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PERIYAR MANIAMMAI INSTITUTE OF SCIENCE & TECHNOLOGY
(Deemed to be University)
Established Under Sec. 3 of UGC Act, 1956 • NAAC Accredited
think • innovate • transform

WASTEWATER MANAGEMENT SYSTEM

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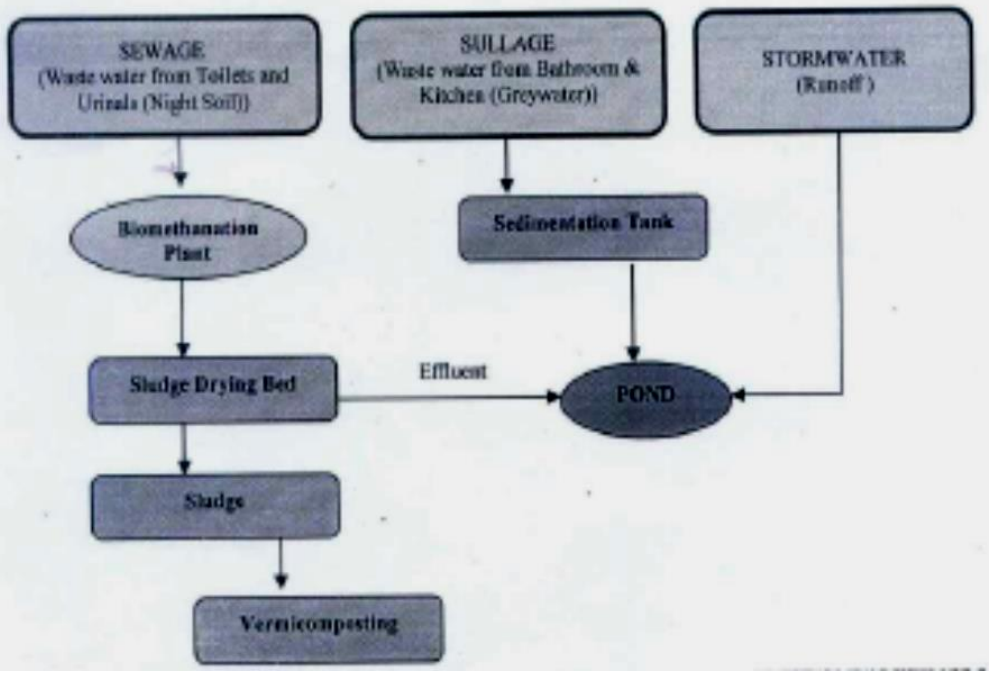
PERIYAR MANIAMMAI

WASTEWATER MANAGEMENT

Periyar Maniammai Institute of Science and Technology, Vallam, Thanjavur, Tamilnadu, popularly known as Periyar Maniammai University (PMU) has an area of about 469646Sq.m which has been transformed into a land of thick foliages, green vegetation with 1618 Nos. of bamboo trees, 38,441 Nos. of other variety of trees such as Azadirachtaindica (Neem), Pongamiapinnata (Pongai), Pterocarpusindices (Vengai), Albizialebbeek (Vaagai), Casuarinauqisetifolia (Casuarinas), Pterocarpussandalinus (Redsandals), Tacfonagranules (Teak), etc. which were developed from waste water effluentand a technology-hub, energy efficient, pollution-free, zero waste and well-laid campus with an ambience for learning from barren and dry wastedland.

This campus is having 22,000 cum capacity percolation ponds to store rainwater and grey water, 10,000 cum capacity pond to store storm water and 1300 cum capacity open well to store rainwater.

The existing wastewater system in the institute is as follows and details were marked in the site plan.



Grey water is the domestic wastewater from bathrooms (bathing, Cloth washing) and Kitchens (Utensils washing). With minimum treatment, grey water can be recovered and used for applications such as toilet flushing, gardening and floor washing).University population is 6576 numbers and water usage 638 cum per day. The waste water generated from our population is about 350 cum per day (1,27,750 cum/year). The waste water (Grey water) is collected from all buildings through 150 mm diameter well laid conduits of PVC pipe. The total length of pipe line is 3258 m. Moreover, in order to collect storm water, 950m length open channel is provided. This grey water and storm water is allowed to sedimentation tank to remove settleable solids and it is collected in the 20,000 cum capacity percolation pond. This water will be pumped and used for watering to the entire campus plantations such as bamboo, coconut and lawns etc.

