Atal Mission for Rejuvenation and Urban Transformation

CONSTRUCTION OF 5MLD STP AT KWA SITE AT ELAMKULAM IN KOCHI

DETAILED PROJECT REPORT

Ram Biologicals

8/5288-1, Near Kuttyadi Irrigation Project Office,
Moottoli, Kakkodi P.O., Calicut-673611
Mob: 9446048233, 0495-4025433

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VOLUME I

REPORT

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EXECUTIVE SUMMARY

1. In order to rejuvenate and transform urban India, the Ministry of Urban Development, Government of India has rolled out the flagship mission of Atal Mission for Rejuvenation and Urban Transformation (AMRUT). The purpose of AMRUT is to (i) ensure that every household has access to tap with assured supply of water and a sewerage connection; (ii) increase the amenity value of cities by developing greenery and well maintained open spaces (e.g. parks); and (iii) reduce pollution by switching to public transport or constructing facilities for non-motorized transport (e.g. walking and cycling).

2. As per the L.O.A vide no. Dated 5/12/17, The Executive Engineer (Project Division) of Kerala Water Authority Kochi,M/s Ram Biologicals Kakkodi,Calicut has been hired as the Consultant for the preparation of Detailed Engineering Report for a new 5MLD Sewage Treatment Plant at KWA Elamkulam Site in Kochi under AMRUT project for 2015-16.

3. The scope of consultant under the proposed mission is the preparation of DPR for the proposed 5 MLD Sewage Treatment Plant based on MBBR Technology at KWA Site at Elamkulam in Kochi. The scope covers preparation of Conceptual Plan, Designing, and Estimation with inputs provided in LOA and further studies including stake holder's consultations. Accordingly the DPR is prepared in a phased manner based on the level of priority and needs.

4. Kochi surrounded by back water and the sea is experiencing high ground water condition. Kochi corporation comprising an area of 94.88 KM^2 with a population of 6,33,553 as per the 2011 Census is experiencing severe pollution due to frequently overflowing septic tanks and in-discriminate discharge of septage into the water bodies. Both the surface water and ground water are polluted. Two numbers of 100m^3/day capacity septage plants have been installed already, one at Brahmapuram and other at the Cochin Port area near to Willington Island. In Kochi, only small locality near Kadavanthra and M G Road has been covered under an existing

sewerage scheme established long back with a 4.5MLD capacity STP at Elamkulam which is more or less disfunctional.

5. Commissioned in 1959, the existing Sewage Treatment Plant of 4.5MLD consists of two inlet chambers, flow measuring arrangements as preliminary treatment which is not properly functioning. After Grit Chamber there is Primary Clarifier followed by Aeration Tanks. Bio Solids treatment consists of Sludge Digestion followed by the Sludge Drying Beds. The Beds are dis-functional and no regular sludge collection and disposal arrangements exits now. No facility for dis infection exits at present. The partially treated water is directed from the open drain to the nearly Chettithara Canal.

6. The Operation and Maintenance of the STP is now under the control of a sewerage sub division. It was reported that there are 600 odd connections both domestic and commercial. Though there are lot of new applicants the same has not been sanctioned because of the capacity limitations and unsatisfactory functioning of the STP. Power is supplied through a transformer provided by KSEB in the premises exclusively for the STP. There is no Substation existing inside the compound, though the connection is treated as High Tension (200KVA Demand). Monthly power charges vary from Rs. 60000 to 70000/month.

7. The treatment scheme proposed is split into four distinct parts:
   - **Pre-treatment:** this comprises of mechanical, manual screening and grit removal tank. After pre-treatment the sewage shall be taken to biological treatment plant at uniform rate.
   - **Secondary Treatment:** comprising two MBBR reactors. The sludge from the secondary clarifier will be send to the sludge sump.
   - **Tertiary Treatment:** This phase consisting of filtration and disinfection processes. Excess sludge produced in biological treatment process shall be collected in sludge tank and digested aerobically. The excess sludge dewatered in centrifuge and finally disposed or used as organic manure**.** The tertiary treated water will be stored in a RCC Tank for 30minutes detention to facilitate the disinfection.
8. The treated water will have quality,
   BOD < 10

TSS < 30

COD < 50

The water can be consumed for reuse applications such as gardening, washing of roads; construction purposes etc. the sludge cakes can be used as manure. Unused treated water can be discharged in to nearby Chettithara canal.

9. The layout has been prepared in two ways, namely one for accommodating a 5MLD plant and the other for enhancing the capacity to 5MLD by addition of units in future; the pre-treatment alone is designed for 10MLD.

10. The cost of DPR worth to Rs. **12,55,79,000/-** (Twelve Crores Fifty Five Lakhs and Seventy Nine Rupees only). Annual O&M cost worth Rs. **47,05,000/-** (Fourty Seven Lakhs Five Thousand Rupees only). Including 5 years O&M total cost will be Rs. **2,87,20,000/-** (Two Crores Eighty Seven Lakhs Twenty Thousand Rupees Only). The DPR contains two volumes as suggested. Volume I contain Reports and Drawings and volume II contain Estimates Supported by PWD Observed Data/ Rate Analysis

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Chapter 1

INTRODUCTION

1.1Background

As per the Letter of Acceptance vide no. Dated 5/12/17, The Executive Engineer (Project Division) of Kerala Water Authority Kochi, M/s Ram Biologicals, Kakkodi, Calicut has been hired as the Consultant for the preparation of Detailed Engineering Report for a new 5MLD Sewage Treatment Plant at KWA Elamkulam Site in Kochi under AMRUT project for 2015-16.LOA is attached as **Annexure A**

1.2 Project Setting and Rationale

Kochi surrounded by back water and the sea is having high ground water condition. Kochi corporation comprising an area of 94.88 KM² with a population of 6,33,553as per the 2011 Census. City is experiencing severe pollution due to frequently overflowing septic tanks and in-discriminate discharge of septage into the water bodies. Both the surface water and ground water are polluted. Two numbers of 100m³/day capacity septage plants have been installed already, one at Brahmapuram and other at the Cochin Port area near to Willington Island. In Kochi, only small locality near Kadavanthra and M G Road has been covered under an existing sewerage scheme established long back with a 4.5MLD capacity STP at Elamkulam which is more or less dysfunctional presently. Now under AMRUT the long pending need for a modern STP is being materialized after establishing new STP, KWA can retrofit the old STP and upgrade the same to new standards.

1.3Need for Sewerage Scheme

The sewerage project in respect of which considerable public and social resources are being used, form a basic infrastructure for the country and an indisputable indicator of civilisation and development. The works cover a number of substantial social needs and aim to improve the quality of life and to protect public health and the environment. Some of the benefits and advantages of the sewerage system are as follows:

- **Upgrading the quality of life**

The operation of the sewerage system has relieved these areas to a great extent from previous problems that were caused by the continuous emptying of cesspools.The sewerage system provides a healthier and more appropriate way to manage liquid wastes.

- **Preserving the natural environment**

With the operation of the sewerage system no more pollution of ground water is effected and the discharge of sewage waste in surface water will be significantly reduced. Clogging of drains and weed menace of surface water will be reduced resulting in the rejuvenation of the canals and the back water system.

- **Saving and processing waters**

Water is a substantial natural resource for our country and it should be managed in the best possible manner. The tertiary treated effluent at the wastewater treatment plant is reused for agricultural and other purposes thus helping conservation of precious water resources.

- **Standard of living**

Enhanced quality of ground and surface water minimises water borne diseases. As a result of the above, the sewerage system contributes to further development and increase of the standard of living of the town of Limassol inhabitants. Considering all the above advantages, there is no doubt that if we all cooperate, we and our children will enjoy a better quality of life in the years to come and that we will secure a better environment to the forthcoming generations.

Though there were proposals under JNRUUM and ADB funded KSUDP for two separate sewerage projects, they didn't materialize. Under AMRUT itself a DPR has been prepared for the Decentralized type of sewerage system and STPs in wards 15, 16, 17 networks being designed as an interceptor sewerage system. The main drinking water supply of Kochi C.D.P area is from the 225MLD Water treatment plant at Alwaye and the 100MLD Water treatment plant at the Maradu. The source of former is the Periyar and the later from the Muvattupuzha River. The average per capita availability can be considered as 150lpcd. The sewerage projects aims to mitigate the existing environmental pollution and clean the contaminated canal and backwater system.

1.4 AMRUT Project

In order to rejuvenate and transform urban India, the Ministry of Urban Development, Government of India has rolled out the flagship mission of Atal Mission for Rejuvenation and Urban Transformation (AMRUT).The purpose of AMRUT is to:

(i) Ensure that every household has access to tap with assured supply of water and a sewerage connection
(ii) Increase the amenity value of cities by developing greenery and well maintained open spaces (e.g. parks)
(iii) Reduce pollution by switching to public transport or constructing facilities for non-motorized transport (e.g. walking and cycling).

The Mission will focus on the following Thrust Areas:

(i) Water Supply
(ii) Sewerage facilities and septage management
(iii) Storm Water drains to reduce flooding
(iv) Pedestrian, non-motorized and public transport facilities, parking spaces
(v) Enhancing amenity value of cities by creating and upgrading green spaces, parks and recreation centers, especially for children.

1.5General

The objective of treatment of sewage through biological processes is to stabilize decomposable organic matter and remove other harmful contaminants prior to discharge onto a land or waterway or water body. The degree of treatment depends on the desired waste water quality.

5 MLD Sewage Treatment Plant based on MBBR Technology is proposed to treat the raw sewage collected from the existing network. The new STP is proposed as an alternative to the existing STP at Elamkulam, in the same premises. Necessary provision for collecting the raw sewage from the existing inlet point in the premises to the new plant is specified and the units of the new plants are designed so that it aids easy O&M and maximum space utilisation.

The treatment of sewage can be stated under three stages. The primary treatment is the first stage of treatment where in all the physical matters are removed through screening, primary settling and through degritting. The secondary treatment removes all the biological matters through biological decomposition of degradable matters through MBBR Technology. The secondary treatment also comprises of sludge handling, management issues with disposal aspects. The tertiary Treatment process comprises of disinfection of treated sewage and its recycling proposals.

Chapter 2

SCOPE OF WORK BY THE CONSULTANT

2.1 General

The scope of consultant under the proposed mission is the preparation of DPR for the proposed 5 MLD Sewage Treatment Plant based on MBBR Technology at KWA Site at Elamkulam in Kochi. The scope covers preparation of Concept Plan, Designing, Estimation and we will approach the project on the basis of service level framework, and carry out required investigation. Accordingly the DPR is prepared in a phased manner based on the level of priority and needs. The DPR for sewage treatment plant at KWA Elamkulam Site in Kochi is presented here.

The Letter of Acceptance specifies the following scope of the consultants:

1. Extension of the two numbers of 600mm pumping main up to the entry point of new STP
2. Design of individual components of the new STP with MBBR as the technology
3. Preparation of layout drawing
4. Structural, mechanical and electrical design and detailing
5. Sizing and listing of all units and equipments
6. General Arrangement Drawing
7. Wiring Diagram
8. Foundation Design with given parameters of safe loads by the client
9. All Drawings
10. Detailed costing as per DSR 2016
11. Submission of Draft DPR
12. Submission of final DPR after correction

The DPR shall be in two volumes

Volume I: Reports and Drawings

Volume II: Estimates Supported by PWD Observed Data/ Rate Analysis

Chapter 3

EXISTING 4.5MLD STP – QUICK CONDITION ASSESSMENT

3.1 Existing Pumping Stations & Pumping Mains

There are two main pumping stations with the existing network one at Kadavanthra and the other at the Maharaja's college ground at MG Road. Both the pumping mains were reported to be of 600mm CI tyton pipes. Capacity of both the wet wells is 1300m³. Pump set capacity for the MG Road station is 30HP whereas the Kadavanthra Station is 75HP. it is assumed that the minor extension of the mains will not adversely change the pump duty conditions. The discharge and head of these pumping stations are given below:

M G Road P.H No. 1 : 30HP-38lps against head of 12m

Kadavanthara P.H No. 2: 75HP-225lps against a head of 14m

3.2 The Existing Sewage Treatment Plant

The existing STP was commissioned in 1959 and inaugurated by the then Honourable President of India Sri. Rajendra Prasad. The plant is designed with ASP as the technology. Preliminarily treatment is defective and tertiary treatment including chlorination is absent. Only secondary treatment is partly functional.

