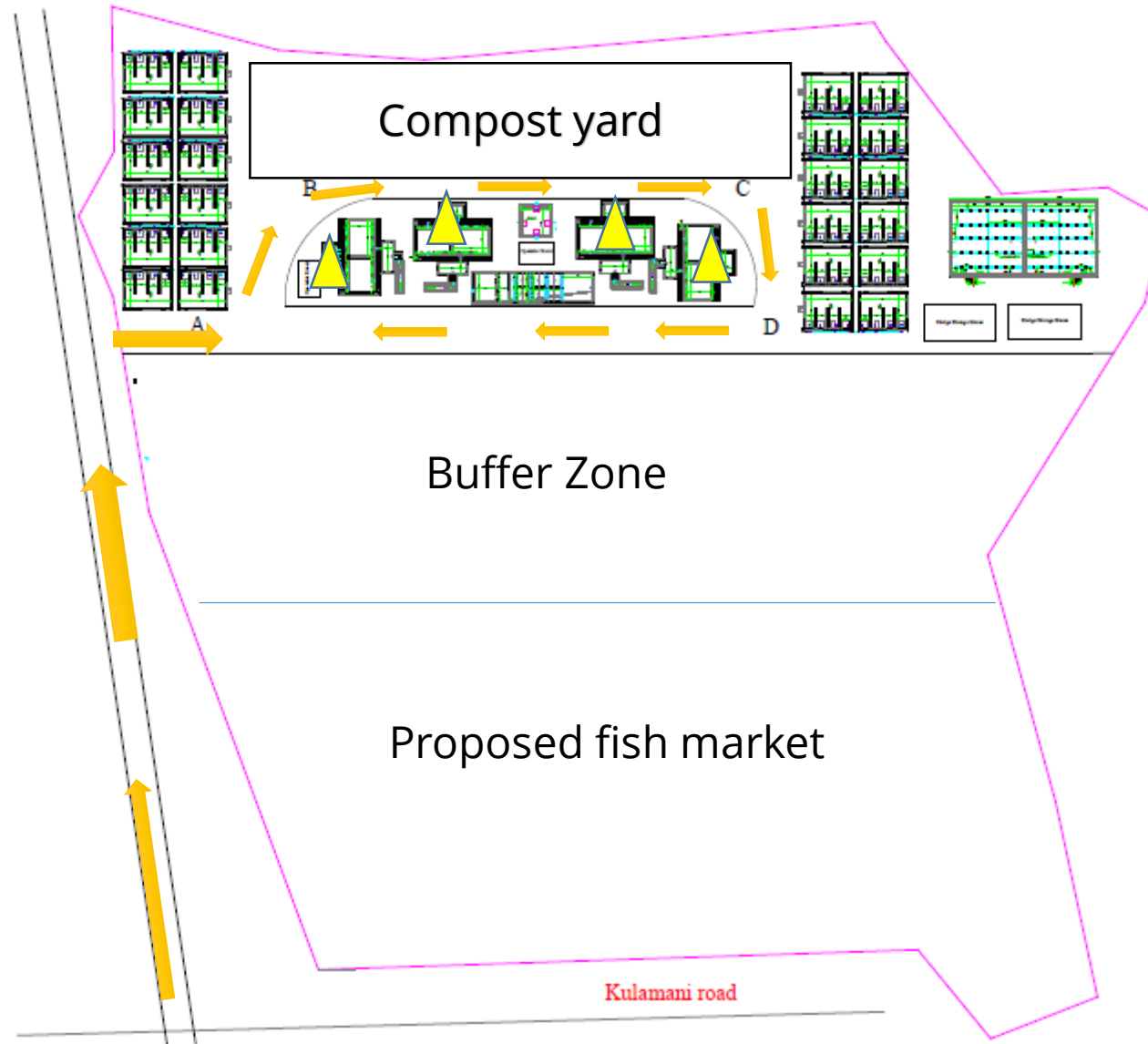
- Proposed site for Fish Market - Buffer zone of 30 – 50 meters between FSTP boundary and fish market
- Nearby areas not connected to sewerage

# FSTP Master Plan

Master Plan -FSTP, Tiruchirappalli-32Cum



# FSTP – Truck route



 Discharge points



# FSTP - Implementation



# FSTP – Design Overview

Parameters	Tiruchirappalli
Treatment capacity	32 KLD
Maximum number of cesspool vehicles discharged per day ( 4 m <sup>3</sup> capacity)	8 Nos.
Input sludge	Faecal sludge, Septage, Fresh sludge from public toilets and CTs ( proportionate dilution with FS)
End Product	Treated water Compost (co-compost with MSW)
Area Requirement	1.6 acres
Estimated Cost	Rs. 3.6 Crore
O&M Requirement per year	Rs. 19,00,000