The Biomethanation plant in Periyar Maniammai Institute of Science & Technology is multi feed with the following feeds like cattle dung, night soil, vegetable waste and food waste . The gas producing capacity of the digester is 500cum per day. The human waste collected from all buildings through 200 mm diameter PVC pipe. The total length of laid pipe line is 4250 m to the plant. The volume of gas produced will generate 60 KWe of electricity. This will not only generate significant quantity of Biogas but also generate the digested material about 120 metric tons in year a used as a high grade soil conditioner for in house and locals at normal cost. The Digester is of 16.2m diameter and 5.7m height. Quantity of feeding required per day is 10 tons. Nearly 2960 cum per year of waste water is generated from this plant. The waste water collected is also used for recycling and reusing after treatment.

For optimal use of water for irrigating the landscapes, PIMST practices various modern systems like drip irrigation, sprinkler irrigation, rain gun method. These methods not only help in controlling irrigation to the level required for the landscaping but also save water thereby indirectly help maintaining underground water level at least to some extent. This is the high time to think of optimum use of precious fresh water

BIO – METHANATION GAS PLANT – 500 m^3
PERIYAR MANIAMMAI UNIVERSITY
DETAILS OF BIO – GAS PLANT

Back Ground:

Periyar Maniammai University is an institution in promotion of renewable energy activities in the southern part of the country in the last two decades. After being elevated to deemed university status, the connected load was increased and the university is now planning for decentralizing the energy needs.

Cost of the Project :

The complete construction cost of the bio gas plant (RCC) was rupees 37 lakhs and engine 15 lakhs (100% gas mode). The miscellaneous expensed towards construction of RCC structure for engine room, synchronizing panels, gas cleaning equipments costed Rs. 5 lakhs. The total cost of the project amounts to 60 lakhs. The beneficiary's scope can be recovered in three years time. When this amount is taken on loan the repayment period will be around 5 years.

Parameters : 500 m^3 volume, HRT 30 days, mechanized inlet & mixing . RCC structure, FRP conical dome, matrix agitation, grit removal well and performance evaluation micro – processed.

GEOMETRICAL DESIGN :

The plant is a multi feed plant with the following feeds

1. Cattle Dung
2. Night Soil
3. Vegetable and Kitchen waste

Design of Digester :

Even though the plant is multi feed plant for the purpose of working at the volume, Cow dung feed is a taken as the basis assuming that all the feeds can be fed in the required proportion at the time of working.

Gas producing capacity of the Digester = 500 m^3 / day

A kilogram of Dung cow produce 0.05 m^3 of bio gas. (Ref : Bio gas Technology B.T.Nijaguna). So quantity of dung required to produce 500 m^3 bio gas = 1 / 0.05 x 500 = 10,000 kg of dung.

Assuming a feed : Water ratio of 1: 1 to make a slurry, the volume required per day = 10000 + 10000 =20000 kg = 20 m^3

Assuming a retention time of 42 days for fermentation.

Total Volume required = 42 x 20 = 840 m^3

Taking the dimension of the digester as given in the standard drawing whose inner diameter is 16.20 m and an effective depth of 4.10 m

Volume of Digester = π /4 x $(16.2)^2$ x 4.1 m = 844.66 m^3

Hence the digester can accommodate the required amount of slurry .

In let for Cow dung :

Assuming only cow dung as the fixed for case

1) Cow dung required = 1 / 0.05 x 500 = 10,000 kg

Quantity of slurry = 10000 + 10000 =20000 kg = 20 m^3

This quantity is proposed to be stirred in four times a day. So the volume required for single slurry 20 / 4 = 5 m^3

Assuming a inlet chamber of 2.7 m diameter and effective depth of 1 m volume =

$\pi/4 \times (2.7)^2 \times 1\ m = 5.70\ m^3$. Hence adequate.