STP consists of 2 inlet chambers, flow measuring arrangements as preliminary treatment which is not properly functioning. After Grit Chamber there is Primary Clarifier followed by Aeration Tanks. Bio Solids treatment consists of Sludge Digestion followed by the Sludge Drying Beds. The Beds are dis-functional and no regular sludge collection and disposal arrangements exits now. No facility for dis infection exits at present. The partially treated water is discharged from the open drain to the nearby Chettithara Canal which is the receiving water body. The present project is proposed to cover the five divisions partially or fully.

- Elamkulam : Division 54
- Kadavandra : Division 57
- Eranakulam South : Division 62
- Ghandi Nagar : Division 63
- Eranakulam Central : Division 66

➢ Households and commercial establishments are already covered in the project.

➢ The STP covers a present population of 30000 and the treatment plant can be beneficial to a projected population of 41000 in future.

The functional operating staffs allowed to KWA for the STP is as follows,

Operator	:	2Nos
Assistant Operators	:	1Nos
Scavenger	:	1Nos
Fitter	:	1Nos
Plumber	:	1Nos
Waterman	:	1Nos
Sweeper	:	1Nos

3.3 Plant Working Details

The Operation and Maintenance of the STP is now under the control of a sewerage sub division. It was reported that there are 600 odd connections both domestic and commercial. Though there are lot of new applicants the same has not been sanctioned because of the capacity limitations and unsatisfactory functioning of the STP. Power is supplied through a transformer provided by KSEB in the premises exclusively for the STP. There is no Substation existing inside the compound, though the connection is treated as High Tension (200KVA Demand). Monthly power charges vary from Rs. 60000 to 70000/month.

At a time inflow is through one of the two pumping mains in a staggered fashion.

Table 3.1: Daily Pumping Duration (Inflow)

No 1 Pumping Station at MG Road		
6AM to 9:30AM	:	3.30 hrs
11.00AM to 2.00 PM	:	3.00 hrs
4:30PM to 10:30 PM	:	5.30 hrs
Total	=	12.00hrs
No 2 Pumping Station at Kadavanthra		
9:30AM to 11AM	:	2:00 hrs
2:00PM to 4:30PM	:	2:30 hrs
Total	=	4.30hrs
Total Exiting Pumping Duration/day = 16:30 hrs		

At rated discharge of pump the inflow may be,

From No. 1 PH = $12\times38\times3600\times10^{-3}$ = $1641.60m^3$

From No. 2 PH = $4.5\times225\times3600\times10^{-3}$ = $3695.00m^3$

…….....

Total Inflow = $5286.60m^3$

ie., = **5.286MLD**

3.4 Photos of Existing Plant

Fig 3.1: Mechanical Screen

Fig 3.2: Manual Screen

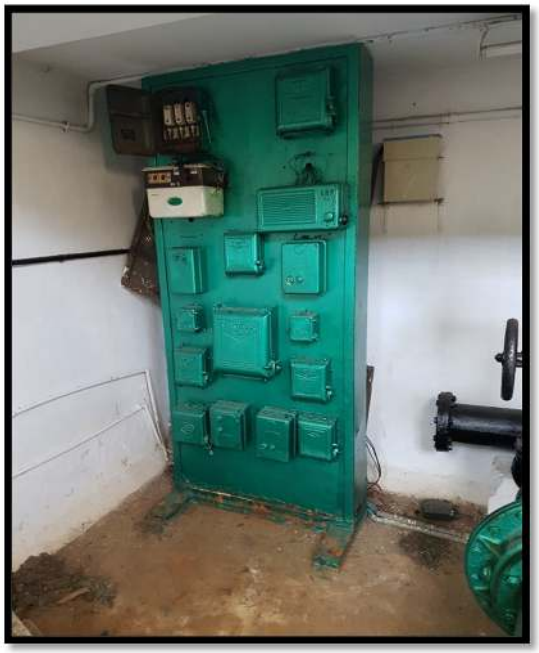

Fig 3.3: Electrical Panel

Fig 3.4: Pump House

Fig 3.5: Primary Settling Tank

Fig 3.6: Aeration Tank

Fig 3.7: Final Settling Tank

Fig 3.8: Sludge Storage Yard

Chapter 4

WASTE WATER QUALITY- INFLUENT AND EFFLUENT

4.1 TOR Requirement

As per LOA consultant is required to prepare detailed engineering report of 5MLD MBBR Type STP in the premises of the existing STP at Elamkulam with influent quality as mentioned below,

Table 4.1: Influent Quality

Parameter	**Units**	**Values**
BOD	mg/l	380
COD	mg/l	1000
pH	-	6.0 – 9
Oil & Grease	mg/l	150
NH3-N	mg/l	200

4.2 Visit by Consultants and Discussions

The Consultants M/S RAM Biologicals visited the STP site and held discussions with the KWA and CMMU staffand collected the relevant data. During the visits it was visually clear that the influent quality is of weak to medium quality sewage. On perusal of the waste water influent quality reports maintained by KWA, the same was confirmed. The results of the tests conducted on 27/04/2016, 26/05/2016, 16/07/2016, 20/08/2016, 17/09/2016and 28/10/2016 revealed that influent quality of vital parameters are as show below,

Fig 4.1: Consultant-KWA Joined Site Visit

Table 4.2: Influent Quality of Vital Parameters

Parameter	**Units**	**Maximum Value**	**Minimum Value**
BOD	mg/l	113	101
pH	-	7.5	6.6
Oil & Grease	mg/l	7.5	7.2
Suspended Solids	mg/l	35	29

The test results are attached as **Annexure B**

On Further deliberation KWA also agreed of designing the STP with medium sewage quality as the influent.

4.3 Effluent Water Quality Requirements

Ministry of Environment Forest and Climate Change as per notification dated 13/11/2017 stipulates following effluent quality for the discharge into water bodies except for Metro Cities.

Table 4.3: Effluent Water Quality Requirements

Parameter	**Units**	**Values**
BOD	mg/l	30
COD	mg/l	1000
pH	-	6.0 – 9
TSS		100
Fecal Colliform	mpn	<1000

The Notification is provided as **Annexure C**

Since more stringent Indian Standards are likely to be introduced in near future and reuse applications to be made mandatory, it was decided to provide the effluent quality after treatment as follows

Table 4.4: Effluent Water Quality after Treatment

Sl No.	Parameter	Limit	Unit
1	COD	100.00	mg/lt
2	BOD	< 10.00	mg/lt
3	TSS	30.00	mg/lt
4	Total Nitrogen (As N)	10.00	mg/lt
5	Total Phosphorous (As P)	< 2	mg/lt
6	pH	6 to 9	

7	E Colliform	1 x 10^3	mpn/100ml

The KWA Officers requested to include provision for an office building with a meeting/classroom. Nursing students periodically visit the STP and attend classes conducted by KWA Staff as part of their Curriculum. But during presentation in front of the high level committee for AMRUT under the chairmanship of the Additional Principal Secretary LSGD, the decision was not to provide an office building with a meeting/classroom.

Chapter 5

ADMINISTRATIVE APPROVALS

5.1 General

Draft proposal with estimates were presented in front of the high level committee for AMRUT under the chairmanship of the Additional Principal Secretary LSGD. During deliberation the committee suggested following deviations in to proposals / RC estimates.

a. To delete provision for office building
b. To provide O&M estimate for 5 years as suggested as against 10 years as estimated below

Accordingly approval was issued for a STP sum of 1370 lakhs for the Elamkulam STP under KWA and the consultants were directed to prepare detailed estimates and DPR accordingly.

Chapter 6

LOCATION SPECIFIC DETAILS

6.1 Location Details of STP

The site is located at Elamkulam near to the SahodaranAyyappan (SA Road) and it is approximately 150m away from SA road through Fathima church road. The location is blundered by Chettithara canal on its either sides. The extent of land available is 2.5 acres.

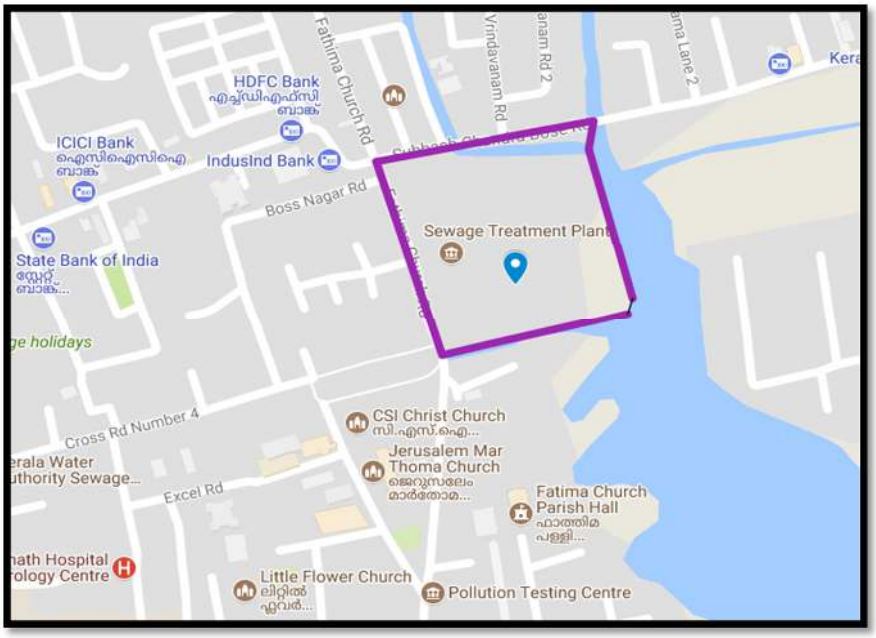

Fig 6.1: Area –Existing 4.5mld STP Compound AtElamkulam

The site is bounded by

West	:	Fathima Church Road
North	:	Subash Chandra Bose Road
East	:	Chettithara Canal
South	:	Chettithara Canal

There are residential houses close to both the above mentioned roads. Even though the STP Units are only partially functional, there is no odor or vector nuisance observed. There are no local complaints also. It was confirmed that site is safely above the High Tide level (HTL) and there is no history of backflow through the outfall channel. The proposed site is covered with thick bushes all over along with trees fit for fire wood. A part of this is needed to be cut and remove. Compensatory afforestation within the premises can be done which will function as a green belt for the STP.

6.2 Soil Profile

The soil profile is one of the most important concepts in soil science. It is a key to understanding the processes that have taken in soil development and is the means of determining the types of soil that occur and is the basis for their classification. The soil profile is defined as a vertical section of the soil from the ground surface downwards to where the soil meets the underlying rock. The soil profile can be as little as 10 cm thick in immature soils and as deep as several metres in tropical areas where the climate is conducive to rapid alteration of the underlying rock to form soil. In temperate areas, the soil profile is often around a metre deep and in arid areas somewhat shallower than this.

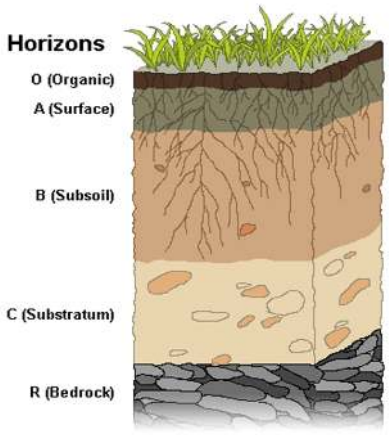

Fig 6.2: General Soil Horizons

The purposes of the Geo-Technical Investigation are as following:

a. To perform the required field investigation including soil boring with related field tests within the bore hole, collecting samples.
b. To determine the type, extend to the sub-surface material up to 30m depth.

Soil at 3m depth is sand (white) with N-Value 24. From 13.5m to 39.3m N-Values range from 3 to 9. Soil at depth of 56m is clayey sand (Black) with N-Value >50. The geotechnical recommendation provided by the client is pile foundation assuming a safe load of 85T and 65T for pipes of diameter 750mm and 600mm respectively at 50 to 55m depth.