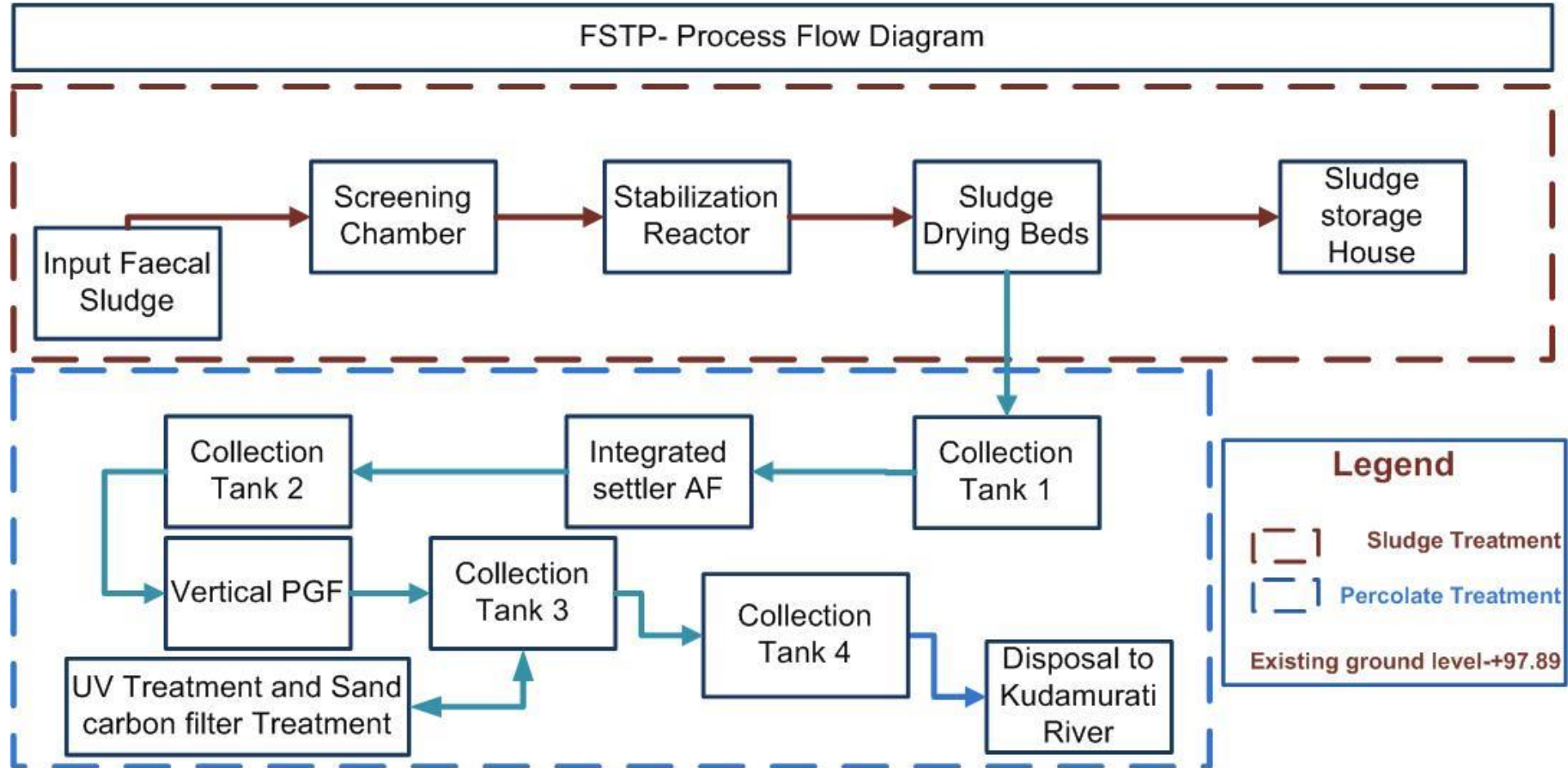


# Treatment efficiency and end products

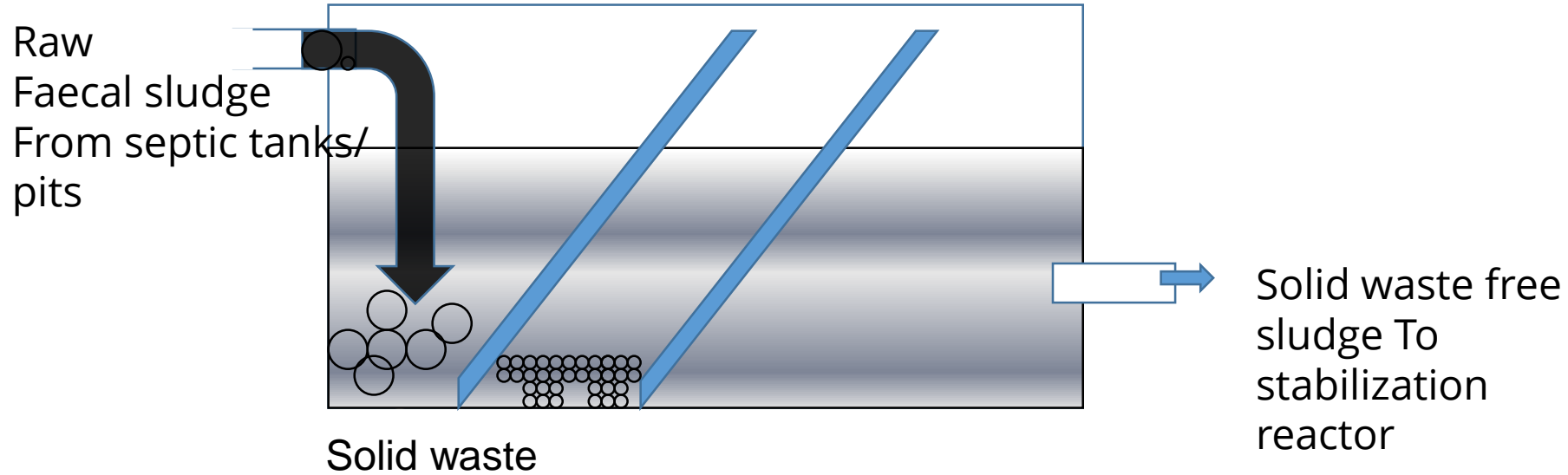
Parameters	Input	CPCB Standards for discharge into water body	CPCB Standards for Irrigation
COD	30000 mg/L	< 250 mg/L	N.A
BOD	20000 mg/L	< 30 mg/L	100 mg/L
TSS	6000 mg/L	<100 mg/L	200 mg/L
E-Coli	- N.A-	< 1000 MPN per 100 mL	N.A

End Products	
Treated water	Reused for plantations in the buffer zone, excess treated water to be discharged in the adjoining natural drain.
Bio Solids	Dried sludge to be co-composted with municipal organic waste.