Note : There will be two units of the above size inlets. The second one will be used for stirring and as inlet for cow dung. The first unit whose effective height will be 1.4 m will act as storage unit for cow dung before being let in to the second unit namely the stirring unit / inlet.

In let for Night Soil :

The Strength of students in the Hostel = 3500

\ssuming 0.5 – 1 kg of excreta per student to the weight of Night soil = 1750 kg – 3500 kg restricted to 2000 kg = 2 m^3

Assuming 1:1 ratio for Night soil : Water volume of slurry to be handled = 2+2 = 4 m^3.

Assuming a cylindrical chamber of size = 2.40 m dia and 1 m height, the volume =

$\pi/4 \times (2.4)^2 \times 1\ m = 4.5\ m^3$. Hence adequate.

Note :

There will be two units of the same size. One to function as a surge tank for the Night soil which will be following continuously. The second will be the stirring unit / inlet.

In let for Vegetable and food waste :

The quantity of each of the feeds when feed in to digester as a combined feed is as follows

Night Soil	=	2000 kg
Vegetable waste	=	4000 kg
For Kitchen waste	=	500 kg
Dung	=	3500 kg
Total	=	**10,000 kg**

Total quantity of Vegetable & Kitchen waste for this unit = 4500 kg = 4.5 m^3 .
Assuming a cylindrical chamber of size 2.4 m dia and 1 m height, then the volume
$\pi/4 \times (2.4)^2 \times 1$ m $= 4.5$ m^3. Hence adequate.

PIPE PROVISIONS :

There will be two pipes each 6" in diameter. One for Night Soil and the other for other waste. The bottom tip of feed pipe will be located at 6 m from the junction of the partition and ring wall. The tip will be 1 m above the base and 2 m away from the wall. The pipe may be sloped at 60 degree to the horizontal. The point of penetration should be worked out theoretically and worked out in the field.

At the midpoint of the semi perimeter and equidistant from the feed pipes the suction and recirculation pipes will be provided. The tip of the suction and recirculation pipes will be 2 m from the slurry level and it will be distance 3 m from the wall. The recirculation pipe will be slanting and end up at 0.5 m from the base and discharged at 2 poiints on either side of the pipe.

The Sludge pipe to be provided in the machination chamber shall have the same specification as feed pipes but will be located at midpoint of semi perimeter.

For dewatering purpose the depth of slope concrete may be provided for a depth of 12" at the partition wall and 5" at the midpoint of semi perimeter with the centre at 2 m from the wall a depression (pool) of diameter 1 m may be provided of 4 inches.

BIO METHANATION GAS PLANT

GAS PRODUCTION RATE (G)