Chapter 7

TECHNOLOGY OPTION FOR STP

7.1 Unit Operations

The unit operations involving wastewater treatment are classified generally given as below,

Table 7.1: Unit Operations

SI No.	UNIT	FUNCTION	UNIT OPERATIOS /PHASES
1	Primary	• Removal of rags, floating matter, grit, oil and grease etc.	• Screening • Grit removal • Oil and grease trap
2	Secondary	• Removal of Bio degradable organic matter and suspended solids • Also include nutrient removal (Nitrate and Phosphate) in advanced technologies	• Aerobic suspended growth (Aerobic and anaerobic)Lagoon • Chemical oxidation process • Nitrate and phosphate removal • Chemical oxidation • Suspended growth • Nitrification/De-nitrification • Air stripping • Ion exchange • Chemical treatment • Biological nutrient removal system
3	Tertiary	• Polishing the effluent for reuse application	• Pathogen removal • Chlorine compounds • O_3 ,UV Radiation • Membrane filtration • Filtration variation • Carbon Adsorption • Iron exchange

The unit operations and process can be further classified as below

Table 7.2: Unit Operations and Processes

Si No.	Unit Operation	Functions	Treatment Devices
1	Screening, coarse	Removal of coarse solids such as sticks, rags and other debris in untreated waste water by interception(surface straining)	Bar rack
2	Screening fine	Removal of small particles	Fine screen
3	Screening micro	Removal of fine solids floatable matter and algae	Micro screen
4	Comminution	In stream grinding of coarse solids to reduce size	Comminutor
5	Grinding/ maceration	Grinding of solids removed by bar racks. Side stream grinding of coarse solids	Screenings grinder Macerator
6	Flow equalization	Temporary storage of flow to equalize flow rates and mass loadings of BOD and suspended solids	Equalization tank
7	Mixing	Blending chemicals with waste water and for homogenizing and maintaining solids in suspension	Rapid mixer
8	Flocculation	Promoting the aggregation of small particles into larger particles to enhance their removal by gravity sedimentation	Flocculator
9	Accelerated sedimentation	Removal of grit Removal of grit and coarse solids	Grit chamber Vortex separator
10	Sedimentation	Removal of settle able solids Thickening of solids and bio solids	Primary clarifier High – rate clarifier Gravity thickener
11	Floatation	Removal of finely divided Suspended solids and particles with densities' close to that of water also thickens bio- solids Removal of oil and grease	Dissolved air floatation(DAF) Induced air floatation

12	Aeration	Addition of oxygen to biological process Post aeration of treated effluent	Diffused aerator, mechanical aerator, cascade aerator
13	VOC control	Removal of volatile and semi volatile organic compounds from waste waters	Gas stripper Defused air and mechanical aeration
14	Depth filtration	Removal of suspended solids	Depth filters

7.2 Selection of Technology for the Proposed STP

The Client has specified MBBR as the secondary treatment option due to following reasons.

1. MBBR has been in existence sufficiently for a long time, also in India and is a proven technology.
2. Minimum footprint
3. Better Stabilized sludge
4. Better Effluent Quality
5. Less sophisticated
6. Spare parts available
7. Lower life cycle cost
8. Nil odour nuisance and other environmental hazards

7.3Moving Bed Bio Reactor (MBBR) Technology/Details

MBBR technology employs thousands of polyethylene biofilm carriers operating in mixed motion within an aerated wastewater treatment basin. Each individual bio-carrier increases productivity through providing protected surface area to support the growth of heterotrophic and autotrophic bacteria within its cells. It is this high-density population of bacteria that achieves high-rate biodegradation within the system, while also offering process reliability and ease of operation.

This technology provides cost-effective treatment with minimal maintenance since MBBR processes self-maintain an optimum level of productive biofilm.

Additionally, the biofilm attached to the mobile biocarriers within the system automatically responds to load fluctuations.

7.3.1 Process Benefits

- **Compact Design:** A fraction of the size of conventional systems
- **Expandable:** Capacity can be easily upgraded by simply increasing the fill fraction of biofilm carriers
- **Single Pass Process:** No return activated sludge stream required
- **Load Responsive:** Actively sloughed biofilm automatically responds to load fluctuations
- **Minimal Maintenance:** No F/M ratios or MLSS levels to maintain

MBBR processes are an excellent solution for common wastewater applications including:

- BOD Reduction
- Nitrification
- Total Nitrogen Removal

Moving Bed Biofilm Reactor systems deliver a flexible, cost-effective, and easy-to-operate means to address current wastewater requirements and the expandability to meet future loads or more stringent discharge requirements within a compact design.

7.3.2 Features of MBBR

In Fluidized aerobic process a non-clogging biofilm reactor with special grade plastic media having density close to that of water is used. This plastic media has more surface area and biofilm grows on these media which move along with the water in the reactor. This movement within the reactor is generated by providing aeration with the help of diffusers placed at the bottom of aerobic reactor. The thin biofilm on the elements enables the bacteria to act upon the biodegradable matter in sewage and reduce BOD / COD content in the presence of oxygen present in air. Area requirement for this process is 1/10 of space required for conventional sewage treatment plant. Power requirements

are low as recycling of sludge is not done in this method as required in ASP. This can take shock loads and can with sand variation. Expected COD/BOD removal is more than 95%.

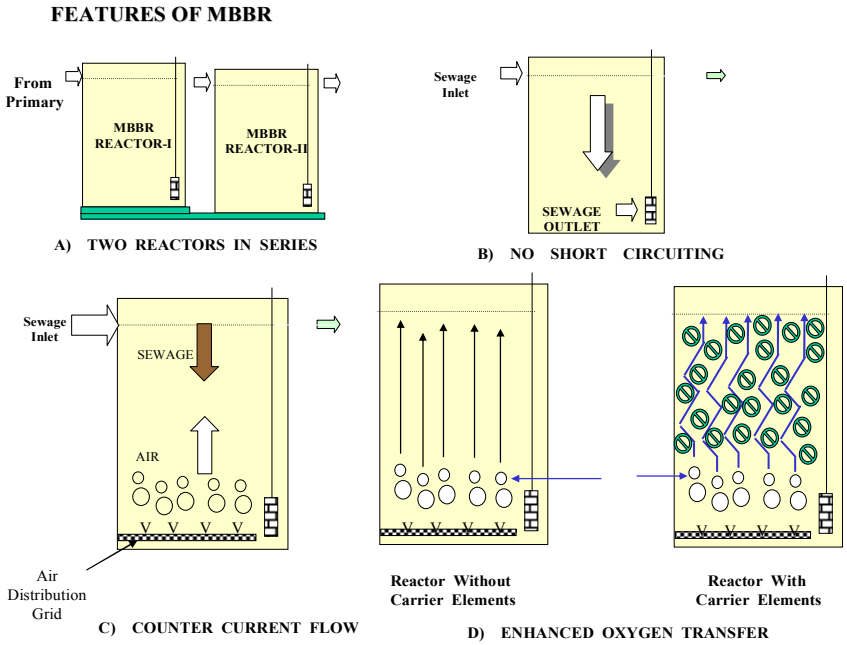

Fig7.1: Features of MBBR

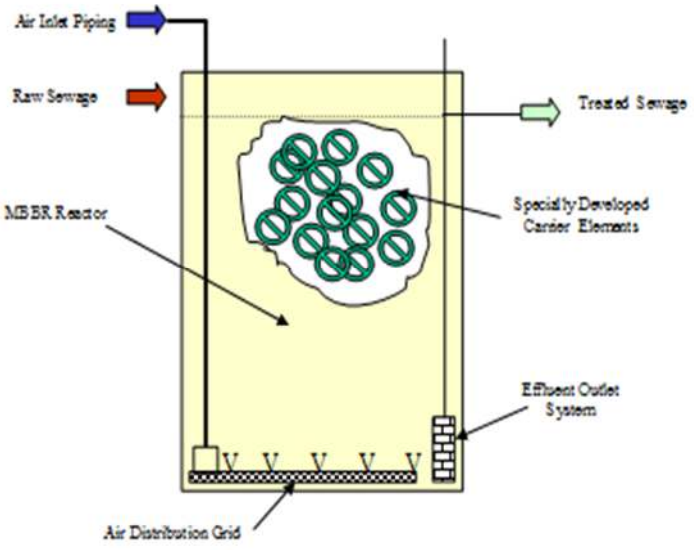

Fig7.2: Essential Components of MBBR

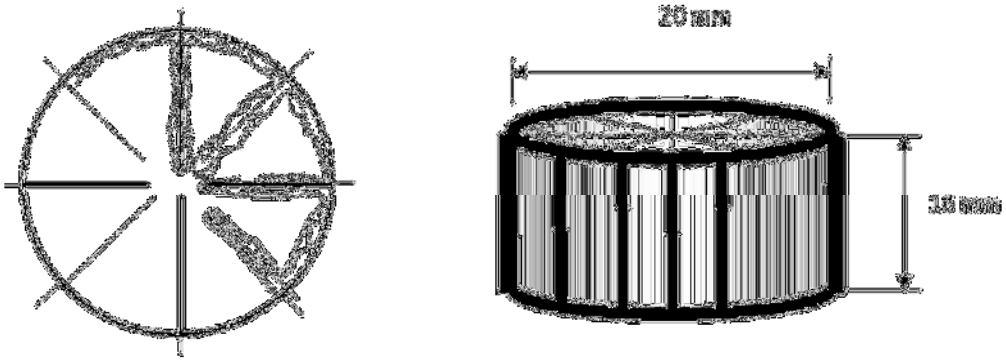

Fig7.3: MBBR Media

7.3.3 Advantages of MBBR

- Sensitivity to small power downs is low.
- Sludge re – circulation not needed and the system is self-sustaining.
- Very small area around 1/10th of conventional system is required.
- Higher degree of treatment.
- High degree of coli forms removal.
- Less chlorine dosing required.

7.4Treatment Scheme

The treatment scheme offered is Biological Treatment using MBBR Process. Excess aerobic biological sludge generated will be aerobically digested in a Sludge Holding Tank and dewatered in a filter press and then shall be used for land fill or can be used as manure for agricultural purposes. Sludge drying beds are also provided for dewatering the sludge. The treatment scheme proposed is split into three distinct parts viz.

- **Primary Treatment:** Floating matter removal is achieved by the fine and coarse screens. Grits shall be removed in the Grit Chamber. Sand and other particles of specific gravity > 2.65 are settled in the Grit Chamber. Screenings and Grit are periodically removed, dried and disposed. Parshall flume facilitates flow measurement. An Equalization Tank of 3hr of Hydraulic retention is provided to take care of the peak loads. Intermittent aeration facilitates nutrient removal(Nitrification & De-Nitrification).

- **Secondary Treatment:** It comprises of two MBBR tanks and settling tank.With submersible pumps, the sewage is pumped to the 1st MBBR tanks where the biological treatment occurs. The microorganism attached to the moving biofilm which sets in motion by aeration eats up the biomass as described earlier. For complete BOD/COD removal the process is repeated in a second MBBR connected in series to the former. Nutrient removal also takes place here. The Clarified supernatant liquid is led by gravity to the secondary clarifier for the solid – liquid separation.

The biologically treated sewage enters the clarifier at through a central shaft and it is then distributed equally. The suspended solids settles down and is mechanically scraped and removed. The sludge which settles at the bottom of the Clarifier is collected in the Sludge Sump.

After MBBR, treated water is stored in a RCC Tank. This tank will act as a feed tank for the tertiary treatment in Pressure Sand Filter (PSF) & Activated Carbon Filter (ACF). I nos of centrifugal pump will feed the PSF & ACF in building up adequate pressure into filters. Backwash water will be fed into the centrate sump for recirculation.

- **Tertiary Treatment:** Wastewater from secondary clarifier is filtered using pressure sand filter and activated carbon filter. Treated water is then disinfected by chlorination.

7.4.1 Receiving Chamber

The existing inlet point in the plant premises is connected to the collection tank designed for the new plant through gravitational flow. Both black water from WCs and grey water from bath room, toilets etc. shall be directly fed in to the collection tank. The average quantity of flow in to the receiving chamber is assumed to be 208.33cum/hr whereas peak flow is taken as 520.83cum/hr. Dimension of receiving chamber is 2.5×1.5×2m with a free board of 0.5m.

7.4.2 Screen Channel

After receiving chamber, sewage passes through screening chambers provided. The principal role of the fine screening is to remove floating materials from the sewage that could damage subsequent process equipment, eliminate materials that may inhibit the beneficial reuse of bio solids and reduce overall treatment process effectiveness. Screened materials are mechanically removed by the scrappers. In case of emergency, the screen chamber can be bye passed to the manual screen chamber so that the treatment is continuously ensured.

A mechanical coarse screen in SS (grade: 316) with bar thickness of 10mm, 20 mm clear bar spacing between bars, 38cm width of opening and sized as 4 x 0.45 x 0.4m and a mechanical fine screen in SS (grade: 316) with bar thickness of 10mm, 6 mm clear bar spacing between bars, 38cm width of opening and sized as 4 x 0.45 x 0.4m are provide. Approximate removal rate of BOD and TSS in the fine screen is in the range of 5- 10% and 5-30% respectively. Manually cleaned course screen are used in case of emergency by by-passing. The collected material of screening is sent to landfill area for safe disposal.