# Flow Description



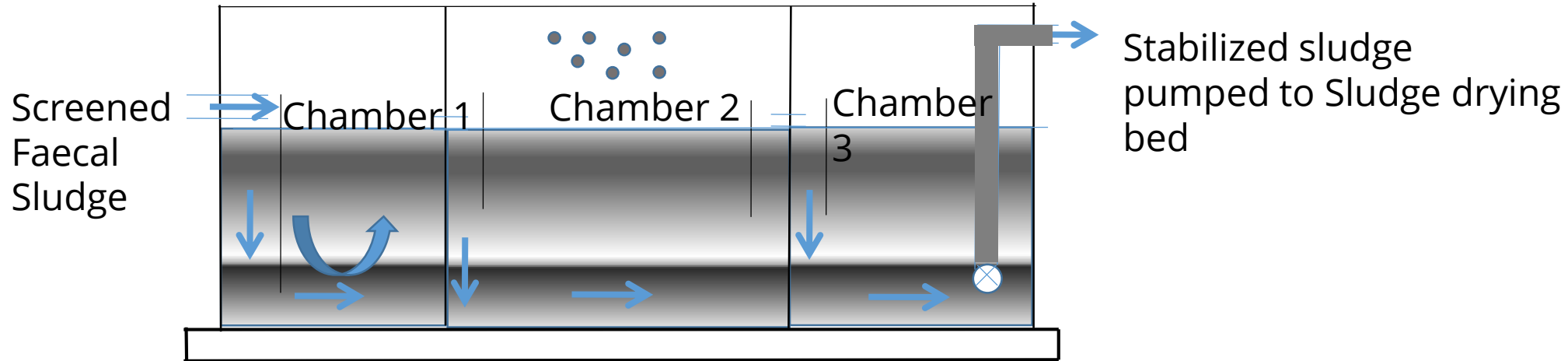
# Screening Chamber



- Removal of solid waste
- Removal of sand and grit
- Consists of a coarse screen and fine screen
- Effluent is discharged into stabilization reactor for further treatment



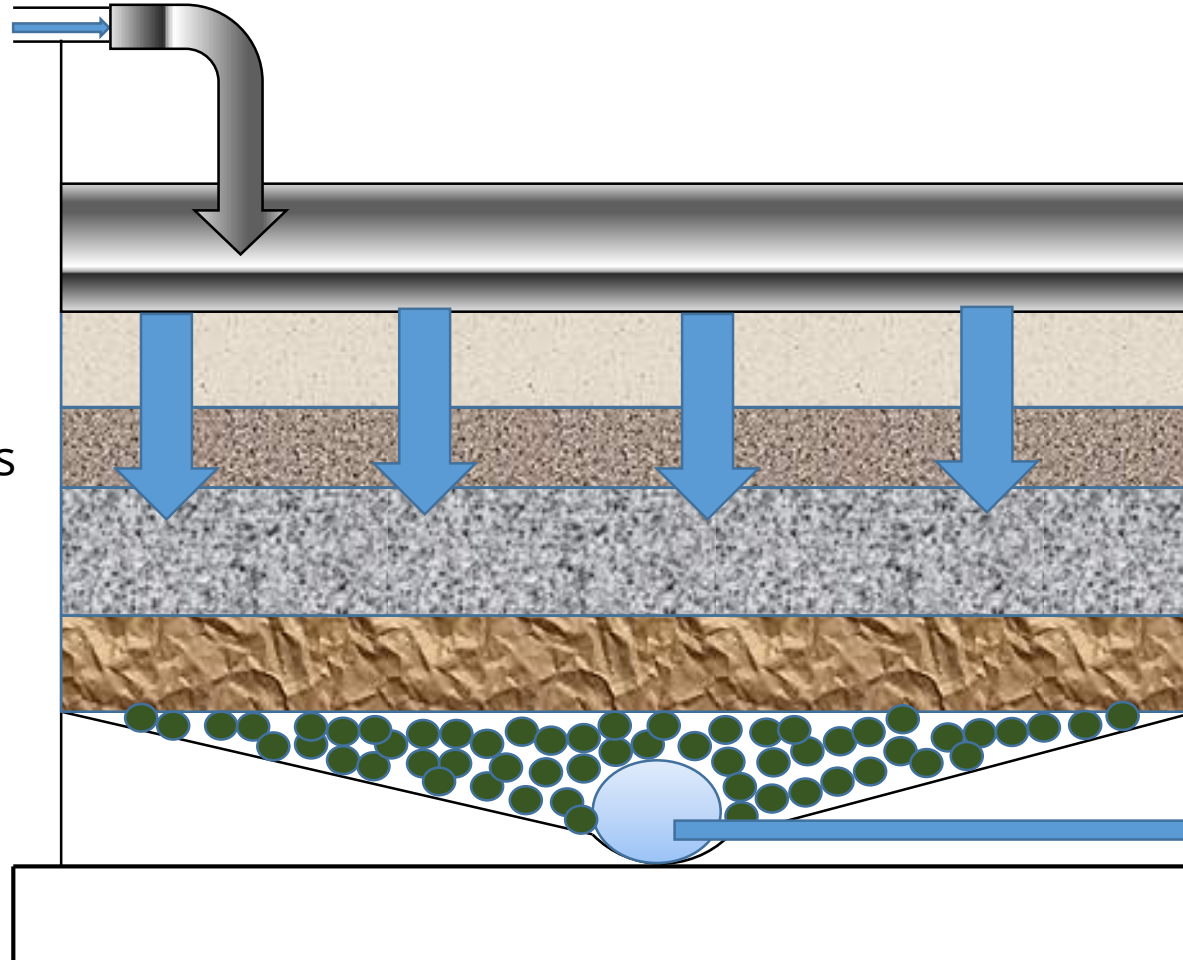
# Stabilisation Reactor



- Consists of three chambers: Mixing, Stabilization and solid liquid separation
- Digests the organic solids and reduces smell
- Total retention period is 11 days
- The sludge along with the water is pumped into sludge drying beds