G = W X 0.05

500 m^3 = W X 0.05

W = 500 / 0.05 = 10,000 kg

ACTIVE SLURRY VOLUME Vs

VS = HRT 2 W / 1000

= 42 x 2 x 10,000 / 1000 = 840 m^3

CALCULATION OF H and D

D = 2.5 H

H = $(Vs / \pi)^{1/3}$

= $\pi / 4 D^2 H = Vs$

H = $(840/ \pi)^{1/3}$ = 6.42 m

Height of the Digester = 6.42 m

D = 2.5 X 6.4 m = 16.20 m

Diameter of Digester = **16.20 m**

DOME HEIGHT dh

0.6 G = $(\pi / 6)d h$

= $(3(D/2)^2 + dh^2$

P = $0.75 D^2$

Q = $- 0.6 (6 / \pi) G$

R = $(P/3)^3 + (q / 2)^2$

A = ((-q/2) + square root of R)$^{1/3}$

B = ((-q/2) - square root of R)$^{1/3}$

Dh = A+B

P = $0.75 \times (16.2)^2$ = 196.83

Q = - 572.95

R = $(196.83 / 3)^3 + (572.95/2)^2$

A = 282429.53+82067.92 = 364497.45

= (-57295 / 2) + square root of 364497.45)$^{1/3}$

= 286.475 + 603.73 = 9.4

B = -286.475 – 603.73 = -6.69

Dh = 9.4 – 6.69 = 2.70 m

Dome Height = 2.70 m

V.A.Bar

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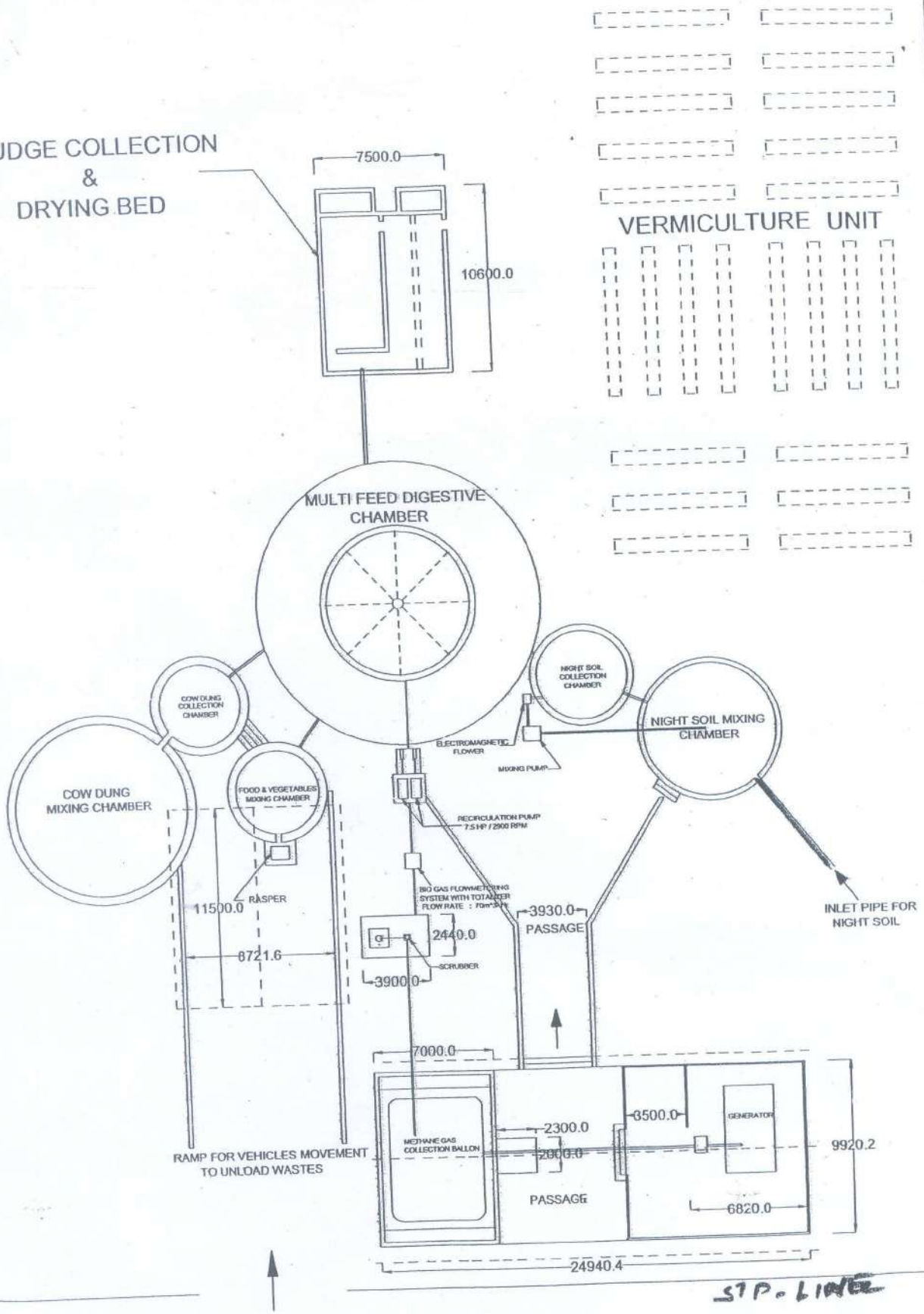
O GAS PLANT IN PERIYAR MANIAMMAI UNIVERSITY