7.4.3 Grit Separator

The grit chamber is used to remove grit, consisting of sand, gravel, cinder, or other heavy solids materials that have specific gravity much higher than those of theorganic solids in wastewater. Grit chambers are provided to protect moving mechanical equipment from abrasion and abnormal wear; avoid deposition in pipelines, channels, and conduits; and to reduce frequency of digester cleaning. Two numbers of grit chambers are provided in the plant (1W+1SB) with a dimension of 3.65 x3.65 x0.7m.

7.4.4 Approach Channel for Parshall Flume

A Parshall flume is a fixed, hydraulic structure that is placed in a flow stream to determine the flow of water. The flume accelerates flow by both a contraction of the parallel sidewalls and a drop in the floor elevation in the throat. It is used to measure volumetric flow rate in industrial discharges, municipal sewer lines, and influent/effluent flows in wastewater treatment plants. A throat width of 38cm and a mouth width of 83cm

are provided from the table. The total approach channel length is given as 3m width a channel width of 83cm. The approach channel for parshall flume is designed to have a dimension of 0.38x0.83x3m.

7.4.5 Equalisation Tank

Flow equalization is used to minimize the variability of water and wastewater flow rates and composition. Each unit operation in a treatment train is designed for specific wastewater characteristics. Improved efficiency and control are possible when all unit operations are carried out at uniform flow conditions. The equalization tanks are provided (i) to balance fluctuating flows or concentrations, (ii) to assist self-neutralization, or (iii) to even out the effect of a periodic "slug" discharge from a batch process.The design is done to have a hydraulic retention time of 3 hours. A circular tank with diameter 14.5m is proposed with a depth of 4m.

7.4.6 Mixing Equipment

Mixers are often employed in equalization basins to achieve homogeneity in and to aerate the wastewater. Various types of mixers are available. The classification of mixers depends on the flow pattern the mixers produce. A mixer having capacity 396.1cum/hr is provided to ensure efficient mixing.

7.4.7 Sewage Pump Pumping to MBBR

Horizontal Centrifugal, level controlled, submersible, detachable non clog submersible pump sets (2W+1SB) shall be used to lift sewage to the MBBR chamber of the STP from Equalization Tank. The specification for the pumps shall be non-clog, solids handling (NC-SH) pumps of 23HP with a discharge of 312.50cu/hr with open impellers.

7.4.8 Moving Bed Bio reactor (MBBR)

Moving Bed Biofilm Bioreactor (MBBR) process uses the whole tank volume for biomass growth. It uses simple floating media, which are carriers for attached growth of biofilms. Biofilm carrier movement is caused by the agitation of air bubbles. This compact treatment system is effective in removal of BOD as well as nitrogen and

phosphorus while facilitating effective solids separation.Design of the reactor is based on the actual wastewater characteristics and local conditions. MBBR units are placed in series based on the load entering each reactor. Neutralised and settled wastewater passes through MBBR for reduction in BOD/COD.

The standard filling of carrier is below 70% with a maximum specific area not more than 465m^2/m^3. The design is done to have a volume of media about 40% and specific surface area preferably 450m^2/m^3 Smaller carriers need smaller reactor volume at a given loading rate (as g/m^2d) when the carrier filling is same. A circular MBBR tank is designed with diameter 9m with a depth of 4m.

7.4.9 Air Blowers

Aeration is the most critical component of a treatment system using the Moving Bed Bio Reactor. A well designed aeration system has a direct impact on the level of sewage treatment it achieves. An ample and evenly distributed oxygen supply in an aeration system is the key to rapid, economically-viable, and effective wastewater treatment. Two numbers (1W+1S) of air blowers of 50KW with a discharge of 1800cum/hr are provided.

7.4.10 Secondary Clarifier

Clarifiers are settling tanks built with mechanical means for continuous removal of solids being deposited by sedimentation. A clarifier is generally used to remove solid particulates or suspended solids from liquid for clarification and (or) thickening. Secondary Clarifier is a circular basin in which effluent from the activated sludge process is held for a period of time during which the heavier biomass (microorganisms) settle to the bottom as “activated sludge”. There is no need for sludge recirculation in MBBR due to its high MLSS values. So secondary settling tanks are just used for removing excess settleable solids present in the effluent comes out from MBBR tanks. One number of secondary clarifier with 14m diameter and 3.5m depth is provided with a retention period of 2.5hrs.

7.4.11 Sludge Sump

Total sludge generated in the secondary clarifier is calculated as 1037.5kg/day. Sludge sump is designed to have a hydraulic retention time of 2hrs. One number of sludge sump having circular shape with diameter 2.5m and depth 2m is provided.

7.4.12 Thickener Feed Pump

The major function of sludge thickener feed pump is to transfer the sludge from sludge sump to sludge thickener. Two numbers (1W+1SB) of non-clog, submersible pumps are provided with a discharge of 10.5cum/hr.

7.4.13 Sludge Thickener

Sludge thickening normally refers to the process of reducing the free water content of sludge or Thickening is a procedure used to increase the solids content of sludge by removing a portion of the liquid fraction. Total sludge generated is calculated as 1037.5kg/day with a solid holding rate of 40.00kg/sqm/day. The thickened sludge will be having a consistency of 3% of total sludge. One number of sludge thickeners (Gravity Type) with 6.2m diameter and 3m depth is provided. Thickened sludge is collected in a sludge sump for feeding the dewatering equipment.

7.4.14 Filter Press/ Centrifuge Feed Pump

A filter press is a piece of batch operation, fixed volume equipment that separates liquids and solids using pressure filtration OR filter press is a piece of batch operation, fixed volume equipment that separates liquids and solids using pressure filtration. Slurry is pumped into the filter press and dewatered under pressure. Two numbers (1W+1SB) of screw pumps of 1.0HP with a discharge of 4.0cum/hr.

7.4.15 Sludge Centrifuge

Centrifugal thickening and dewatering of sewage sludge is a high speed process that uses the force from rapid rotation of a cylindrical bowl to separate wastewater solids from liquid. The centrifugal force in the decanters is utilized to separate the solids from the water. The use of organic flocculants, the polyelectrolytes, made it possible to coagulate the fines sludge particles to relatively large sludge floc in the centrifugal field so that reliable separation of solids and water could take place.

Two numbers of centrifuges (1W+1SB) are provided with a capacity of 0.84cum/hr. A dosing tank is provided for Poly Electrolyte dosing in centrifuge and thickener. Poly Electrolyte dosing is fixed as 2.0kg/1000kg for a sludge generation rate of 1037.5kg/day. Therefore a dosing tank is designed with dimensions 0.75x0.75x1.5m.

7.4.16Treated Water Tank

The treated water is finally fed in to the treated water tank having a capacity of 108m^3.Treated water from Activated Carbon filter is pumped in to the treated water tank of dimension 6x6x3m. Hydraulic retention time of 60 minutes is given in the treated water tank.

7.4.17 Pressure Sand Filter (PSF)

The treated water which is collected in the filter feed tank shall be pumped into the Pressure Sand Filter using the Filter Feed Pumps. They are the most popular method for removal of turbidity from water. The Pressure Sand Filter consists of a multiple layer of sand with a variety in size and specific gravity. These Filters are designed to remove turbidity and suspended particles present in the feed water with minimum pressure drop. Raw water flows down wards through the filter bed and as the suspended matter, which is treated by addition of a coagulant like alum or poly electrolyte, is retained on the sand surface and between the sand grains immediately below the surface. There is steady rise in the loss of head over a period of time and the flow reduces once the pressure drop across the filter is excessive. The filter is then taken out of service and cleaning of the filter media is effected by flow reversal also called as backwash. To assist in cleaning the bed, the backwash operation is sometimes preceded by air scouring by way of agitation through the under drain system. The air scouring agitates the sand with a scrubbing action, which loosens the intercepted particles.

Fig7.4: Pressure Sand Filter

Pressure sand filter is designed to have a dimension of 3mØ and 2.5m height. The work pressure is 3.5bar and it can be increased up to a maximum of 5.25bar. Materials used in pressure sand filter are sand and anthracite (Dual media).

7.4.18 Activated Carbon Filter (ACF)

Filtered wastewater from Pressure sand filter is then passed through the Activated Carbon Filter. **They** are generally employed in the process of removing organic compounds and/or extracting free chlorine from water, thereby making the water suitable for discharge.

Activated carbon is commonly used for removing organic constituents and residual disinfectants in water supplies. This not only improves taste and minimizes health hazards; it protects other water treatment units such as reverse osmosis membranes and ion exchange resins from possible damage due to oxidation or organic fouling. Activated carbon is a favoured water treatment technique because of its multifunctional nature and the fact that it adds nothing detrimental to the treated water. Most activated carbons are made from raw materials such as nutshells, wood, coal and petroleum.

Carbon filtering is a method of filtering that uses a bed of activated carbon to remove contaminants and impurities, using chemical adsorption. Each particle/granuleof carbon provides a large surface area/pore structure, allowing contaminants the maximum possible exposure to the active sites within the filter media.

The dimension of Activated Carbon Filter is 3mØx2.5m height. Materials used in ACF are Activated carbon preferably of coconut shell with surface area 850m^2/gm and mean particle diameter of 2mm with iodine value not less than 600 (Preferably 900).

Fig 7.5: Activated Carbon Filter

7.4.19Chorine Contact Tank

Chlorination is by far the most common method of wastewater disinfection and is used worldwide for the disinfection of pathogens before discharge into receiving streams, rivers or oceans. Chlorine is known to be effective in destroying a variety of bacteria, viruses and protozoa, including Salmonella, Shigella and Vibrio cholera. Disinfection is achieved at this facility through chlorination using chlorine gas. The purpose of the Chlorine Contact Tanks is to allow sufficient time for the chlorine to disinfect the water. A chlorine contact tank is designed having dimensions 6x6x3m and a retention time of 30 minutes. Gas chlorinator having capacity 0.42kg/hr with two numbers (1W=1SB) of vaccum feed type dosing pumps are provided for proper functioning.

7.4.20Effluent Channel

Effluent Conveyance System called as Effluent Channel is provided to carry treated effluent from STP to the Chettichira canal. Channel depth and width are 1m and 0.6m respectively.

7.4.21 Outfall

The disinfected clear effluent shall be let out to the Chettithara Canal through a RCC covered channel of adequate slope. Since the site is elevated above the High Tide level, there is no threat of back flow

7.5 Power Requirement

The total running power requirement is 163HP/136KW and the installed capacity is 350HP/260KW. The single largest motor capacity is 67HP (Air blower). An Indoor type transformer and a Generator is proposed with the following capacities.

a. Transformer : 250KVA

b. Generator : 250KVA

7.6 Other Facilities

Following provisions are also included in the proposal

1. Comfort room cum office in the laboratory
2. Internal Roads
3. Storm Water Drain
4. Providing Lawns
5. Planting trees
6. Bye-passing Arrangements
7. Walkways for all major elevated units
8. Walkways/ground pavements
9. Water Supply and sanitation arrangements
10. Laboratory

7.7 Plant Layout

The new 5MLD plant is proposed to be constructed towards the eastern side of the existing plant. Layout can be either of a single plant in a more compact manner or can be done leaving space for identical units for construction in future more or less in a modular fashion. Though this there will be slightly increase cost of piling/cabling etc. the same will facilitate construction of new plant of equal or lesser capacity. The

O&M of which will be easierand less costly. New components are planned away from the proposed unit. Future it will maximise land usage. Both the layouts have been prepared for comparison. Costing done will suit the later.