# Sludge Drying Bed

Faecal sludge pumped from stabilization reactor



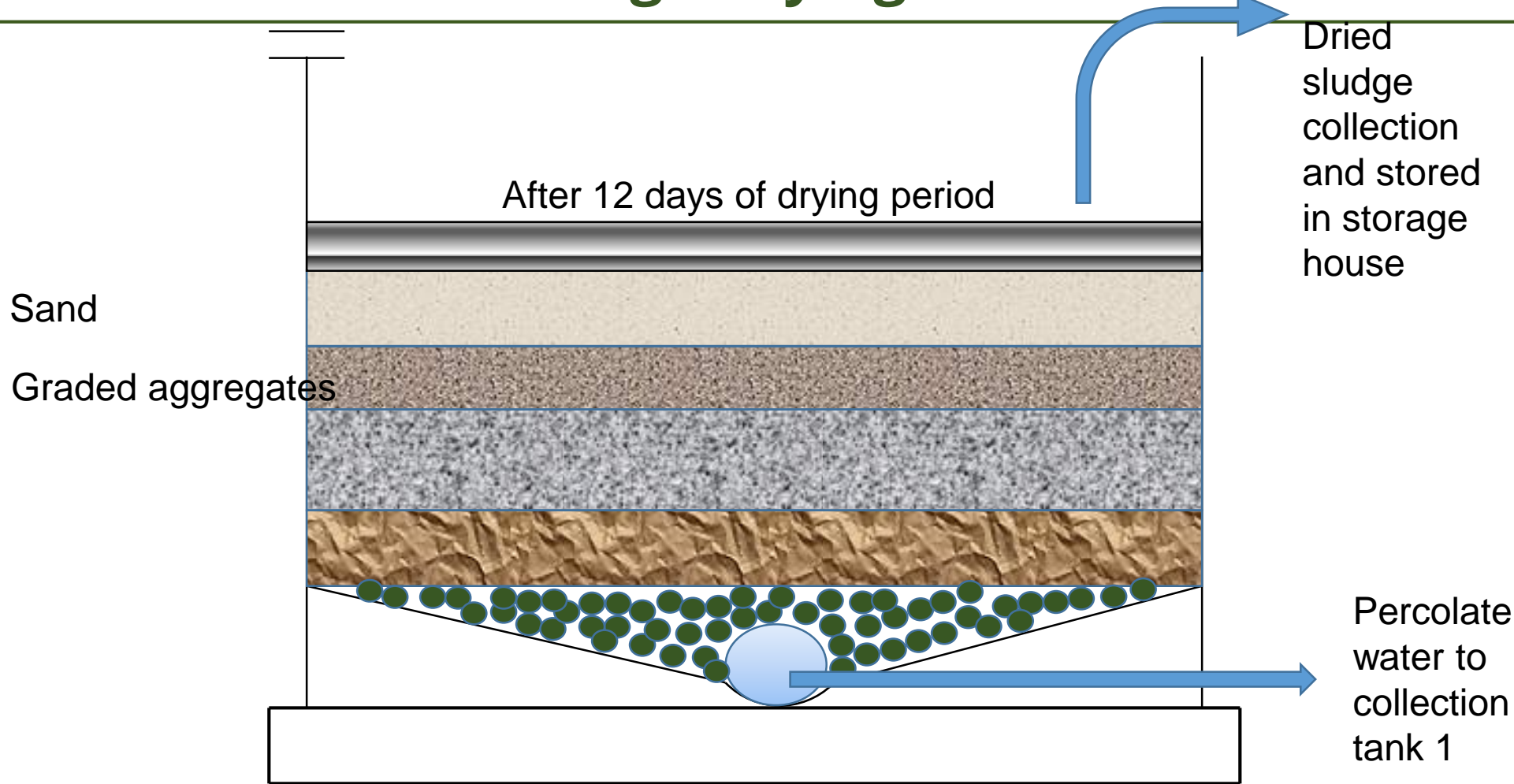
Sand

Graded aggregates

To collection tank 1

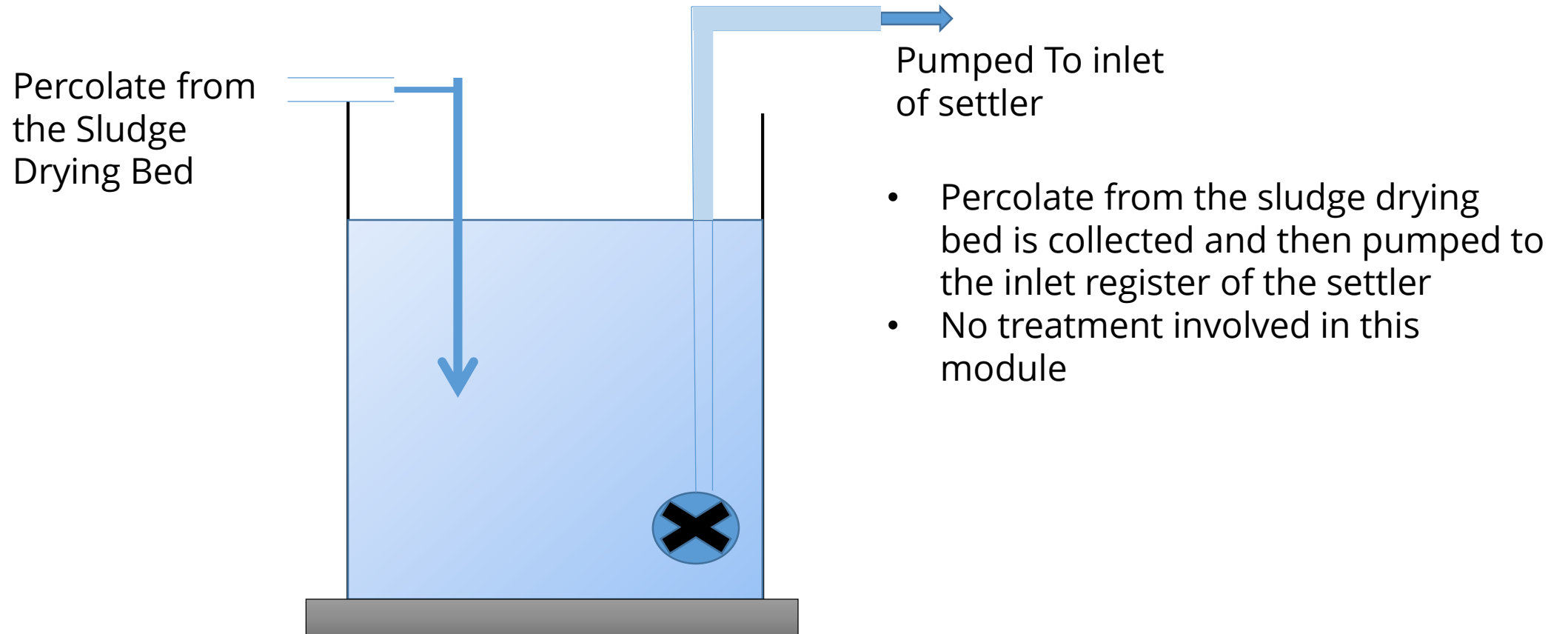
- Sludge from Stabilization reactor is applied on the sludge drying bed
- The bed has filter media of sand and graded aggregates

