Decentralised Wastewater Treatment

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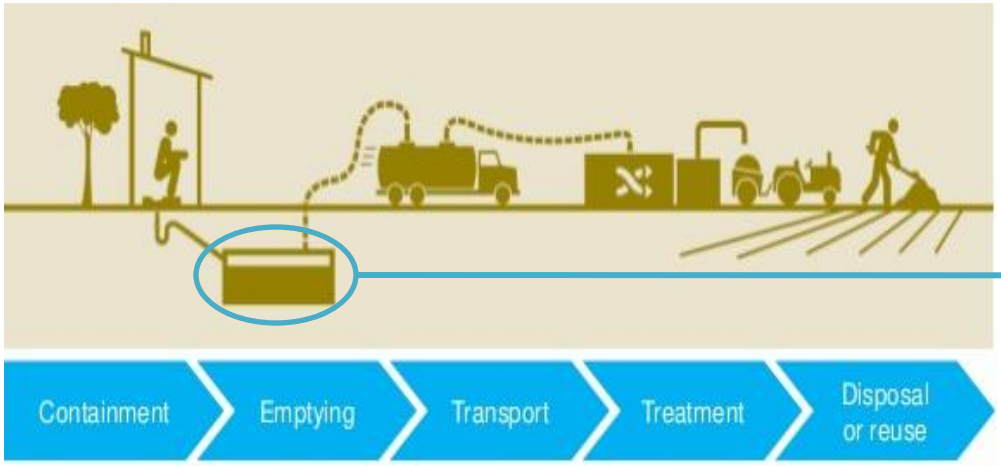
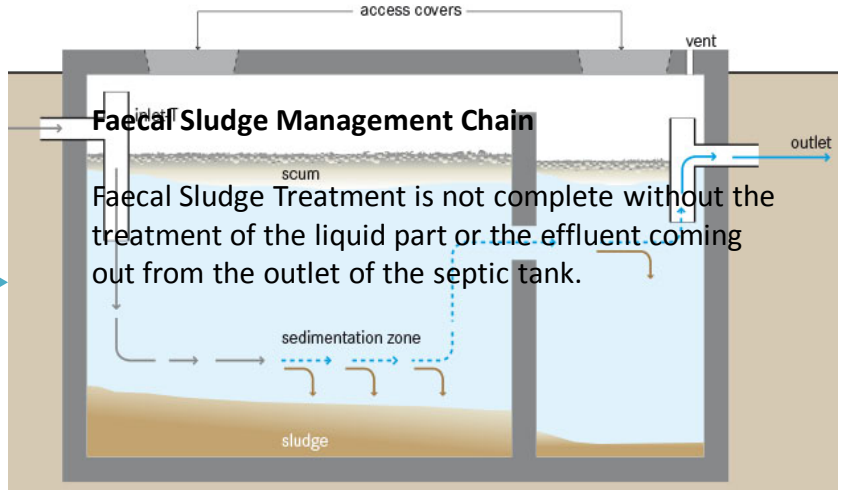
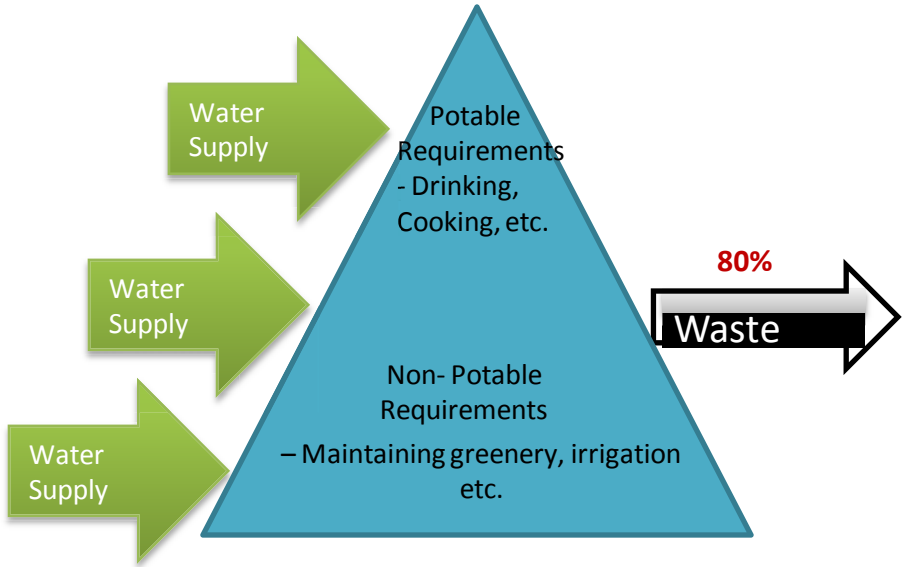
Faecal sludge management – Complete sanitation solution?