Chapter 8

PROCESS FLOW AND DESIGN

8.1 Process Flow Diagram

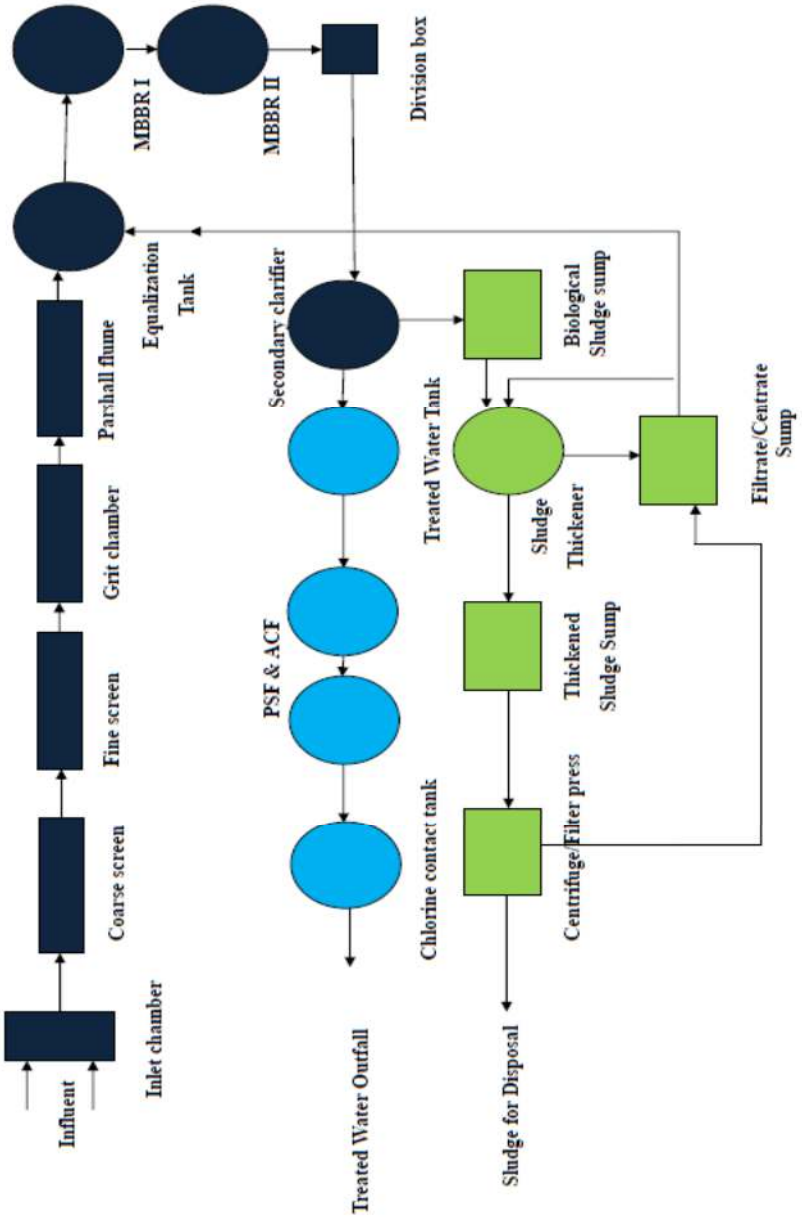

Fig 8.1: Process Flow Diagram

8.2 Process Design

MBBR PROCESS				
Capacity: Average Flow			**5MLD**	
Sl No	Description of Parameter	Value	Unit	Reference/ Remarks
a.	Quantity of Sewage Generated	5000000.00	LPD	
		5000.00	Cum/day	
		208.33	Cum/hr	
b.	Population Equivalent	41667		
c.	Assumed Peak Factor	2.50		
d.	Peak Design Flow	520.83	Cum/hr	
		0.145	Cum/sec	
RAW SEWAGE CHARACTERISTICS				
a.	Average Sewage flow entering the treatment plant	208.33	Cum/hr	
b.	Peak Sewage flow entering the treatment plant	520.83	Cum/hr	
c.	COD	500.00	mg/Lt	
d.	BOD	250.00	mg/Lt	
e.	TSS	400.00	mg/Lt	
f.	Total Nitrogen (As N)	40.00	mg/Lt	
g.	Total Phosphorous (As P)	7.00	mg/Lt	
h.	FecalColliform	3×10^7	mpn/100ml	
i.	E Colliform	4×10^7	mpn/100ml	
j.	Chlorides as Cl	170.00	mg/Lt	
k.	pH	6 to 9		

Table 8.1: Process Design of 5MLD Capacity STP **for** KWA, Kochi

TREATED SEWAGE CHARACTERISTICS (AFTER FILTRATION)				
a	COD	100.00	mg/Lt	
b	BOD	10.00	mg/Lt	
c	TSS	30.00	mg/Lt	
d	Total Nitrogen (As N)	10.00	mg/Lt	
e	Total Phosphorous (As P)	< 2	mg/Lt	
f	pH	6 to 9		
g	E Colliform	1 x 10^3	mpn/100ml	
1	**RECEIVING CHAMBER**			
	Quantity of Flow (Ave)	208.33	Cum/hr	
	Peak Flow	520.83	Cum/hr	
		0.145	Cum/Sec	
	Average Retention Time for the Peak Flow	45.00	sec	
	Volume of the Inlet Chamber	6.51	Cum	
	Assumed Depth of flow	2.00	m	
	Area Required for Inlet Chamber	3.26	Sq.m	
	Length of the tank	2.50	m	
	Breadth of the tank	1.30	m	
	Say	1.50	m	
Provide the Dimensions of Receiving Chamber as 2.5 m x 1.5 m x 2 m SWD + 0.5 m Freeboard				
2	**MECHANICAL COARSE SCREEN CHANNEL**			
	Peak Design Flow	0.145	Cum/s	
	No. of screen	1.00	Nos. (Working)	

	Peak Flow rate per screen	0.145	m^3/sec..	
	Velocity at Peak flow	0.950	m/sec.	Assumed Peak Velocity
	Area required for screen	0.15	m^2	
	Assuming depth of flow	0.40	meter	
	Width of opening	0.38	meter	
	Say	0.41	m	
	Clear Bar Spacing	20	mm	
	Bar Thickness	10.00	mm	
	No of Opening	14	Nos	
	Inside width of screen	0.41	m	
	Provide chamber width	0.45	m	
	Velocity	1.15	m/sec.	
	Full height of the Channel	1.00	m	
	Angle of inclination	70.00	degree	
	Actual Velocity at Peak flow	0.73	m/sec.	> 0.6m/s , Hence OK
	Length of channel required D/s	2.10	m	
	Say	2.50	m	
	Length of channel U/s	1.50	m	
	Total Length of channel	4.00	m	
Provide the Dimensions of Mechanical Coarse Screen Channel as 4 m x 0.45 m x 0.4 m SWD + 0.6 m Freeboard				
3	**MECHANICAL FINE SCREEN CHANNEL**			
	Peak Design Flow	0.145	Cum/s	
	No. of screen	1.00	Nos. (Working)	
	Peak Flow rate per screen	0.145	m^3/sec..	

	Velocity at Peak flow	0.950	m/sec.	Assumed Peak Velocity
	Area required for screen	0.15	m^2	
	Assuming depth of flow	0.40	meter	
	Width of opening	0.38	meter	
	Say	0.41	meter	
	Clear Bar Spacing	6	mm	
	Bar Thickness	10.00	mm	
	No of Opening	26	Nos	
	Inside width of screen	0.41	m	
	Provide chamber width	0.45	m	
	Velocity	2.04	m/sec.	
	Full height of the Channel	1.00	m	
	Angle of inclination	70.00	degree	
	Actual Velocity at Peak flow	1.29	m/sec.	
	Length of channel required D/s	2.10	m	
	Say	2.50	m	
	Length of channel U/s	1.50	m	
	Total Length of channel	4.00	m	
Provide the Dimensions of Mechanical Fine Screen Channel as 4m x 0.45m x 0.4 m SWD + 0.6 m Freeboard				
4	**MANUAL COARSE SCREEN CHANNEL-Standby**			
	Peak Design Flow	0.145	Cum/s	
	No. of screen	1.00	Nos. (Working)	
	Peak Flow rate per screen	0.145	m^3/sec..	
	Velocity at Peak flow	0.950	m/sec.	Assumed Peak Velocity

	Area required for screen	0.15	m^2	
	Assuming depth of flow	0.40	meter	
	Width of opening	0.38	meter	
	Say	0.41	m	
	Clear Bar Spacing	20	mm	
	Bar Thickness	10.00	mm	
	No of Opening	14.00	Nos	
	Inside width of screen	0.41	m	
	Provide chamber width	0.45	m	
	Velocity	1.15	m/sec.	
	Full height of the Channel	1.00	m	
	Angle of inclination	45.00	degree	
	Velocity at Peak flow	0.60	m/sec.	> 0.6m/s , Hence OK
	Length of channel required D/s	1.90	m	
	Say	2.20	m	
	Length of channel U/s	1.50	m	
	Total Length of channel	3.70	m	
Provide the Dimensions of Manual Coarse Screen Channel as 3.7 m x 0.41 m x 0.4 m SWD + 0.6 m Freeboard				
Daily Screening Quantity				
	Daily Sewage Quantity	5000	m^3/day	
	Rate of Screening Quantity	0.015	$m^3/1000m^3$	
	Daily Screening Quantity	0.075	m^3/day	
5	**GRIT SEPERATOR**			

	No. of Grit Units	2		(1W+1SB)
	Peak Flow	0.145	Cum/s	
	Flow in Each Unit	0.145	Cum/s	
	Computation of Settling Velocity: Stoke's Law			
	Grit Particle Size	0.150	mm	
	Specific Gravity of Particle	2.65		
	Hydraulic Retention Time	60.00	Sec	
	Volume of the Grit Chamber	8.68	m^3	
	Surface Overflow Rate (SOR)	959	cum/sqm/d	Assumed
		0.011	cum/sqm/sec	
	Area	13.03	m^2	
	SWD	0.70	m	
	Proposimg a Square Channel of Size	3.61		
	Length of Grit Seperator	3.65	m	
	Width of Grit Seperator	3.65	m	
	Critical Displacement Velocity (Vc)	[8k/f(Ss-1)gd]^0.5		
	Where,			
	K	0.040		
	f	0.03		
	Ss	2.65		
	d	0.00015	m	
	Vc	0.097	m/sec	
	Horizontal velocity of flow Vh should be kept less than the critical displacement velocity Vc			
	SWD	0.70	m	

	Vh	0.06	m/sec	<Vc , Hence Safe
	HRT at Peak Flow	64.46	Sec	> 60, Hence Safe
Provide the Dimension of Grit Separator as 3.65 m x 3.65 m x 0.7 m SWD + 0.5 m Freeboard				
6	**APPROACH CHANNEL FOR PARSHALL PLUME**			
	Lower value of flow in MLD	1	MLD	Sizing done as per CPHEEO Manual Appendix A - 5-9
	Higher value of flowin MLD	12.5	MLD	
	Lower value of flow in lps	12	lps	
	Higher value of flow in lps	145	lps	Assumed from 0.885 to 0.99
	Throat width (W) in m, from Table	0.38	m	
	Mouth width (D)in m,from Table	0.83	m	
	Liquid depth in m at low flow	0.06	m	
	Liquid depth in m at high flow	0.30	m	
	velocity at mouth in low flow in m/s	0.25	m/sec	
	velocity at mouth in high flow in m/s	0.57	m/sec	
	Approach channel width, m	0.83	m	
	Approach channel, liquid depth, m	0.30	m	
	Approach channel, Length, m	3.00	m	
	Free Board	0.7	m	

	Total Depth			
Provide the Dimension of Approach Channel For Parshall Plume as 0.38mx0.83mx3m SWD + 0.7 m Freeboard				
7	**EQUALIZATION TANK**			
	Average Design Flow	208.33	Cum/hr	
	Hydraulic Retention Time	3.0	hours	
	Volume of the Tank	625.00	Cum	
	Assumed Depth of Liquid column (SWD)	4.0	m	
	Area required for the equalization tank	156.25	Sq.m	
	No. of Tanks Proposed	1		
	Area required for each equalization tank	156.25	Sq.m	
		14.11		
	Propose a Circular Tank			
	Diameter of theTank	14.11	m	
	Say	14.50	m	
	Actual Capacity Provided	660.19	Cum	

Check for Capacity

Maximum Peak hours = 2 hours

2hrs peak flow = 2×520.83 =1041.66

Has 2hrs average capacity = 2×208.33 =416.66

Required Storage = 625.00 m^3

Actual Storage Provided = 660.19>625m^3

Hence OK

Provide the Dimension of Equalization Tank diameter as 14.5 m ϕ x 4 m SWD + 0.5 m Freeboard	
7.1	**MIXING EQUIPMENT**

	No . Of Tanks	1.00		
	Capacity of Tank	660.2	Cum	
	Mixing Rate	0.60	Cum/hr	
	Capacity of Mixer	396.1	Cum/hr	
	Mixing Rate	0.004	KW/m³	
	Capacity of Mixer	2.64	Kw	
		3.54	HP	
	Say	4.00	HP	
Provide the Mixing Equipment of Size 4 HP of Mixing Capacity 0.6cum/hr				
7.2	**SEWAGE PUMP PUMPING TO MBBR**			
	No. of pumps	3		(2W+1S)
	Type of Pumps - Submersible Sewage Transfer /Horizontal Centrifugal- Non Clog)			
	Average flow	5000.00	Cum/day	
	Peak Design Flow	12500.00	Cum/day	
	Number of working hours	20	hrs	
	Flow Capacity of Each Pump required	312.50	Cum/hr	
	Proposed pumps 2numbers (1W + 1SB), flow per Pump	312.50	Cum/hr	
		86.81	lps	
		0.087	Cum/sec	
	Head required	10.00	m	
	Efficiency	50	%	
	HP required for pump	22.71	HP	(Q*H*9.81*0.75)/0.5
	Provide Pumps of Capacity	25	HP	