# Sludge Drying Bed

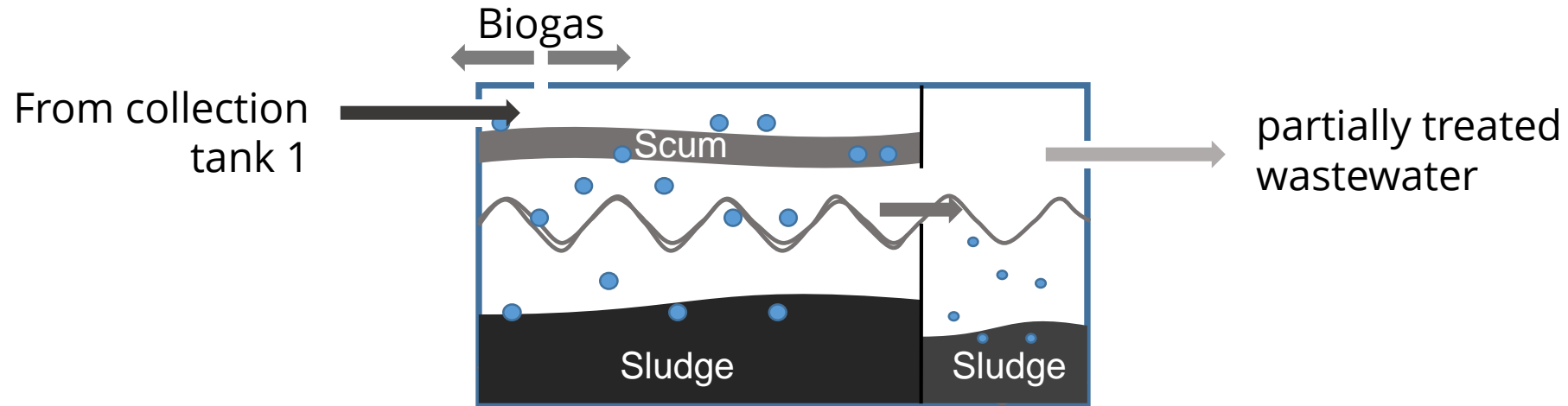


- ✓ Water percolates through the filter media and gets collected in collection tank 1
- ✓ After 12 days of drying the sludge is collected and stored in sludge drying bed for

# Collection Tank -1



# DEWATS - Settler

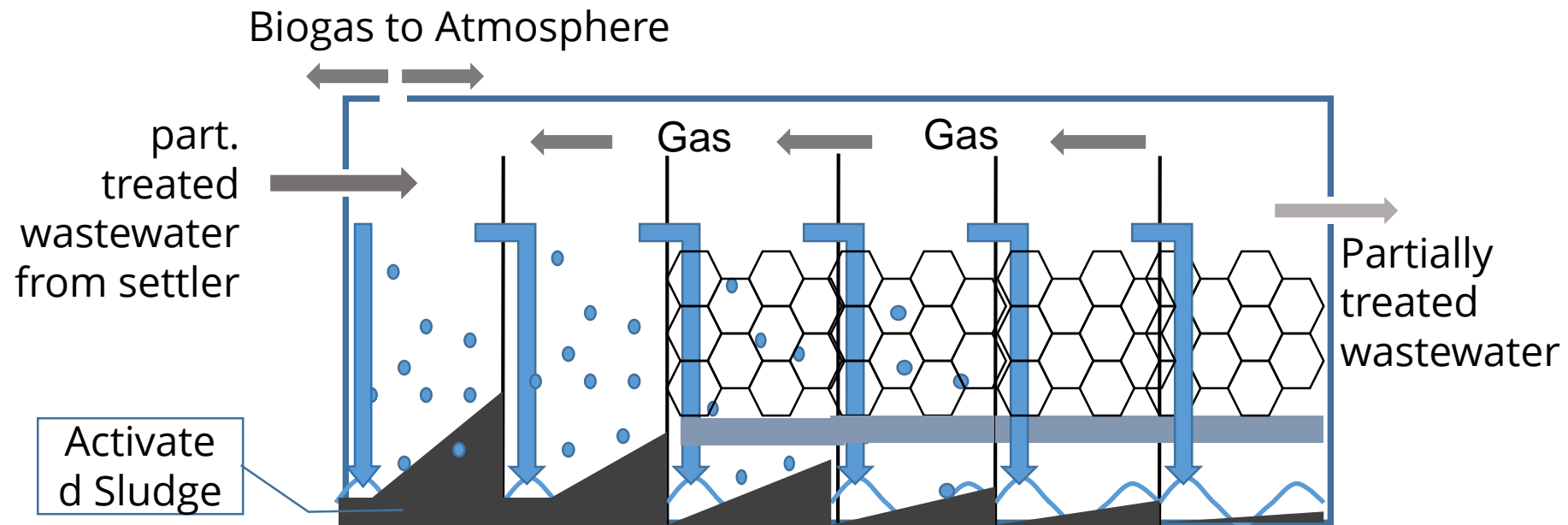


- Settler removes the heavy particles which settle down at the bottom of the first chamber
- The retention time is around 2 - 4 hours