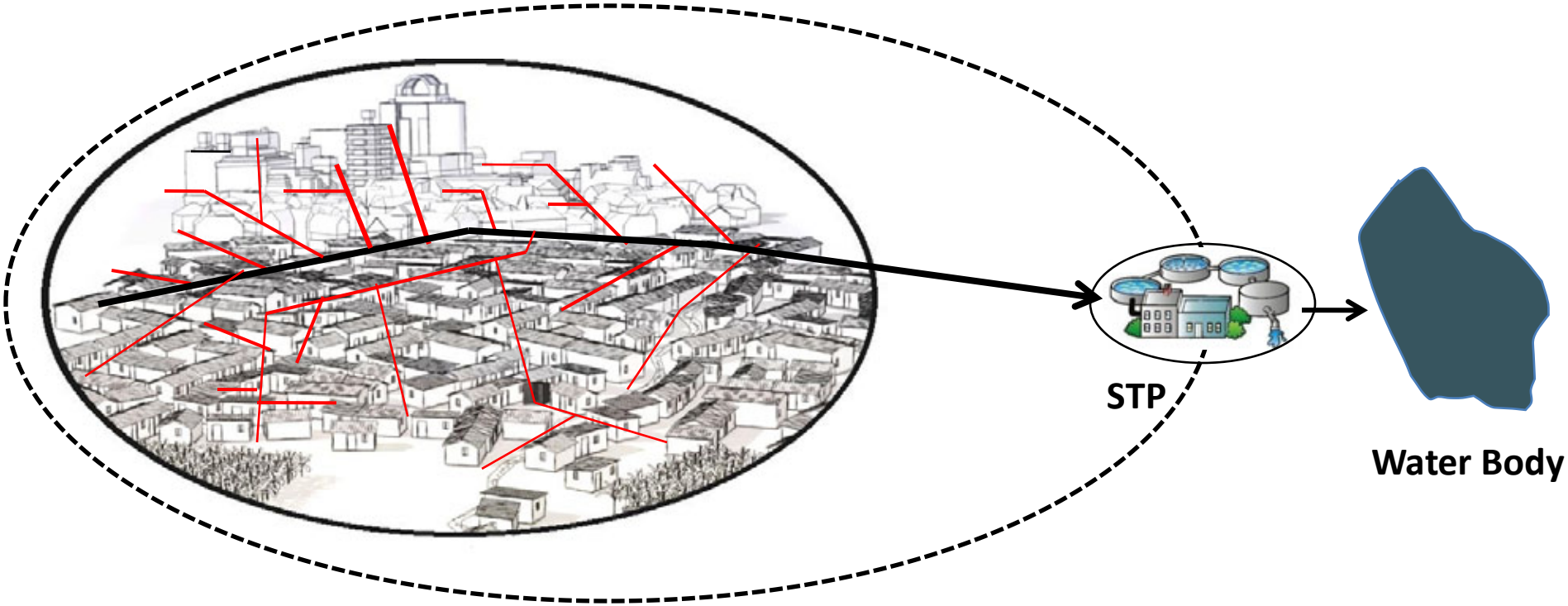




Under no circumstances shall effluent from septic tank be allowed into an open channel drain or body of water without adequate treatment. – Model Building Bye-Laws, 2016



Conventional wastewater treatment
Current sewage paradigm



Centralised system serving the city centre and outskirts

Cost Estimates of Select Technologies

Technology	Cost /mld (at 2008 prices) in Rs.lakhs
Waste Stabilization Ponds	25
UASB + Post treatment	55
Activated Sludge Process, C-Tech, FAB	87

- Cost of Interception & Diversion works (main trunk sewers, SPS excl. house connections, branch and lateral sewers) and cost of land acquisition is around Rs. 3-4 crore per MLD