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AR MANIAMMAI UNIVERSITY

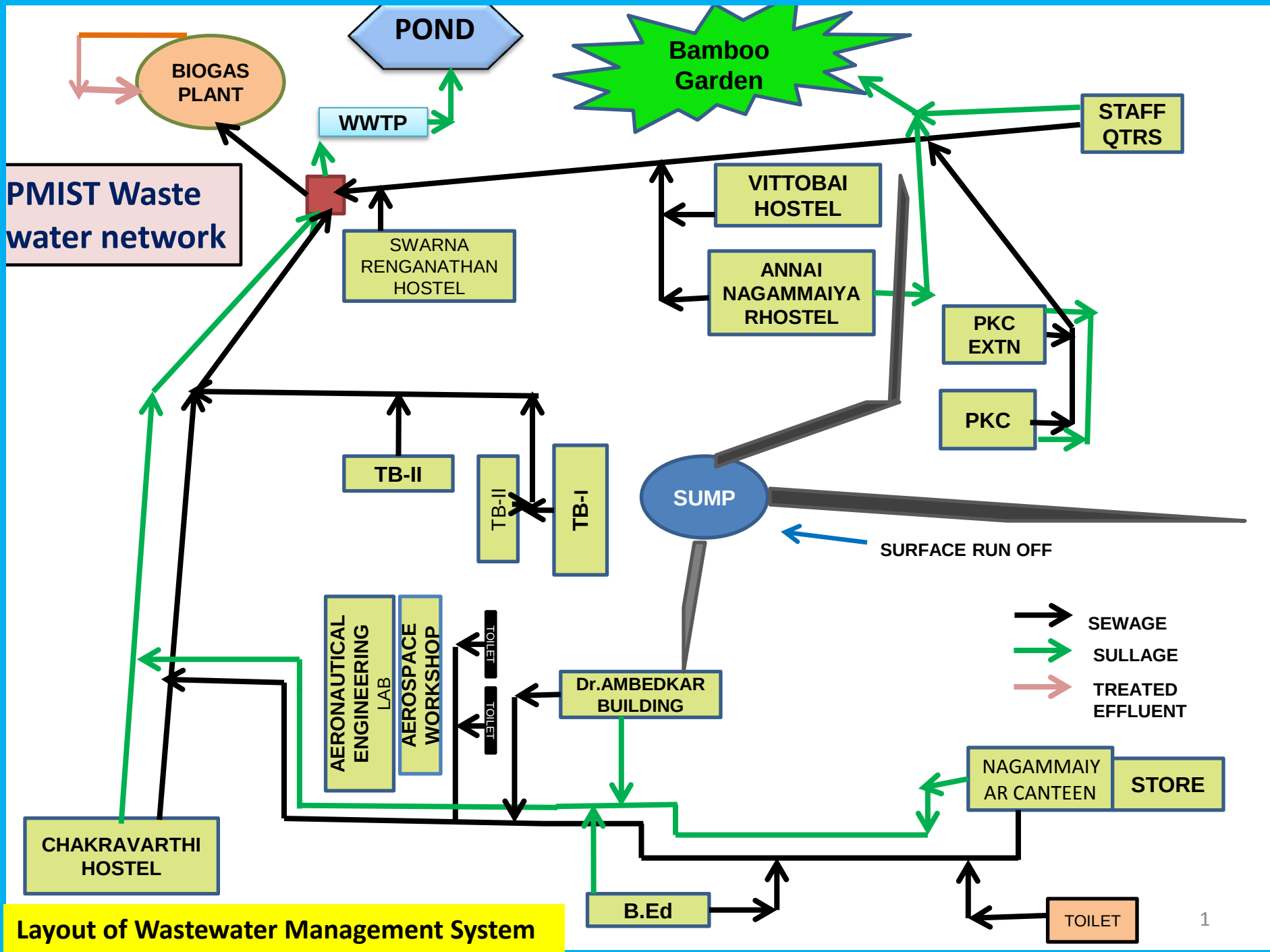
ESTATE OFFICE

SEWAGE TREATEMENT PIPE LINE DETAILS

Description of Work	Chamber No	Chamber Size in Metre	Length in Metre	From Chamber to Chamber	Remarks
From Canteen to B.Ed Block site up to Bio – Gas Plant					
From Toilet Canteen towards West C_1	C_1	1.70 x 1.70	-	1	
From Toilet Chamber 1 and West C_2	C_2	1.70 x 1.70	8.85	1 to 2	Inner distance
From Chamber 2 to Chamber 3	C_3	1.70 x 1.70	9.25	2 to 3	do
From Chamber 3 to Chamber 4	C_4	1.70 x 1.70	11.40	3 to 4	do
From Canteen corner chamber 5 to Main line Chamber 4	C_5	1.70 x 1.70	18.70	5 to 4	do
From Main line chamber 4 to chamber 6	C_6	1.70 x 1.70	17.60	4 to 6	do
From Main line chamber 6 to chamber 7	C_7	1.70 x 1.70	10.80	6 to 7	do
From Main line chamber 7 to chamber 8 – B.Ed block North East corner	C_8	1.70 x 1.70	14.20	7 to 8	do