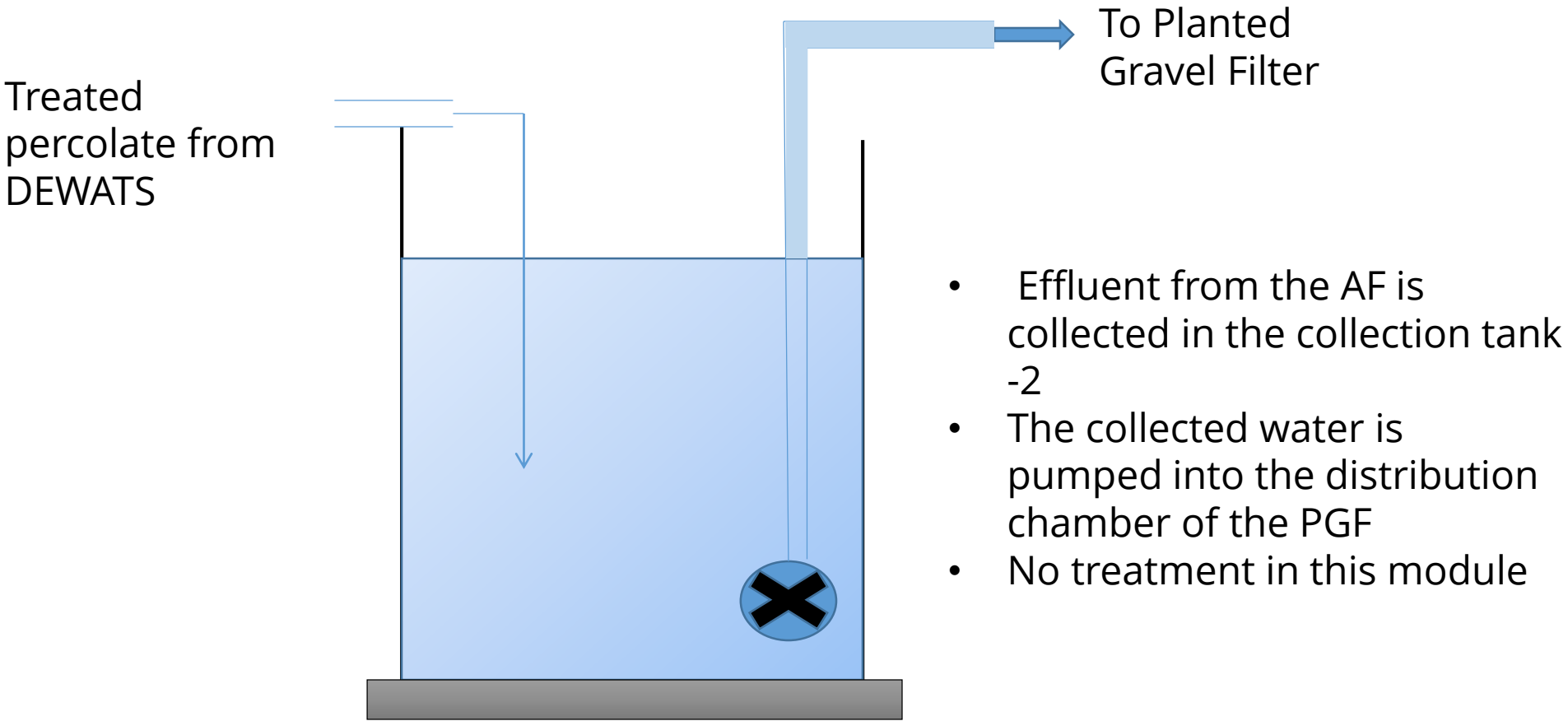
# DEWATS - Anaerobic Filter

## Secondary treatment

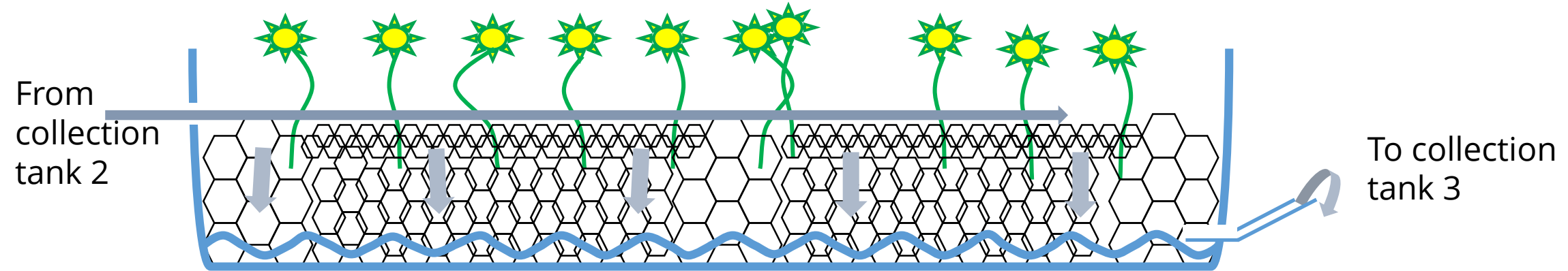


- The partially treated wastewater from the settler goes into the Anaerobic filter
- Treatment and removal of the soluble pollutants are removed in this module
- It has filter media in the chambers which help in provide surface area for biofilms to grow