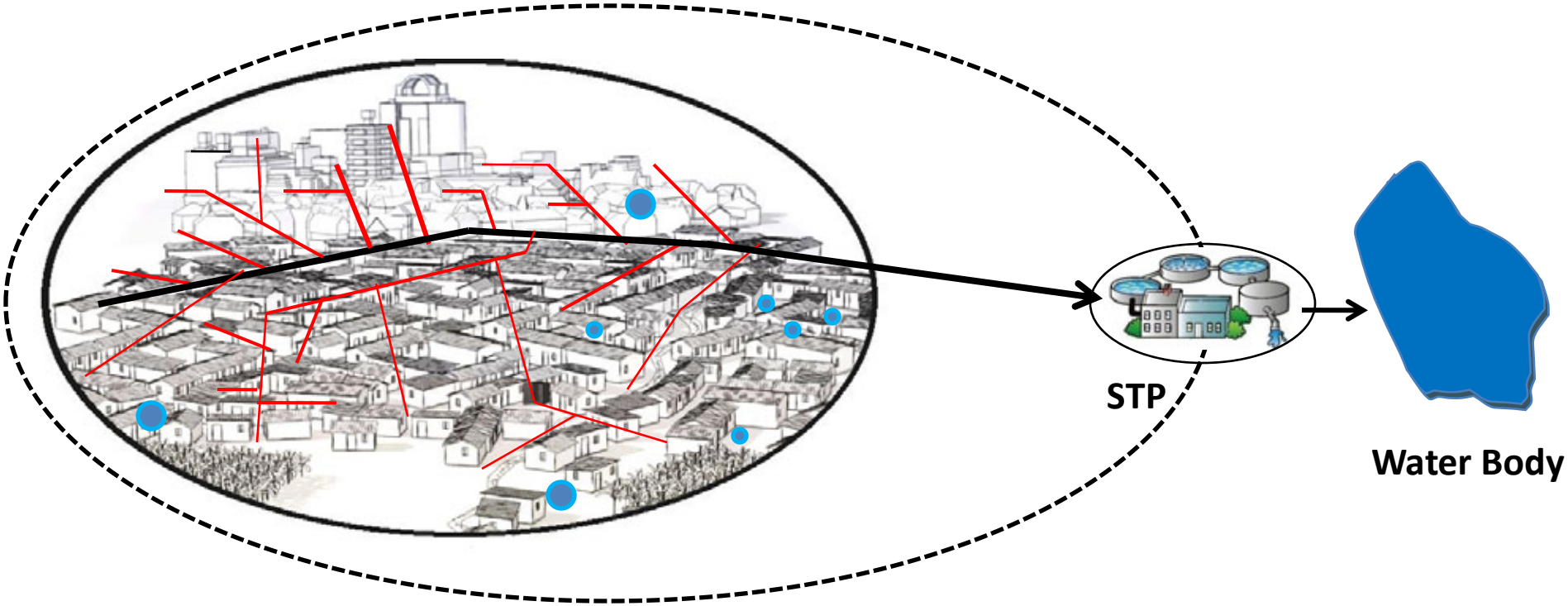
The administrative approval of the estimate has been accorded by Delhi Jal Board vide Resolution No 1267/DJB dated 09.10.06, Rs 4, 40,03,950/- for 7MGD pumping station at Punjabi Bagh.

- Estimated Class I & II Sewage Generation in year 2020 = 45000 MLD

- Cost would increase to the extent of Rs. 45,000 crore to Rs. 1,32,000 crore.

Note – *Rs 1 lakh = USD 1,510/- , Rs 100 lakh = Rs 1 crore (USD = 151000/-), Rs 1 crore = Rs 10 million and Rs. 1 lakh = Rs. 0.01 crores*

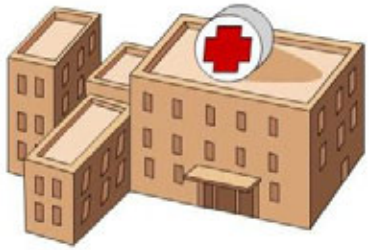
Conventional wastewater treatment and reuse
Current sewage paradigm