From Main line Chamber 8 to B.Ed block site C_{8a}	C_{8a}	1.70 x 1.70	17.85	C 8 a to 8	do
From C_{8b} line to C_{8a}	C_{8b}	1.70 x 1.70	16.70	C8b to C8a	do
From C_{8c} line to C_{8b}	C_{8c}	1.20 x 1.20	20.10	C8c to C8b	do
From C_{8d} line to C_{8c}	C_{8d}	1.20 x 1.20	9.00	C8d to C8c	do
From C_{8e} line to C_{8d}	C_{8e}	1.20 x 1.20	7.30	C8e to C8d	do
From C_{8f} line to C_{8e}	C_{8f}	1.20 x 1.20	28.30	C8f to C8e	do
From C_{8g} line to C_{8f}	C_{8g}	1.20 x 1.20	9.65	C8g to C8f	do
From C_8 to C_9	C_9	1.70 x 1.70	59.80	C 8 to C 9	do
From C_9 to C_{10}	C_{10}	1.70 x 1.70	20.80	C 9 to C 10	do
From C_{10} - Arch Building to C_{11} Arch back side corner	C_{11}	1.70 x 1.70	47.20	C 10 to C 11	do
From C_{11a} to C_{11}	C_{11a}	1.70 x 1.70	18.80	C 11 a to C 12	do
From C_{11} to C_{12} - Work shop corner	C_{12}	1.70 x 1.70	37.80	C 11 to C 12	do
From C_{12} to C_{13}	C_{13}	1.70 x 1.70	40.80	C 12 to C 13	do
From C_{13} to C_{14} – Mechanical block middle side	C_{14}	1.70 x 1.70	38.60	C 13 to C 14	do