Provide 3Nos of Submersible NC-SH Horizontal Centrifugal Pumps of 25HP with a Discharge of 312.50cum/hr				
8	**MOVING BED BIO REACTOR (MBBR)**			
	Average Design Flow	5000.00	Cum/day	
	No.of Streams	1.00		
	BOD of Incoming Sewage	250.00	mg/l	
	TSS of Incoming Sewage	400.00	mg/l	
	BOD required after treatment	10	mg/l	
	BOD to be removed	240	mg/l	
	No. of Tanks Proposed	2		
	PROCESS CALCULATION			
	BOD Loading rate	3.50	Kg/Cum/Day	4-7 kg/cum/day as per Page 955, M&E
	Quantity of BOD removed per Day	1200.00	Kg/Day	
	Volume of Reactor Required	342.857	Cum	
	Volume of Media Required	40.00	%	
	Media Volume Required	137.14	cum	
	Volume of Tank required	479.997 Say 480.00	cum	
	Considering 1 Streams, 2 Tanks			
	Volume of each Tank	240.00	cum	

	Assumed liquid Depth (SWD)	4.00	m	
	Area of each tank	60.00		
	Propose a Circular Tank			
	Diameter of theTank	8.80	m	
	Say	9.00	m	
	Actual Capacity Provided	254.34	Cum	
Provide the Dimension of Moving Bed Bio Reactor (MBBR) Dia as 9 m ϕ x 4 m SWD + 0.5 m Freeboard				
Provide inter connection pipe = 200mm Dia DI K9				
9	**AIR BLOWERS**			
9.1	**For MBBR Tank**			
	Assumed BOD reduction in the MBBR tank	95%	Percent	
	Incoming BOD of Raw sewage	250.00	mg/L	
	BOD to be reduced	237.50 say 240	mg/L	
	BOD Load	1200.0	kg/day	
	Oxygen required to remove BOD load	1.2	kg/kg of BOD	
	Oxygen required	1440.0	kg/day	
	Weight of O2 in 1kg of air	0.232		Standard
	Density of Air	1.201		Standard
	Oxygen Transfer Efficiency	0.170		15 to 30 % for fine bubble diffuser

	Oxygen Required per Day	29133.94	Cum/day	
		1213.91	Cum/hr	
	Air Required	**1213.91**	**Cum/hr**	
	Safety Factor	25.00	%	
		303.48	Cum/hr	
	Add 20% for Anoxic Equalisation Tank , Sludge Tank etc	242.78	Cum/hr	
	Actual Air Requirement	**1760.18**	**Cum/hr**	
	No.of Blowers Working	1.00		
	Air Required per Blower	1760.18	Cum/hr	
	1cum/hr	0.59	cfm	
	Air Required in CFM	1038.50	cfm	
	Pressure	8.82	psi	(0.6kg/sqcm)
	Volumetric Efficiency	0.65	%	
	Power Requirement for Blower	61.44	HP	(0.00436*cfm* psi)/Eff
		45.83	KW	
	Say	50.00	Kw	
Provide 3Nos (2W+1S) of Air Blowers of 25KW with a Discharge of 1800cum/hr				
10	**SECONDARY CLARIFIER**			
	No.of Stream	1	Nos	
	No.of Tanks	1	Nos	
	Average Flow	208	Cum/hr	
	Retention Period	2.5	hrs	
	Volume of Tank Required	520.8	Cum	
	Volume of Each Tank	520.8	Cum	
	Assumed Depth	3.5	m	

	Area of Each Tank	148.81	sqm	
	Propose a Circular Tank			
	Diameter of theTank	13.77	m	
	Say	14.00	m	
	Actual Capacity Provided	538.51	Cum	
Provide the Dimension of 1No SECONDARY CLARIFIER Dia as 14 m ϕ x 3.5 m SWD + 0.5 m Freeboard				
INFLUENT PIPE				
	Velocity of Average Flow	1.0	m/sec	
	Area	0.145	sqm	
	Inner Dia of Feed Pipe	0.43	m	
	Say	450.00	mm	
11	**SLUDGE SUMP**			
	Sludge Generated			
	Average Flow	5000.00	cum/day	
	TSS	400.00	mg/l	
	BOD	250.00	mg/l	
	Assumed TSS Sludge	30	%	
	Assumed BOD Sludge	35	%	
	Slugde Generated - TSS	600.00	Kg/day	(Average Flow X 30% of TSS)
	Slugde Generated - BOD	437.50	Kg/day	(Average Flow X 35% of BOD)
	Total Sludge	1037.50	Kg/day	
	% of Sludge with 1.02Specific Gravity	1.00	%	

	Sludge Volume per Day	101.72	cum/day	(Total Sludge x 10%)/1.02
		4.24	cum/hr	
	Sludge Sump			
	Assumed Hydraulic Retention time	5.00	hr	
	Volume of Tank	421.20	cum	
	Assumed Side Water Depth	2.00	m	
	Area of the tank	10.60	sqm	
	Propose a Circular Tank			
	Diameter of theTank	3.67	m	
	Say	3.75	m	
	Actual Capacity Provided	22.88	Cum	
Provide the Dimension of 1No Total Sludge Dia as 3.75m ϕ x 2 m SWD + 0.5 m Freeboard				
12	**THICKENER FEED PUMP**			
	General			
a	Application	Sludge Transfer to Thickener		
b	Specific Gravity	1.03		(1W+1SB)
c	Type	Non Clog Submersible		
d	Quantity	2.00	(1W+1S)	
	Design Data			
a	Pump Working Hours	10.00	hrs	(3 to 4 stages)
b	Capacity of pump required	10.17	Cum/hr	
		0.00283	Cum/Sec	
c	Head required	15.00	m	

d	Max Solid Size Permissible	40.00	mm	
e	Efficiency	50	%	
f	HP required for pump	1.109	hp	
g	Recommended Size	1.250	HP	
h	BKW at Duty Point	0.933	KW	
	Material of Construction	20.00		
a	Casing	2% Ni - CI		
b	Impeller Semi Open	CF-8M		
c	Rotor Shaft	SS-410		
d	Fasteners in Liquid	SS-410		
e	Motor Housing	CI IS 210 Gr. FG 260		
	Motors :	20.00		
a	Type	Submersible		
b	RPM	1450		
c	Frequency	50 ± 3% HZ		
d	Voltage	415 + 6% - 10%		
e	Insulation	Class - F		
f	Enclosure	IP - 68		
f	Quantity	1 No of Each pump		
g	KW	1.000		
	Recommended Delivery Line	100.00	mm	
Provide 2Nos (1W+1S) of Thickener Feed Pump of 1.25HP with a Discharge of 10.5cum/hr				

13	**SLUDGE THICKENER (GRAVITY TYPE)**			
	No of Units	1.00		
	Total Sludge	1037.50	Kg/day	
	Solids Loading Rate	40.00	Kg/sqm/day	
	Thickening Area Required	25.94	Sqm	Total Sludge/SLR
	Surface Loading Rate	12	Cum/sqm/day	
	Sludge Volume per Day/SLR	8.48	m^3	
	Max Area taken	25.94	Sqm	
	Area of Distribution Chamber	10.00	%	
	Total Area Required	28.53	Sqm	
	Propose a Circular Tank			
	Diameter of the Tank	6.03	m	
	Say	6.20	m	
	Thickener Area Available	30.18	sqm	
	Side Water Depth (SWD)	3.00	m	
	Actual Volume Provided	90.53	Cum	
	Thickened Sludge Consistency	3.00	%	
	Thickened Sludge Volume	31.13	cum/day	3% of Total Sludge
Provide the Dimension of 1No SLUDGE THICKENER (GRAVITY TYPE) Dia as 6.2 m ϕ x 3 m SWD + 0.5 m Freeboard				

Thickened Sludge Pump				
	Inlet Pipe Diameter			
	Flow	10.1716	cum/hr	
		0.0028	Cum/sec	
	Velocity	1.00	m/sec	
	Pipe Area Required	0.0028	Sqm	
	Pipe Dia	0.0600	m	
	Say	100	mm	
	Thickener Mechanism			
	Type	Central Drive Type		
	Material of Construction			
a	Sections	MS Sections as per IS - 226		
b	Walkway	5mm Chequered Plates		
14	**FILTER PRESS / CENTRIFUGE FEED PUMP**			
	Type	Screw Pump		
	No. of pumps	2	Nos	(1W+1S)
	No of Working Pump	1	Nos	
	Volume to be Pumped	31.13	Cum/day	
	Centrifuge Working Hours	8.00	hrs	
	Capacity required in Pump	3.89	Cum/hr	
	Capacity Provided	4.00	Cum/hr	
		0.0011	Cum/Sec	
	Head	15.00	m	
	Efficiency	50	%	

	HP required for pump	0.444	hp	
	Say	1.0	HP	
	Load	0.746	KW	
	Recommended Delivery Pipe	150	mm	
Provide 2Nos (1W+1S) of Centrifuge/Filter Press Feed Pum of 1.0HP with a Discharge of 4.0cum/hr				
15	**SLUDGE CENTRIFUGE**			
	Sludge Flow Rate to Centrifuge			
	No of Centrifuges	2.00	(1W + 1S)	
	Capacity of Centrifuge	0.84	Cum/hr	
	Poly Electrolyte Dosing For Centrifuge & Thickener	10.00	%	
a	**Dosing Tanks**			
	Sludge Volume	1037.50	Kg/day	
	Dose	2.00	Kg/1000kg	
	Quantity of Poly Electrolyte	2.08	Kg/Day	
	Concentration	0.10		
	Volume of Tanks @ 24hr	2.08	Cum	
		2080.00	litres	
	Volume	86.67	lit/hr	
	Volume required for 8hrs	0.69	Cum	
	Liquid Depth of Tank	1.50	m	
	Area Required	0.46	sqm	
	Propose a Square Tank			
	Length = Breadth	0.68	m	

	Say	0.75	m	
Provide the Dimensions of Dosing Tanks as 0.75 m x 0.75 m x 1.5 m SWD + 0.5 m Freeboard				
b	**Dosing Pumps**			
	No of Dosing Pumps	2.00	(1W + 1S)	
	Required capacity of Dosing Pumps	86.67	lit/hr	
	Provided Volume of Tank	0.84	Cum	
	Velocity Gradient	300.00	S^-1	
	Constant at 200cc Water Temperature	0.001139		
16	**CHLORINE CONTACT TANK (CCT)**			
	Type	Square		
	Hydraulic Retention Time	30.00	Minutes	
	Average Flow	208.33	Cum/hr	
	Volume of the tank	104.17	Cum	
	Assumed Liquid Depth	3.00	m	
	Area of the Tank	34.72	Sq.m	
	Propose a Square Tank			
	Length = Breadth	5.89	m	
	Say	6.00	m	
Provide the Dimensions of Sludge Flow Rate to Centrifuge as 6 m x 6 m x 3 m SWD + 0.5 m Freeboard				
17	**GAS CHLORINATOR**			
	Dosing Rate			
	Chlorine Mixing			

	Average Flow	5000.00	Cum/day	
	Chlorine Dosing Rate	2	mg/L	
	Capacity of Gas Chlorinator Required	0.42	kg/hr	Say 0.5kg/hr
	No of Dosing Pumps	2	(1W+1S)	
	Type	Vacuum Feed Type		
		Flow Proportional Dosage		
	Daily Requirement	10.00	kg	
	Monthly Requirement	300.00	Kg	
18	**PRESSURE SAND FILTER**			
	Average Flow	5000.00	Cum/day	
	Filter Operating hours	20.00	hrs	
	Operating flow	250.00	Cum/hr	
	Filter Loading rate	12.00	Cum/hr/Sq.m	
	Area of the Filter required	20.83	Sq.m	
	No.of Filters	3.00		
	Area of each Filter	6.94	Sq.m	
	Diameter of the Filter Required	3.00	m	
	Heigh of the filter	2.50	m	
	Operating Pressure	3.50	Bar	
	Test Pressure	5.25	Bar	
	Filter Media	Sand &Antracite (Dual Media)		
Provide the Dimension of 3Nos of Pressure Sand Filter as 3 m x Diametre with 2.5m Shell height				
19	**ACTIVATED CARBON FILTER**			
	Average Flow	5000.00	Cum/day	
	Filter Operating hours	20.00	hrs	