Incorporation of Decentralised Wastewater Treatment linked to local Reuse

DWWT Application

Public toilets



Hospitals

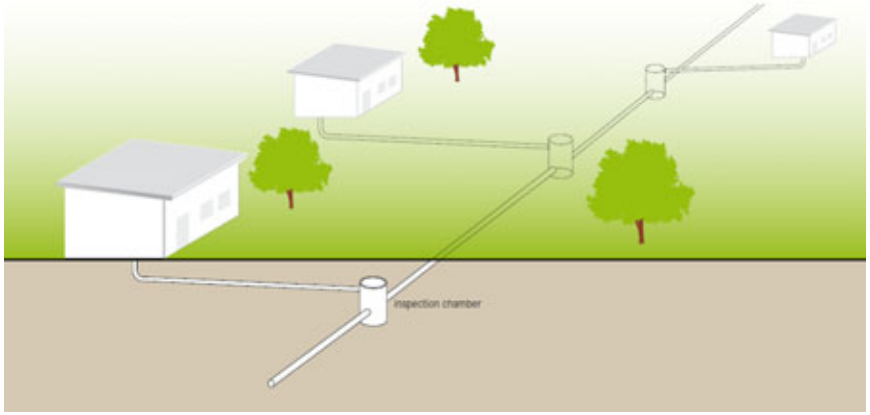
Markets/Offices

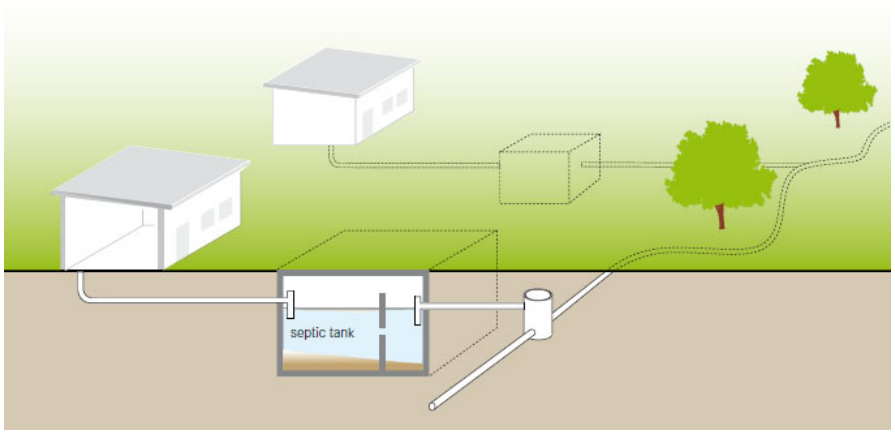
Single house

Residential areas

Schools/colleges

Small Bore Sewage System/ Simplified Sewers



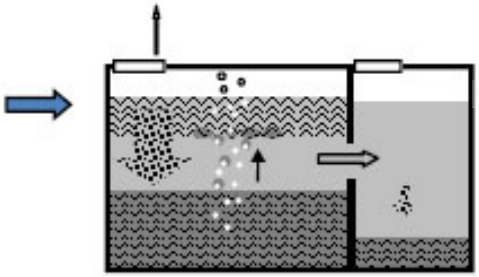


A simplified sewer has smaller diameter pipes laid at a shallower depth and at a flatter gradient than Conventional Sewers. The simplified sewer allows for a more flexible design at lower costs.

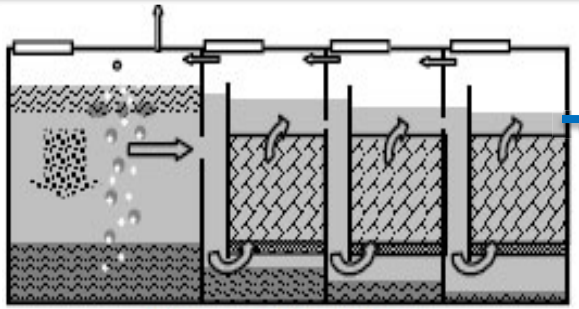
These can also be made solids-free sewer network that carries pre-treated and solid-free wastewater.

(Minimum sewer diameter 100mm, and the gradient is usually 0.5-1%)

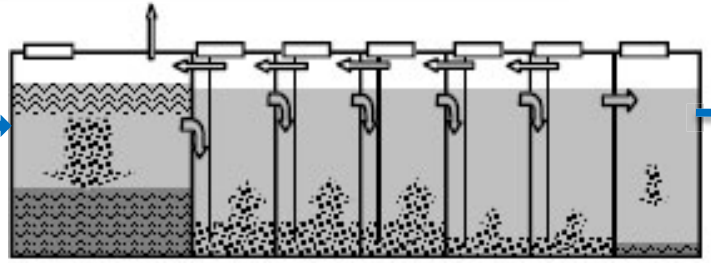
Modules of a Decentralised Wastewater Treatment System