# Collection tank - 2

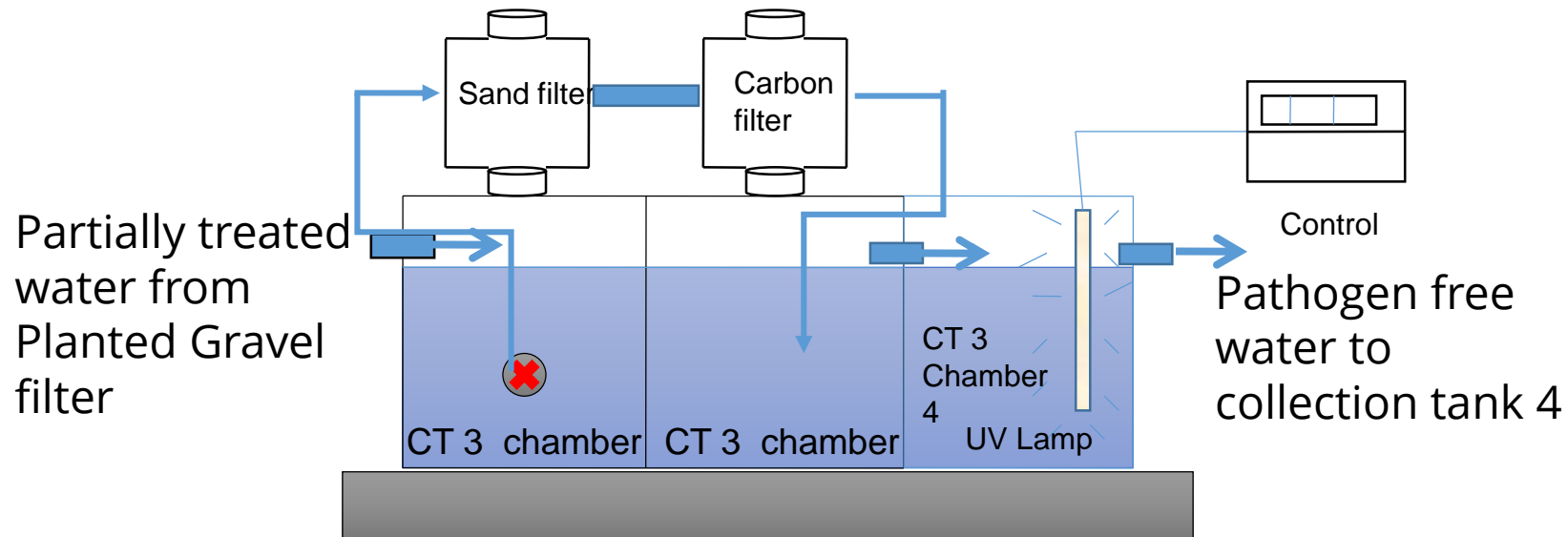


# DEWATS - Planted Gravel Filter



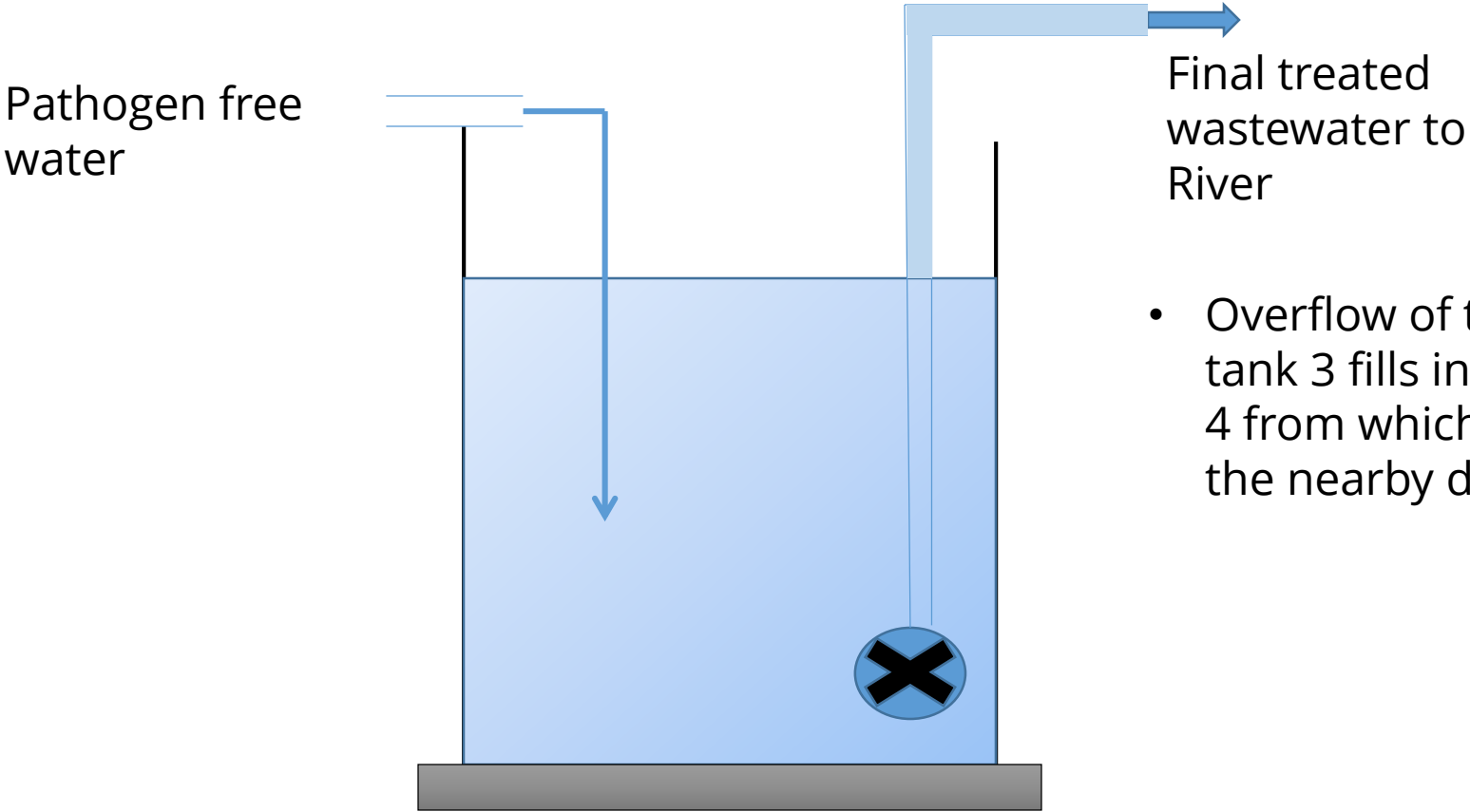
- The water pumped from collection tank 2 is fed into the PGF
- PGF removes the suspended solids and absorbs nutrients
- The percolate from PGF is collected in collection tank 3

# CT 3 with Sand & Carbon Filter and UV lamp



- Water from the PGF is collected in the collection tank 3
- Water from the first chamber is pumped into the sand and carbon filter and discharged into the 2<sup>nd</sup> chamber
- Overflow of 2<sup>nd</sup> chamber is collected in 3<sup>rd</sup> chamber where it is disinfected with UV lamps

# Collection tank - 4



- Overflow of the collection tank 3 fills into collection tank 4 from which it is pumped to the nearby drain



# Co-composting of treated faecal sludge with Municipal organic solid waste-





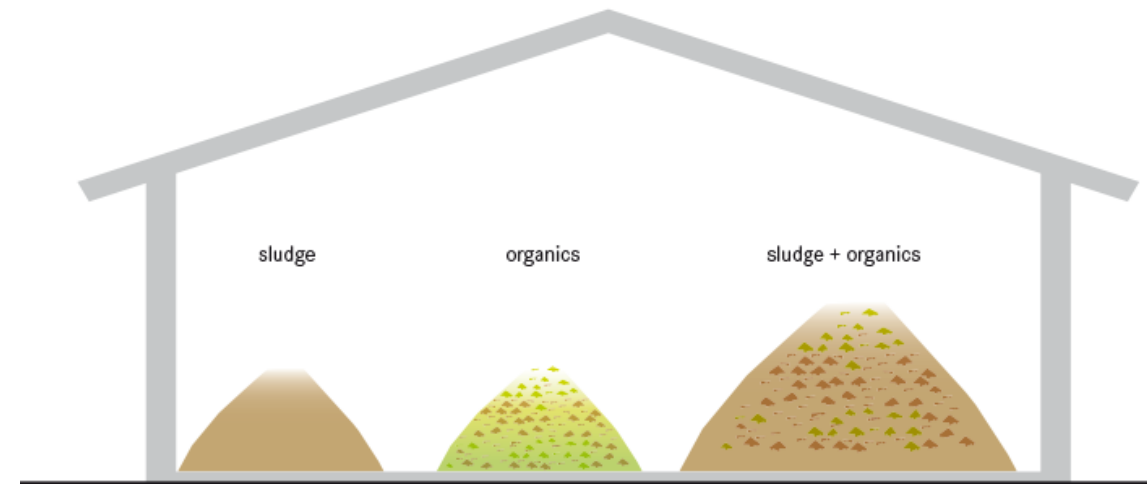
# Feedstock Used



1. Dried Faecal sludge
2. Municipal wet waste
3. Leaf litters

# Steps involved in co-composting process

1. Sorting
2. Shredding
3. Preparation of bed
4. Layering of faecal sludge and organic waste
5. Overturning of the compost layers
6. Collection of compost