	Operating flow	250.00	Cum/hr	
	Filter Loading rate	10.00	Cum/hr/Sq.m	
	Area of the Filter required	25.00	Sq.m	
	No.of Filters	3.00		
	Area of each Filter	8.33	Sq.m	
	Diameter of the Filter Required	3.00	m	
	Height of the filter	2.50	m	
	Operating Pressure	3.50	Bar	
	Test Pressure	5.25	Bar	
	Filter Media	Activated Carbon		
Provide the Dimension of 3Nos of ACTIVATED CARBON FILTER as 3 m x Diametre with 2.5 m Shell height				
20	**FILTER FEED PUMPS**			
	Provide Filter feed pumps of capacity	250.00	Cum/hr	
	Capacity of pump required	69.44	lps	
		0.0694	Cum/Sec	
	Head	30.00	m	
	Efficiency	50	%	
	HP required for pump	55.556	hp	(Q*H*9.81*0.75)/0.5
	Say	60.0	HP	
	Power requirement for the Pump	44.76	Kw	
Provide 2Nos (1W+1S) of Filter Feed Pump of 56HP with a Discharge of 250cum/hr				
21	**TREATED WATER TANK**			

	Hydraulic Retention Time (HRT)	60.00	Minutes	
	Average Flow	208.33	Cum/hr	
	Volume of the tank	208.33	Cum	
	Assumed Liquid Depth	3.00	m	
	Area of the Tank	69.44	Sq.m	
	No . Of Tanks	2.00	Nos	
	Area of Single Tank	34.72		
	Propose a Square Tank			
	Length = Breadth	5.89	m	
	Say	6.00	m	
Provide Filter feed pumps of capacity as 6m x 6 m x 3m SWD + 0.5 m Freeboard				
22	**EFFLUENT CHANNEL**			
	Peak Flow	0.145	Cum/Sec	
	Average Flow	0.06	Cum/Sec	
	Velocity	1.00	m/sec	
	Area at Peak Flow	0.14	Sq.m	
	Area at Average Flow	0.06	Sq.m	
	Assume Width of Channel	0.60	m	
	Depth of Channel required	0.24	m	
	Free Board	0.50	m	
	Total Depth	0.74		
	Say	1.00	m	
	Provide Effluent Channel for Ultimate Capacity	**Provide 0.6 x 1.0m Channel**		
23	**CHECK FOR HYDRUALIC SLOPE**			

a	Hydrualic Radius at Peak Flow, R	0.13	m	Area/Wetted Perimeter
	Velocity	1.00	m/sec	
	Mannings Co-efficient, n	0.013		
	Mannings Formula	V = 1/n*R^2/3*S^1/2		
	Hence Slope, S	0.0025	m	
	Hence Fall in 50m	0.13	m	
24	**DESIGN OF CENTRATE SUMP**			
	Centrate volume	101.72-7.78= 93.94	m^3	
	SWD	2.5	m	
	Area	37.57	m^2	
	HRT	12	hrs	
Provide centrate sump of dimension as 5m x 4m x 2.5m SWD + 0.5 m Freeboard				
25	**QUANTITY OF EFFLUENT/DAY**			
$5000m^3$-101.72 = $4898.28m^3$				
26	**SIZE OFF TRANSFORMER AND GENERATOR**			

Chapter 9

ENVIRONMENTAL ASSESSMENT

9.1 Introduction

The present project is to be implemented to treat the Sewage generated with a treatment plant of capacity 5 MLD for Kerala Water Authority at Elamkulam, Eranakulam. The environmental impact assessment study pertains to the sewage treatment plant proposed.

- **Purpose:** The purpose of impact assessment study is to identify potential adverse and beneficial environmental impacts, and to document the mitigation and monitoring measures that would be incorporated in project to eliminate or minimize the adverse impacts.
- **Scope:** The components of this project include construction of a new sewage treatment plant. The study is based on field surveys, secondary data and design data.

9.2 Description and Need of the project

- **Need for the Project:** The proposed project will provide Sewage Treatment for the households and commercial institutions in and around Elamkulam.
- **Location:** The project location is near to the SahodaranAyyappan (SA Road) and it is approximately 150m away from SA road through Fathima church road. The location is blundered by Chettithara canal on its either sides. The available space of an area of 2.5 acres.
- **Coverage:** The present proposed treatment plant has a capacity of 5 MLD which covers population of 30000 in Ernakulam district.

9.3 Applicable Environmental Regulations

Applicable environmental regulations for proposed project are mentioned in details below

a. Disposal of sewage generated during construction phase will attract the provisions of the Water (Prevention and Control of Pollution) Act, 1974 and requires consents to establish and operate from the Andhra Pradesh Pollution Control Board.
b. Installation of generators and concrete mixture plant by the contractor during the construction stage of the project would require NOC from the Andhra Pradesh Pollution Control Board as per the Air (Prevention and Control of Pollution) Act, 1981.
c. The proposed project in construction phases may attract the provisions of Noise Pollution (Regulation and Control) Rules, 2000 if the noise level from the construction machinery and equipment is high.

9.4 Baseline Environmental Profile

9.4.1 Physical Resources

- **Air Quality:** No major sources of air pollution were identified during the field surveys except for foul gases within the existing STP due to dysfunctional unit. The traffic flow is expected to have some impact on air quality.
- **Noise Levels:** With the existing road carrying traffic passing through busy commercial areas, the noise levels of the region seems to be high.

9.4.2 Ecological Resources

As the project area highly urbanized, presence of wildlife or endogenous species is very unlikely. In addition, within the project area there are no forests, protected areas, costal resources or fisheries.

9.4.3 Economic Development

- **Land Use:** Predominant land use in the project area is outside the CDP.
- **Water Supply:** Water supply in the Sewage Treatment Plant location presently is dependent on ground water
- **Sewerage and Drainage:** Area around STP is partially sewered. The area is served by round surface drains.

- **Transportation:** The site is situated near to SA road and is easily accessible.

- **Electric Power:** Project area falls inside the service area of KSEB.

9.4.4 Environmental and other significant features

There are no significant environmental and other significant features in the location. The land has been identified in the existing STP site premises, which is under the possession of **KWA.**

9.5 Potential Environmental Impacts and Mitigation Measures

The proposed project influences environment in two distinct phases.

- During Construction phase which would be temporary and short term effects;
- During Operation phase which would have long term effects.

9.5.1 Environmental Impacts during Construction Phase

During the construction phase there would be some impacts on air, noise and water quality. Also there would be some impacts on life due to inconvenience caused to public as a result of construction activity.

- **Air quality** impacts are likely from general construction activities including land clearing, trenching, laying of pipes, construction of foundations, handling and transportation of construction and demolition materials, and from wind erosion of open sites and stock pile areas.
- **Noise pollution** will occur from operation of construction equipment including earth moving and material handling equipment.
- **Water quality** impacts may occur from runoff and waste and sewage generated from construction activity.
- **Disposal of excavated soils, road crust, and precipitate from drainage channels** will not pose a problem; however, disposal of silt may require adequate protection.
- **Traffic congestion, lacks of access to buildings and air and noise pollution caused by construction activities** could have some adverse impacts on trade and commerce in the service area.

9.5.2 Environmental Impacts during Operation Phase

During operation period phase the environmental impacts are likely to be positive. However, there could be some adverse impacts due to operation and maintenance or control.

Lack of proper operation and maintenance of the system could cause over flow of sewage and water logging during rainy season, which would be a nuisance and health hazard to public.

Due to lack of control there may be discharge of industrial effluents into the sewer, which can damage the sewer system, or interfere with downstream treatment process or pass through the treatment plant and cause damage to the environment.

There is potential health hazard to workers engaged in sewer maintenance work. These workers are likely to be exposed to toxic gases and hazardous materials present in the sewage and are likely to contract communicable diseases from exposure to pathogens present in the sewage.

9.5.3 Positive Impacts

As a result of providing Sewerage treatment facility, it ensures better sanitation practices and minimizes the groundwater pollution. This would lead to:

- Abatement of nuisance and public health hazard in the service area. Improved sanitary conditions would result in reduction in incidences of parasitic infections, hepatitis and various gastrointestinal diseases including cholera and typhoid which occur either through direct contact with faecal material or contamination of water and food;
- Fewer incidence of disruption of transportation;
- Accelerate economic growth as a result of improved quality of life within the service area.
- Improvement of water quality of of the area; and
- Employment for local people during the construction phase.
- Minimise water and vector borne diseases.

9.5.4 Mitigation Measures - Construction Phase

Following measures are recommended for mitigation or minimizing the environmental impacts that are likely to occur during the construction phase of the proposed project. The contractor under supervision and direction of super vision consultant shall implement these mitigation measures.

a. Provision of Erosion

- Construction will be scheduled so that large areas of soil are not laid bare during monsoon.
- Ground disturbances will be phased so that it is limited to workable size.
- Exposed surface will be resurfaced and stabilized as soon as possible.
- Trenches will have adequate backfill to prevent subsequent street settlement. Upon completion of backfill the surface shall be restored fully to the level that existed prior to the construction of the sewer.

b. Prevention of Dust Nuisance

- On exposed construction surface during dry/windy periods fugitive dust generation will be suppressed by spraying of water or other suitable means.
- Workers working in dust prone areas will be provided with masks and goggles.
- Excavated material transported by trucks will be cover and/or wetted to prevent dust nuisance.

c. Noise and Emission from Vehicles and Construction Activities

- All construction vehicles will be properly maintained and will have valid "Pollution under Control Certificate".
- Noisy construction activities will be carried out only during normal working hours and local residents will be advised of any unusual or unavoidable noise.
- Where feasible sound barrier will be provided in inhabited areas.

- Prevention of Soil, Ground and/or Surface Water Contamination

- Silt after dewatering will be immediately disposed in approved disposal site.
- Excess excavated soil and spoils will be disposed in approved disposal site.

- Prevention of Water Logging / Flooding

d. Prevention of Soil, Ground and/or Surface Water Contamination

- Silt after dewatering will be immediately disposed in approved disposal site.
- Excess excavated soil and spoils will be disposed in approved disposal site.

e. Prevention of Water Logging / Flooding

- De-watering during trenching and water testing of new lines will be regulated in a manner sothat it does not lead to water logging of the nearby area.

f. **Relocation of Utility Services**

- Utility services such as telephone line, electric poles, and water lines etc. That will be impacted by project construction will be identified and prior assistance from concern authorities will be sought to remove, relocate and restore services of these utilities.
- It will be ensured that these utilities are not damaged due to construction activities.

g. Road Safety and Traffic Management during construction

Corporation in coordination with its consultant will prepare a traffic management plan for approval from the concerned authority. The plan will include:

- Measures to be taken to prevent traffic congestion.
- Provision of temporary safe assess to buildings, which will be blocked due to construction.
- Measures to be taken to ensure safety of traffic passing through the construction area including signs, markings flags, lights and flagmen as may be required.

h. Prevention of Accidents and Damage to Property

All necessary precautions will be taken to prevent accidents and damage to property due to construction activity. Measures taken by contactor will include but not limited to:

- Safe execution of construction work.
- Providing adequate health and safety protection to workers.

i. Health and Safety of Workforce

- All the occupational, health and safety requirement for workforce will be adhere to.
- Periodic health check-up of workers will be provided.
- First aid kit will be provided at construction worksite.
- During the plant cleaning operation the tanks will be adequately vented to ensure that no toxic or hazardous gases are present in the line.
- Workers engaged in cleaning of Sewage treatment plant will be provided with proper protection cover including gumboots, rubber gloves and gas masks.

j. Environmental Health and Safety Considerations at Camp Sites and Construction Worksites

- Camps/compounds will be contained by surrounding the site with a bund or earth mound.
- Camp site will be provided with good quality and sufficient quantity of drinking water and sanitation facilities.
- First aid kit and other safety measures will be provided at camp site.
- Solid waste collection and suitable disposal system provided at camp site.
- Appropriate control measures will be taken to prevent insects/vector diseases.

k. Mitigation Measures- Operation Phase

- To alleviate the proper functioning it would be necessary for ULB to undertake continual routine maintenance of the system. Periodic preventive maintenance carried out by ULB would prevent the plant from shut down.
- Periodic monitoring carried out by KSPCB to ensure the quality of treated water and its proper discharge or reuse.