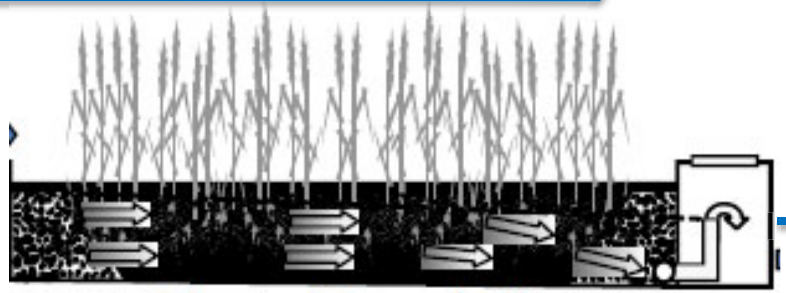
Septic tank / Settler



Anaerobic Filter

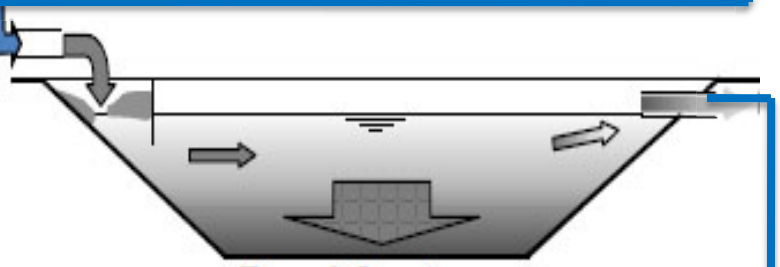


Anaerobic Baffled Reactor



Planted Gravel Filter

Reuse of treated water



Pond Systems

Types of Settlers

3 chambers

2 chambers

Area required : 0.5 sq m per cum

Anaerobic Baffled Reactor (ABR)

Area required : 1 sq m per cum

Anaerobic Filter

Filter materials

River bed stones

High density clay aggregates

Crushed stones

Pumice stones

Filter material after about 5-8 years

Planted Gravel Filter Bed (PGF)

Type of plants for PGF: Canna Indica

They can be yellow folowered, red flowered or sometimes orange

Type of plants for PGF:
Typha angustata

Type of plants for PGF: Scirpus

Scirpus littoralis

Polishing Ponds

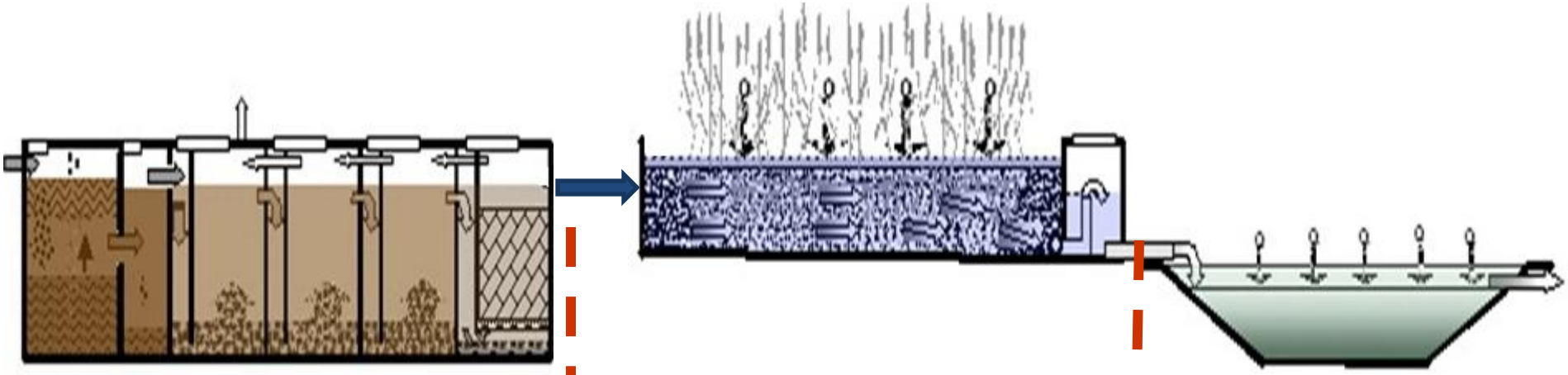
- Designed to provide 1 to 3 days retention time
- Normally operate at a depth of 1 to 1.5 m depth
- Excessive detention time will increase effluent's suspended solids concentrations
- Reduces E coli count

Area required : 1.2 sq m per cum

Tip: Use Gambusia to control mosquitoes

Performance of DWWT

The right combination and dimension of the modules make DWWT successful



Underground anaerobic process
20%-30% BOD removal – Settler
70%-90% BOD removal – Baffled reactor

Above ground level aerobic process
Can be designed as per requirement
Nitrates and Phosphates removal

Odor removal
Pathogen removal

CPCB standards are met at this point (depending upon the design), except for the smell control

Where and When it works? How it works?

For setting up a DWWT system the following steps are followed:

1. Define the objective for setting up the DWWT clearly

- Example: For address the pollution caused to the surroundings.

2. Relevant data collection

- Example: Population and water consumption pattern

3. **Site Feasibility:** Identification of a feasible site (Topography, climatic conditions etc.)