# Steps involved in co-composting process

1. **Sorting**
2. Shredding
3. Preparation of bed
4. Layering of faecal sludge and organic waste
5. Overturning of the compost layers
6. Collection of compost

Sorting of the municipal solid waste is done to remove the inorganic waste which can hinder the composting process. It can be done manually with proper protective gear



# Steps involved in co-composting process

1. Sorting
- 2. Shredding**
3. Preparation of bed
4. Layering of fecal sludge and organic waste
5. Overturning of the compost layers
6. Collection of compost

The sorted municipal waste is then shredded by means of a shredder in order to ease the process of laying it. Shredding also helps in better composting efficiency and air flow





# Steps involved in co-composting process

1. Sorting
2. Shredding
- 3. Preparation of bed**
4. Layering of fecal sludge and organic waste
5. Overturning of the compost layers
6. Collection of compost

The bed is prepared for laying of the faecal sludge and the shredded organic waste. The bottom layer is carefully laid with a thin layer of brown material — leaves, chopped stems, wood chips



# Steps involved in co-composting process

1. Sorting
2. Shredding
3. Preparation of bed
4. **Layering of fecal sludge and organic waste**
5. Overturning of the compost layers
6. Collection of compost

The Feed materials (Faecal Sludge and Wet waste) are carefully layered in 1:2 ratio respectively one on top of another. The height of the compost pile is about 6 feet.





# Steps involved in co-composting process

1. Sorting
2. Shredding
3. Preparation of bed
4. Layering of fecal sludge and organic waste
- 5. Overturning of the compost layers**
6. Collection of compost

After a period of 15 days, the compost pile is overturned to the adjacent bed. This is to enhance the aeration and mixing of the compost. After the first turning, it has to be carried out every week. The thermophilic range of 60 – 70° Celsius is maintained. pH – 6 to 7;



# Steps involved in co-composting process

1. Sorting
2. Shredding
3. Preparation of bed
4. Layering of fecal sludge and organic waste
5. Overturning of the compost layers
6. **Collection of compost**

After the composting process which takes around 60 – 90 days, the compost is black in colour with reduced height. This can be collected by means of a shovel and personal protective gears





# Windrow feedstock after completion of maturation phase



# Characterization of fecal sludge

Sample Marked: "FAECAL" sludge

SL NO	Test	Unit	Result
1	pH	-----	4.60
2	Conductivity	µmhos/cm	3800
3	Organic carbon content	%	44.37
4	Nitrate Nitrogen	%	0.17
5	Soluble phosphates as PO <sub>4</sub>	%	1.50
6	Potassium as K	%	0.07
7	Lead as Pb	mg/kg	BDL
8	Arsenic as As	mg/kg	BDL
9	Chromium as Cr	mg/kg	BDL
10	Cadmium as Cd	mg/kg	BDL
11	Nickel as Ni	mg/kg	BDL
12	Iron as Fe	%	0.015
13	Zinc as Zn	mg/kg	BDL
14	Manganese as Mn	mg/kg	BDL
15	Copper as Cu	mg/kg	0.020

# Characterization of municipal solid waste

## Sample Marked: Muncipal Wet/Waste

SL NO	Test	Unit	Result
1	pH	-----	3.88
2	Conductivity	$\mu\text{mhos/cm}$	2500
3	Organic carbon content	%	53.25
4	Nitrate Nitrogen	%	0.05
5	Soluble phosphates as $\text{PO}_4$	%	0.25
6	Potassium as K	%	0.36
7	Lead as Pb	mg/kg	BDL
8	Arsenic as As	mg/kg	BDL
9	Chromium as Cr	mg/kg	BDL
10	Cadmium as Cd	mg/kg	BDL
11	Nickel as Ni	mg/kg	BDL
12	Iron as Fe	%	0.014
13	Zinc as Zn	mg/kg	BDL
14	Manganese as Mn	mg/kg	BDL
15	Copper as Cu	mg/kg	0.018



## Analysis values of windrow 1

Sl. No.	Parameter	Organic compost (FCO, 2009)	Results of 60 days	Results of 88 days
1	pH	6.5 – 7.5	7.02	7.07
2	Conductivity (as dsm-1), not more than	4	0.15	1.24
3	Particle size	Minimum 90% material should pass through 4.0 mm IS sieve	-	Passes
4	Moisture, percent by weight, maximum	15 – 25	-	30.2
5	Bulk density (g/cm <sup>3</sup> )	Less than 1.0	-	0.77
6	Total Organic Carbon, % by weight, minimum	12	42	18.2
7	Total Nitrogen (as N), % by weight, minimum	0.8	1.21	0.23
8	Total Phosphate (as P <sub>2</sub> O <sub>5</sub> ) % by weight, minimum	0.4	0.48	0.2



## Analysis values of windrow 1

Sl. No.	Parameter	Organic compost (FCO, 2009)	Results of 60 days	Results of 88 days
9	Total Phosphate (as P <sub>2</sub> O <sub>5</sub> ) percent by weight, minimum	0.4	0.48	0.2
10	Total Potassium (as K <sub>2</sub> O), percent by weight, minimum	0.4	2.61	0.98
11	C:N ratio	<20	1:34.7	12.1
12	Lead(mg/kg)	100	85	84.9
13	Chromium (mg/kg))	50	32	31.1
14	Cadmium	5	0.37	0.37
15	Nickel(mg/kg)	50	23.5	23

# Analysis values of microbes

The results for helminthes egg count of the faecal sludge and co-composted sludge :

Pathogen	Treated faecal sludge	Compost standards
Helminth eggs	100 EPG	≤ 3-8 eggs/gram of dry solids (Source: Xanthoulis and Strauss 1991)
Faecal coliforms	60*10 <sup>5</sup> CFU/100ml	<1000 MPN/g (Source: CCME When compost contains only yard waste)

# Thank You