9.6 Environmental Monitoring Plan

Effective implementation of the mitigation measures to mitigate or minimize the environmental impacts would require the project to undertake a comprehensive monitoring programme. The objective of the monitoring programme is to ensure that the construction and operation activities are carried out in an environmentally sensitive and responsible manner, and in accordance with the recommendations of EMP. Recommended monitoring activities of the proposed project is presented in Table 9.1

Table 9.1: Environmental Monitoring Programme of Construction of STP in Elamkulam

Monitoring Category	Type of Monitoring	Minimal Frequency
Construction Phase		
Soils		
Excavation and Back Filling	Monitor adherence to contract specifications	Daily
Erosion	Monitor proper management of excavated soils including timely removed material from project site	Monthly
Surface and Ground Water Quality		
Surface runoff management	Monitor measures to channelize surface runoff	Daily
Contamination from waste and sewage generated from construction activities	Monitor measures taken to prevent contamination of ground and/or surface water from waste and sewage generated from construction activities	Daily
Air/Noise Pollution		
Dust emission during site preparation, excavation	Monitor adequacy of dust suppression measures undertaken	Daily
Storage and transportation of construction materials, excavated soil and silt	Monitor adequacy of measures undertaken to prevent fugitive measures	Daily

Noise and emissions from construction vehicles	Monitor 'Pollution under Control' certificate are current for construction vehicles.	Quarterly
Noise pollution from construction activities	Monitor preventive measures being implemented to curb noise.	Daily
Solid Waste		
Disposal of excavated soil and silt	Monitor to ensure excavated soil and silt are being disposed in approved sites	Weekly
Health and safety of construction workforce		
Health and Safety Requirements	Monitor adherence to all occupational and safety requirements	Weekly
Health Checkup of workers	Monitor adequacy of health checkup services provided including attendance of the physician retained and the extent to which the workforce is availing this service	Monthly
Maintenance of Health and Safety records of work force	Review and monitor health and safety records to ensure all project related accidents are being properly investigated and reported	Monthly
Sanitary conditions of construction campsite	Monitor provisions of shelter, water supply, excreta and solid waste management at campsite	Monthly

Road Safety and Traffic Management		
Traffic Management Plan	Obtain approval to traffic management plan from concerned authority	
Review road safety records	Review and monitor road safety records to ensure all projects related road accidents are being properly investigated and reported	Fortnightly
Community Life and Economic Activities		
Access to public and private properties	Monitoring impacts of project on dwelling and business in the project area	Daily
Hardship and inconvenience to public and business	Monitor to ensure that communities and business face minimal hardship and inconvenience due to construction activities	Weekly
Operation Phase		
Regular Maintenance of Sewage treatment plant	Monitor to ensure that enough quantity of feed is made available for the plant to work continuously	Weekly
Discharge of treated wastewater and dried sludge	Monitor discharge of treated water and sludge and review of consent to operate forms submitted to the KSPCB	On-going Monthly

As mentioned in the above table monitoring programme would be strictly implemented to avoid any adverse impacts on surrounding environment due to project activity. Also during construction activity periodically air and noise quality monitoring shall be carried out near the sensitive locations to ensure the pollution status in the service area.

9.7 Conclusion

From the earlier sections it is conclude that the project is not expected to cause any long term irreversible environmental impact. Most of the environmental impacts that are likely will occur for a short duration during the construction phase of the project. Adequate preventive measures have been incorporated to mitigate or minimize these impacts. The project upon completion would realize several positive impacts, most significant of which being reduction of public health hazard as result of improved sanitation conditions in the service area.

Chapter 10
SIZING OF THE STP UNITS

Table 10.1: Details of Various STP Units

SI NO	COMPONENT	Capacity/Sizing	Nos.	MOC
A	**CONVEYANCE SYSTEM**			
1	Collection system	Laying 120m , 2Nos of 600 K9 DI pipe pumping main to the new Receiving Chamber	1 set	DI Pipe K9
B	**CIVIL WORKS - STP**			
1	Receiving Chamber	2.50x1.50x2.50 m	1	RCC
2	Mechanical Coarse Screen channel	4.00x0.45x1.00 m	1	RCC
3	Mechanical Fine Screen channel	4.00x0.45x1.00 m	1	RCC
4	Manual Coarse Screen channel	3.70x0.41x1.00 m	1	RCC
5	Grit Separator	3.65 x 3.65 x 1.20 m	1	RCC
6	Parshall Flume	3.0 m x 0.83 x 0.38m x 1.20m	1	RCC
6	Anox Equalisation Tank	14.5m Dia X 4.5m	2	RCC
7	Moving Bed Bio Reactor (MBBR)	9m Dia X 4.5m	2	RCC

8	Secondary clarifier	14m Dia X4.0m	1	RCC
9	Sludge sump	3.75m Dia X 2.5m	1	RCC
10	Sludge Thickener	6.2m Dia X 3.5m	1	RCC/MS
11	Secondary Treated water sump	6.0m x 6.0 x 3.5m	1	RCC
12	Tertiary treated water sump ((Chlorine contact tank))	6.0m x 6.0 x 3.5m	1	RCC
13	Pump Houses (Pre-fabricated)	2.0m x 2.0m x 3.0m	3	RCC
14	Sludge Yard	4.0m x 6.0m x 4.0 m	1	RCC
15	Centrifuge Shed	4.0m x 6.0m x 6.0 m	1	RCC
16	Control Room	4.0m x 6.0m x 4.0 m	1	RCC
17	Generator Basement	4.0m x 3.0m	1	RCC
18	Chemical Dosing Room	4.0m x 3.0m x 4.0m	1	RCC
19	Centrate Sump	1.5m Dia x 2.5m	1	RCC
20	Substation Control Panel Room	10.0m x 4.0m x 3.50m	1	RCC
21	Office Building	22.0m x 11.0m x 10.0m	1	RCC
C	**ELECTRO-MECHANICAL WORKS STP**			
1	Mixing Equipment	4HP (1W+1SB)	2	

2	Sewage Transfer Pump (Pumping to MBBR)	23HP (2W+1SB)	2	Submersible CI IS 210 Gr. FG 260
3	Mechanically operated screen	1 No to suit the channel size, (70degree)	1	SS 304 Clear opening 20 & 6 mm.
4	Manually operated screen	1 No to suit the channel size, (70degree)	1	SS 304 Clear opening 20 mm.
5	SS Gates	LOT		SS 304
6	Air Grid and diffusers for ET, MBBRs and sludge sump	LOT		PVC
7	MBBR Media	LOT		PVC/HDPE
8	Air Blowers	50 KW; 1800cum/hr	2	Type : Positive dis placement (Twin Lobe type) MOC : C.I.IS 210 Gr. FG 260 MOC : S.S
9	Thickener Feed Pump (Pumping to Thickener)	1.25HP (1W+1SB)	2	Submersible CI IS 210 Gr. FG 260
10	Centrifuge/Filter Press Feed Pump (Pumping to Thickener)	1.0HP (1W+1SB)	2	Submersible CI IS 210 Gr. FG 260
11	Sludge Centrifuge	0.84Cum/hr	2	

12	Filter feed pump (PSF & ACF)	56 HP	2	CI Wetted parts in SS304, Mono-block
13	PSF (Dual Media)	3.0m dia 2.50m high	3	MS/PP with butterfly valves
14	ACF	3.0m dia 2.50m high	1	MS/PP with butterfly valves
15	Jetting / Cleaning Machine		1	High Pressure pump
16	Generator	250KVA	1	
17	Transformer	250KVA	1	Indoor Type
18	Chlorinator	Elecro type chlorinator or similar equipments of capacity 500gm/hr dosing		

Table 10.2: Load Requirement

Sl No.	Component	Power Requirement		Type	Make
		Working	Standby		
1.	Mixing Equipment	4 HP	-		
2.	Sewage Transfer Pump	46 HP	23 HP	Submersible	
3.	Air Blower	50 HP	25 HP	Twin Lobe	
4.	Thickener Feed Pump	1.25 HP	1.25 HP	Screw	
5.	Centrifuge Feed Pump	1 HP	1 HP	Screw	
6.	Filter Feed Pump	56 HP	56 HP	CF-mono lob	KIRLOSKAR /CROMPTON /Equivalent
7.	Lifting	7.5 HP	-	-	
Total		165.75 HP	106.25 HP		

Chapter 11

COSTING

Table 11.1: General Abstract

ABSTRACT OF ESTIMATE FOR 5MLD STP AT ELAMKULAM, KOCHI		
A	COLLECTION SYSTEM	
1	Extention of 600m DI Pumping Mains	8930000
	SUB TOTAL	8930000
B	PILING	
1	Pile Foundations for Civil Tanks	38270000
	SUB TOTAL	38270000
B	STP CIVIL WORKS	
1	Site Clearing, Levelling & Shifting of Materials	1632000
2	Receiving Chamber, Screen Channel & Grit Chamber	2386000
3	Equalisation Tank	6780000
4	MBBR - 01	2410000
5	MBBR - 02	2410000
6	Clarifier	5738000
7	Sludge Sump	500000
8	Sludge Thickener	1230000
9	Thickened Sludge Sump	500000
10	Filter Feed Tank	1650000
11	Treated Water Tank	1650000
12	Centrate Sump	336000
13	Treated Water Channel	267000
14	Sludge Storage Yard	811000
15	Transformer Housing, Control Room & Laboratory Building	4300000
16	Centrifuge Building	2130000
17	Filter & Generator Foundations	2713000
18	Pump House (4Nos)	788000
19	Internal Roads, Walkways & Storm Water Drain	5748000
17	Landscaping	767000
	SUB TOTAL	43979000
C	MECHANICAL WORKS	
1	STP Equipments wit plant Piping	22900000
	SUB TOTAL	22900000
D	ELETRICAL WORKS	
1	STP Electricals work	11000000
	SUB TOTAL	11000000
E	FURNITURES & LABORATORY ITEMS	500000
	TOTAL (A+B+C+D+E)	125579000

Chapter 12

OPERATION & MAINTENANCE

TENTATIVE COST

Table 12.1: Operation and Maintenance Estimate

PROCESS DESIGN OF 5MLD SEWAGE TREATMENT PLANT FOR KWA , KOCHI				
Operation and Maintenance Estimate				
Sl. No.	Description			Expenditure (Rs)
A.	Power Charges			
a.	Power charges @ Rs. 5 for KWh @ 121.5KWH working at 10hrs a day.			1,82,250
	Total			**1,82,250**
* The rate may fluctuate according to the actual usage of plant and variation in KSEB rates				
B.	Staffs for Operation			
a.	Operators	3	20,000	60,000
b.	Assistant Operator	3	15,000	45,000
c.	General Duty Fitter	3	20,000	60,000
	Sub Total			**1,65,000**
C.	Fuel For Generator (Working Half load 29litres @ 60rs/litr approximately 10hrs a month)			17,400

D.	Cost of miscellaneous materials including chemicals, spare parts & lubricants			
a.	Gas Chlorine (300kg @ Rs.20/kg			6,000
b.	Poly Electrolyte Dose (60kg @ Rs.190/kg)			11,400
c.	Spares, Lubricants & Replacements			10,000
	Sub Total			**27,400**
	Grand Total Per Month			**3,92,050**
	Annual Operation & Maintenance Charge			**47,05,000**
	Treatment Cost per day			**12,890**
	Unit Cost of Treatment per Kilo Liter			**2.58**
5 Years Annual O&M Cost considering 10% annual increase each year				
1.	First Year			47,05,000
2.	Second Year			5175500
3.	Third Year			5693050
4.	Fourth Year			6262355
5.	Fifth Year			6888591
6.	**Grand Total for 5years O&M**			**28,720,000**

Chapter 11

CONCLUSION

The estimated cost for the new proposed 5MLD STP including an Office Building worked out to be **Rs. 12,55,79,000 (Rupees Twelve Crore Fifty Five Lakhs Seventy Nine Thousand Only).** Annual maintenance cost worked out to be **Rs. 47,05,000 (Rupees Forty Seven Lakhs Five Thousand Only)**. It is proposed that the STP Contractor shall maintain the same for a period of 5years. The overall cost of the proposal is worked out to be **Rs 2,87,20,000 (Two Crore Eighty Seven Lakhs Twenty Thousand Only)**

The proposed project will facilitate the mitigation of the present water pollution at least partially. On commissioning the scheme can showcase then necessity for STPs in cities and remove the existing perception among the general public against STPs. Cleaner environment will ultimately improve quality of the life of the citizen.