4. Deciding the **level of treatment** required

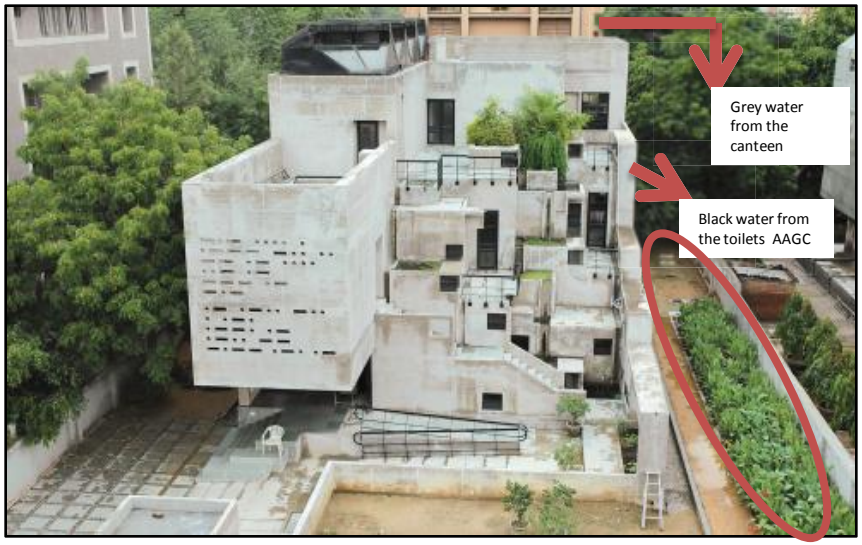
5. **Designing** an appropriate treatment system 

Recommended norms of treated sewage quality for specified activities at point of use
Source: CPHEEO, Manual on Sewerage and Sewage, 2015

	Parameter	Toilet flushing	Fire protection	Vehicle Exterior washing	Non-contact impoundments	Landscaping, Horticulture & Agriculture			
						Horticulture, Golf course	crops		
							Non edible crops	Crops which are eaten	
								raw	cooked
1	Turbidity (NTU)	<2	<2	<2	<2	< 2	AA	< 2	AA
2	SS	nil	nil	nil	nil	nil	30	nil	30
3	TDS	2100							
4	pH	6.5 to 8.3							
5	Temperature °C	Ambient							
6	Oil & Grease	10	nil	nil	nil	10	10	nil	Nil
7	Minimum Residual Chlorine	1	1	1	0.5	1	nil	nil	nil
8	Total Kjeldahl Nitrogen as N	10	10	10	10	10	10	10	10
9	BOD	10	10	10	10	10	20	10	20
10	COD	AA	AA	AA	AA	AA	30	AA	30
11	Dissolved Phosphorous as P	1	1	1	1	2	5	2	5
12	Nitrate Nitrogen as N	10	10	10	5	10	10	10	10
13	Faecal Coliform in 100 ml	Nil	Nil	Nil	Nil	Nil	230	Nil	230
14	Helminthic Eggs / litre	AA	AA	AA	AA	AA	<1	<1	<1
15	Colour	Colourless	Colourless	Colourless	Colourless	Colourless	AA	Colourless	Colourless
16	Odour	Aseptic which means not septic and no foul odour							

All units in mg/l unless specified; AA-as arising when other parameters are satisfied;
A tolerance of plus 5% is allowable when yearly average values are considered.

DWWT – Institutional Building, CSE



Benefit –

Freshwater (groundwater and municipal supply) not used in low end usage.

Monthly saving – Rs. 400 municipal supply and Rs. 2,500 if recycled water is purchase from tankers

Centre for Science and Environment	
Parameters	**Details**
Type of Building	Office Building
Source of Wastewater	Kitchen and Toilets
Capacity of the system	8KLD (Approx 150Users)
Re-use	For maintaining greenery
Capital Cost (2005)	Rs. 2,25,000/-
O&M Cost (per annum)	Rs. 30,000/-
Year of Implementation	2005

DWWT and local reuse at CSE building

DWWT and local reuse at CSE building

Oil Trap
(Preliminary Treatment)

Oil Removal from the wastewater coming out from the canteen

Physical Appearance of Water samples after treatment from various modules

Settler
(Primary Treatment)

- Suspended solid removal
- Two chambered

Anaerobic Baffled Reactor
(Secondary Treatment)

- Organic Degradation (BOD/ COD Removal)
- 10 chambered with anaerobic filters in 2 chambers
- Pebbles used as filter material