[illegible] Hostel	C_{15a}	1.20 x 1.20	7.40	C 15 a to C 15b	do
[illegible] to C 15 c	C_{15b}	1.20 x 1.20	49.90	C 15 b to C 15c	do
[illegible] to C 15 Junction Chamber	C_{15c}	1.20 x 1.20	51.50	C 15 c to C 15	do
From C 15 to C 16 – Mechanical block side	C_{16}	1.20 x 1.20	56.50	C 15 to C 16	do
From C 16 to C 17 – Mechanical block corner	C_{17}	1.20 x 1.50	56.60	C 16 to C 17	do
From C 17 to C 18 – from Mechanical block towards gas plant	C_{18}	1.70 x 1.70	48.90	C 17 to C 18	do
From C 18 to C 19 – from Mechanical block towards gas plant	C_{19}	1.70 x 1.70	45.80	C 18 to C 19	do
From C 19 to C 20 – from Mechanical block towards gas plant	C_{20}	1.70 x 1.70	49.40	C 19 to C 20	do
From C 20 to C 21 – from Mechanical block towards gas plant	C_{21}	1.70 x 1.70	38.50	C 20 to C 21	do
From C 21 to C 22 – from Mechanical block towards gas plant	C_{22}	1.70 x 1.70	50.70	C 21 to C 22	do.
From C 22 to C 23 – from Mechanical block towards gas plant	C_{23}	1.70 x 1.70	59.10	C 22 to C 23	do
From C 23 to C 24 – from Mechanical block towards gas plant	C_{24}	1.70 x 1.70	64.50	C 23 to C 24	do
From C 24 to C 25 – from Mechanical block towards gas plant	C_{25}	1.70 x 1.70	39.80	C 24 to C 25	do
From C 25 to C 26 – from Mechanical block towards gas plant	C_{26}	1.70 x 1.70	24.10	C 25 to C 26	do
From C 26 to C 27 – from Mechanical block towards gas plant	C_{27}	1.70 x 1.70	37.10	C 26 to C 27	do.
From C 27 to C 28 – from Mechanical block towards gas plant	C_{28}	1.70 x 1.70	20.20	C 27 to C 28	do
From C 28 to C 29 – from Mechanical block towards gas plant	C_{29}	2.50 x 2.00	2.80	C 28 to C 29	do

C_{29} to C_{30} - from ...nical block towards ...Hint	C_{30}	2.00 x 2.00	47.40	C 29 to C 30	do
...m C_{30} to C_{31}	C_{31}	2.30 m dia	81.05	C 30 to C 31	do
...m C_{31} to C_{32} - Swarna ...nganathan Hostel corner	C_{32}	2.00 x 2.00	39.35	C 31 to C 32	do
...m C_{32} to C_{33} - corner to ...ot	C_{33}	2.00 x 2.00	7.00	C 32 to C 33	do
...m C_{33} to Collection ...k	C_{33}	2.00 x 2.00	33.25	C 33 to C 34	do
...m Vittobai Hostel old ...amber East west	V.C 1	1.70 x 1.70	9.50	V C_1	do
...m Vittobai Hostel old ...amber North South	V C_1	1.70 x 1.70	10.35	V C_1	do
...ittobai New Chamber to ...rama Renganathan Hostel ...d Chamber	V C_1	1.70 x 1.70	32.00	V C_1	do
Road Rear side line (not in ...e) from East B_1 to B_2	B_1	1.70 x 1.70	31.90	B 1 to B 2	East West side
Road Rear side line from East B_2 to B_3	B_2	1.70 x 1.70	7.95	B 2 to B 3	do
Road Rear side line from East side B_3 to C_{32}	B_3	1.70 x 1.70	58.40	B3 to C 32	do
Road Crossing East West on Nagammaiyar Canteen West Corner and Chamber Near	-	-	20.20	-	do
II) Periyar Knowledge Centre to Staff Quarters line					
From PKC - C_1 to PKC - C_2	C_1	1.70 x 1.70	2.35	PKC - C 1 to C 2	
From PKC – C_2 to PKC – C_3	C_2	1.70 x 1.70	19.75	PKC - C 2 to C 3	
From PKC – C_{3a} to PKC – C_3	C_{3a}	1.70 x 1.70	0.95	PKC - C 3 a to C 3	
From PKC – C_3 to PKC – C_4	C_3	1.70 x 1.70	7.60	PKC - C 3 to C 4	
From PKC – C_4 to PKC – C_5	C_4	1.70 x 1.70	18.30	PKC - C 4 to C 5	
From PKC – C_{5a} to PKC – C_{5b}	C_{5a}	1.70 x 1.70	5.25	PKC - C 5a to C 5b	
From PKC – C_{5b} to PKC – C_5	C_{5b}	1.70 x 1.70	18.30	PKC - C 5 b to C 5	
From PKC – C_5 to PKC – C_6	C_5	1.70 x 1.70	2.70	PKC - C 5 to C 6	
From PKC – C_6 to PKC – C_7	C_6	1.70 x 1.70	27.70	PKC - C 6 to C 7	



Layout of Wastewater Management System