Planted Gravel Filter Bed
(Secondary and Tertiary

- Organic Degradation, Nitrogen and phosphate removal
- Gradient of about 1% to facilitate gravity flow
- Media – River bed pebbles
- Plant species – Canna, Typha

DWWT and local reuse at CSE building

Vortex

Odour removal and nitrates and phosphates removal

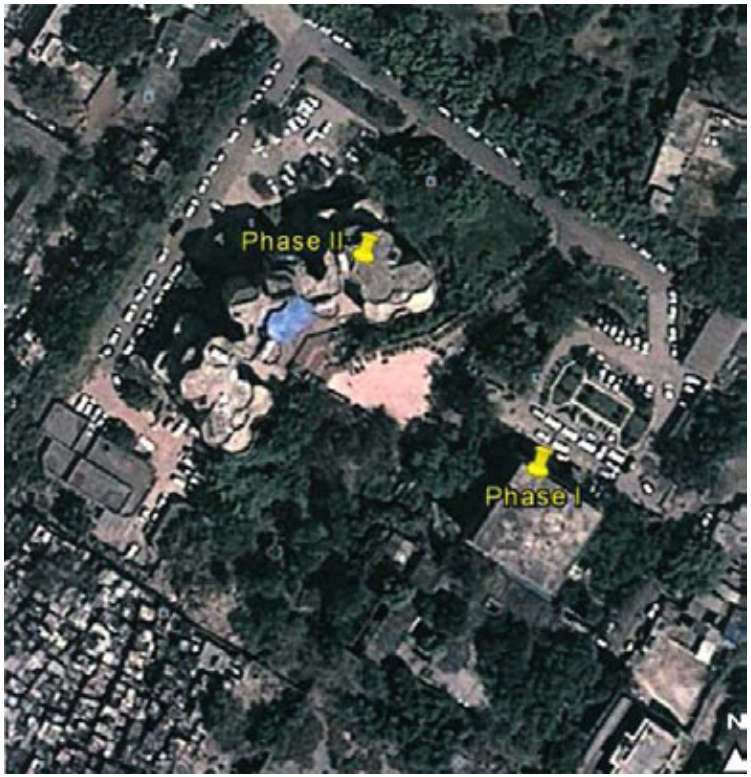
Storage Sump

Storage capacity of 12KLD (approx. One and a half days of storage)

Treated water Reuse

Treated water reused in watering plants and landscape maintenance
Daily usage - ~ 4,000 Liters Per Day

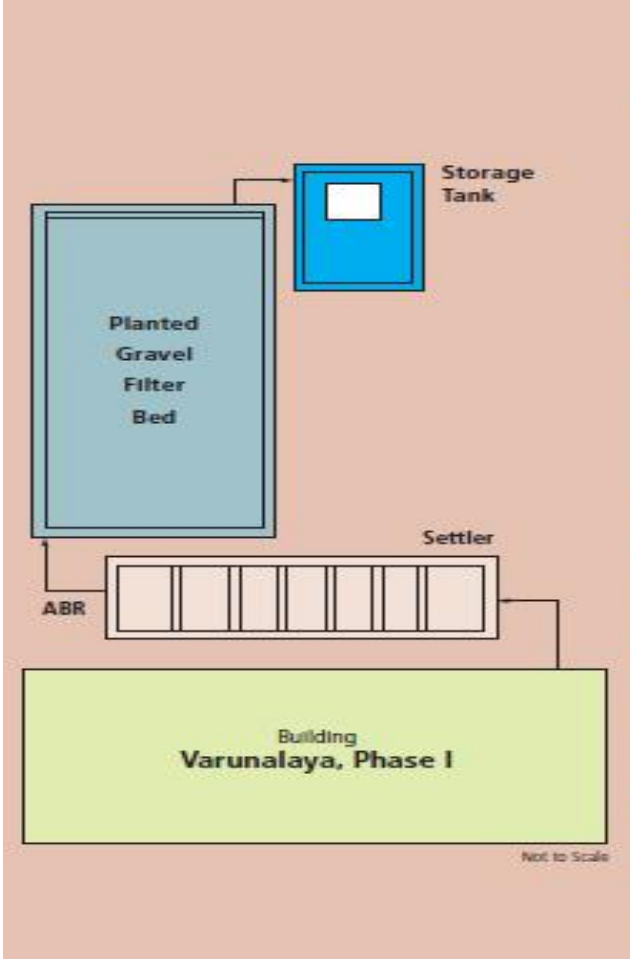
DWWT – Institutional Building, Delhi Jal Board



Varunalaya, Delhi Jal Board	
Parameters	**Details**
Type of Building	Office Building
Source of Wastewater	Toilets
Capacity of the system	8KLD
Re-use	For maintaining greenery
Capital Cost (2015)	Less than Rs. 16Lacs
O&M Cost (per annum)	Not known yet
Year of Implementation	2015 (Implemented by Delhi Jal Board)

Model Project
High visibility – high impact

DWWT and local reuse at CSE building

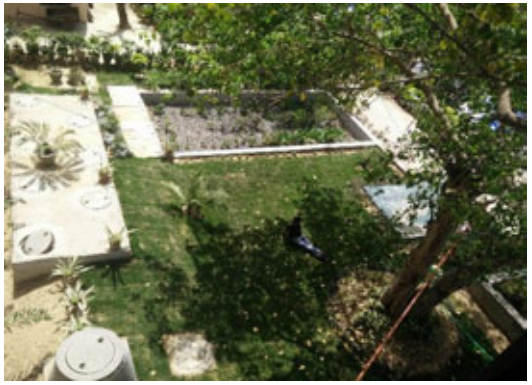


Layout

Excavation at the site

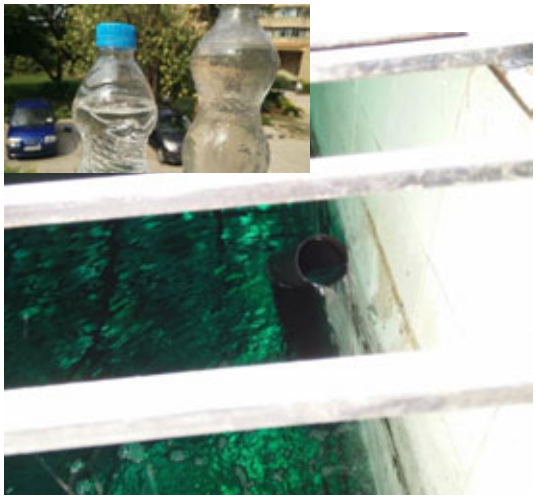
Construction at the site

Top soil leveling for landscaping



Site after landscaping today

DWWT and local reuse at CSE building

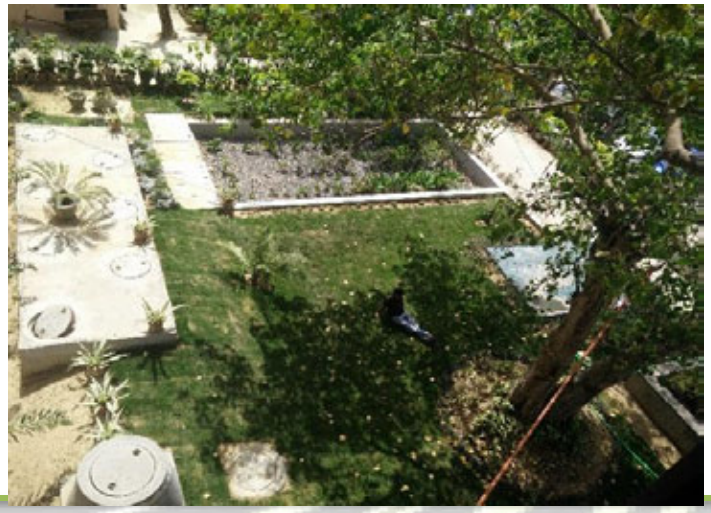


Treated water

Reuse of treated water

Surrounding areas

Parameters	Before	After
pH	7.4	7.5
BOD (mg/L)	110	23
COD (mg/L)	344	96
Total Suspended Solids (mg/L)	376	97
Ammonia (mg/L)	30	20
Phosphate	Traces	Nil
Faecal Coliform (per 100ml)	3600	93



DWWT at Residential building – Individual House


Settler and ABR


Planted filter bed

Residential Building, Sainik Farm, New Delhi	
Parameters	**Details**
Type of Building	Individual Residential Building
Source of Wastewater	Kitchen, Bathroom and Toilet
Capacity of the system	0.8 KLD
Re-use	For maintaining greenery of the garden (500 L/ day)
Capital Cost (2013)	INR 25,000/- (INR 10,000 for plumbing)
O&M Cost (per annum)	INR 4,000/-
Year of Implementation	2013 (Implemented by individual)

No sewerage network in the area.

Self motivation.

THANK YOU

For more information:
Case studies of Decentralised/ Sustainable Wastewater Treatment Technologies
Visit: cseindia.org/node/3798

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