Evaluating and Maintaining the Decentralized Wastewater Treatment system at Sowl Kere

1. Context

1.1 Background

Sowl Kere is spread across an area of 61 acres in Kaikondrahalli, towards the South-East of Bengaluru. Stormwater is the source of water for this lake. The lake holds very little water and is largely dry for most of the year. An attempt was made to increase the inflow to the lake all through the year by directing wastewater from the diversion drain into the lake after passing through an STP.

Fig 1: View of Sowl Kere from the eastern bank (15 Feb 2022)

Fig 2: Sowl Kere Lake Map

(Note: In the map, N - naala and I - Inlet as corresponding with the legend)

1.2 Decentralized Wastewater Treatment System (DTS)

A natural, self-sustaining and zero/low maintenance STP - Decentralized Wastewater Treatment System (DTS) - was designed and implemented by Eco Paradigm through CSR funding in 2016. This system was designed to treat 100 KLD of sewage from the Eastern diversion drain. A culvert was built to get the water to the lakeside at I2 (see Fig 2) from the diversion drain. Post the treatment, treated wastewater first entered the wetland area and then the water spread area.

Fig 3: The Decentralized Wastewater Treatment System

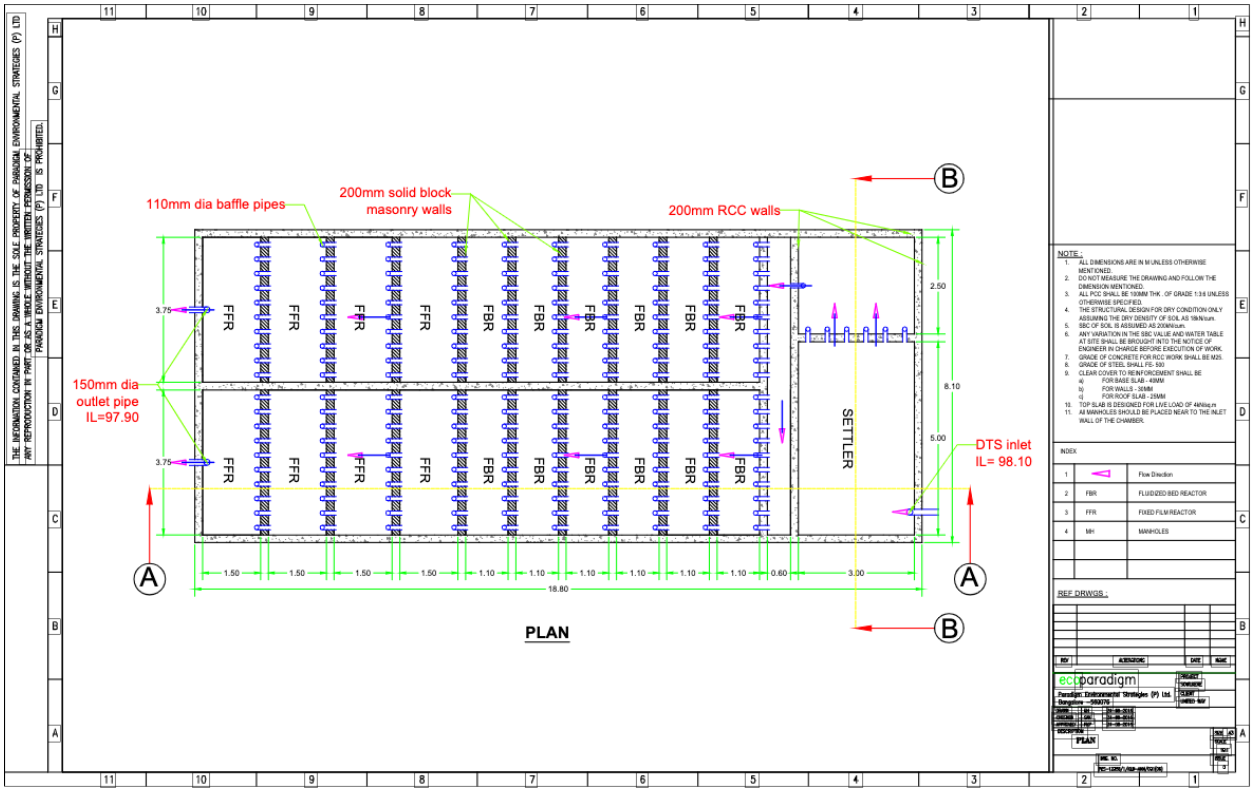

Fig 4: 100 KLD DTS system design

1.3 Status of the Lake as of 2021

The lake continued to remain largely dry even after four years of the STP's functioning. With the designed capacity of the 100KLD DTS, at least some inflows were expected into the lake during the dry season which would result in the presence of some water or moisture adjacent to the DTS system

1.4 Genesis of the proposal to BSF

In 2021, MAPSAS decided to re-evaluate the STP's effectiveness. To investigate the quality and quantity of inflow and outflow of the STP, a proposal was submitted to Bengaluru Sustainability Forum (BSF).

The initiative focused on addressing the following;

- To maintain the STP at an optimum level of functioning.
- To enhance the effectiveness and efficiency of the STP.
- To figure out the quantum of water that can pass through this STP.
- To ensure that the quality of water entering the lake is 'life sustaining'.
- To examine if the second stream could also be directed into this STP.

2. Tasks undertaken

The STP was cleaned and the inlet/outlet piping was revamped in Feb 2022. Output water quality and flow were tested to assess the STP's effectiveness as well. More details are as below.

2.1 Cleaning the Manhole connecting the diversion drain to the culvert

A manhole helps direct water from the eastern diversion drain to the STP through a culvert (marked in Fig 2 near the STP). Accumulated sludge and solid waste were cleaned from this manhole to maintain proper flow.

Fig 5: Manhole after cleaning

2.2 Cleaning and repair of the Inlet to the DTS

The inlet opening in front of the DTS was clogged and its cement lid was broken. This was unclogged and a stronger FRP (Fibre-reinforced Polymer) lid was used to cover it.

Fig 6: Broken inlet before intervention

Fig 7: Inlet unclogged (left) and FRP sheet top lid for the inlet (right)

2.3 Cleaning the DTS

There are 24 manholes to access different parts of the DTS, whose lids were cemented shut for safety reasons. All these manholes were broken open and cleaned thoroughly which ensured that all parts of the STP were cleaned.
Once cleaned all the manholes were cemented back to close them.

Cleaning involved desludging and removal of solid waste. Six tankers of sludge mixed with some amount of solid waste were removed. The cost of removal and transport for each tanker was Rs 16,000. The sludge was to be taken to Anekal, where the plastics were to be separated out and the sludge distributed to farmers. We assume that this would have been carried out responsibly.

Fig 8: Sludge removal from the DTS

Fig 9: Manholes filled with plastic and sludge

2.4 Revamping the outlet pipeline

There are two outlet pipes from the STP. When it was initially set up, the two outlets were combined together into one and then led into the wetland. This caused a lot of blockage issues due to multiple turns in the pipeline. Also, any solids coming from one pipe (due to some malfunction in one part of the STP) could accumulate and cause blockages in the other pipe as well.
To ensure a smoother flow, this was remedied by separating the two pipes and letting them open directly into the wetland area. (see Fig 11)

Apart from this, the pipes had to be better supported at the bottom to avoid bending/breaking caused by the weight of the water passing through them. This was achieved by packing soil beneath the pipes. Soil was also laid on top of the pipes to cover them. This was done to avoid damages due to any impact from the top.

Fig 10: Pipeline supported and covered with soil

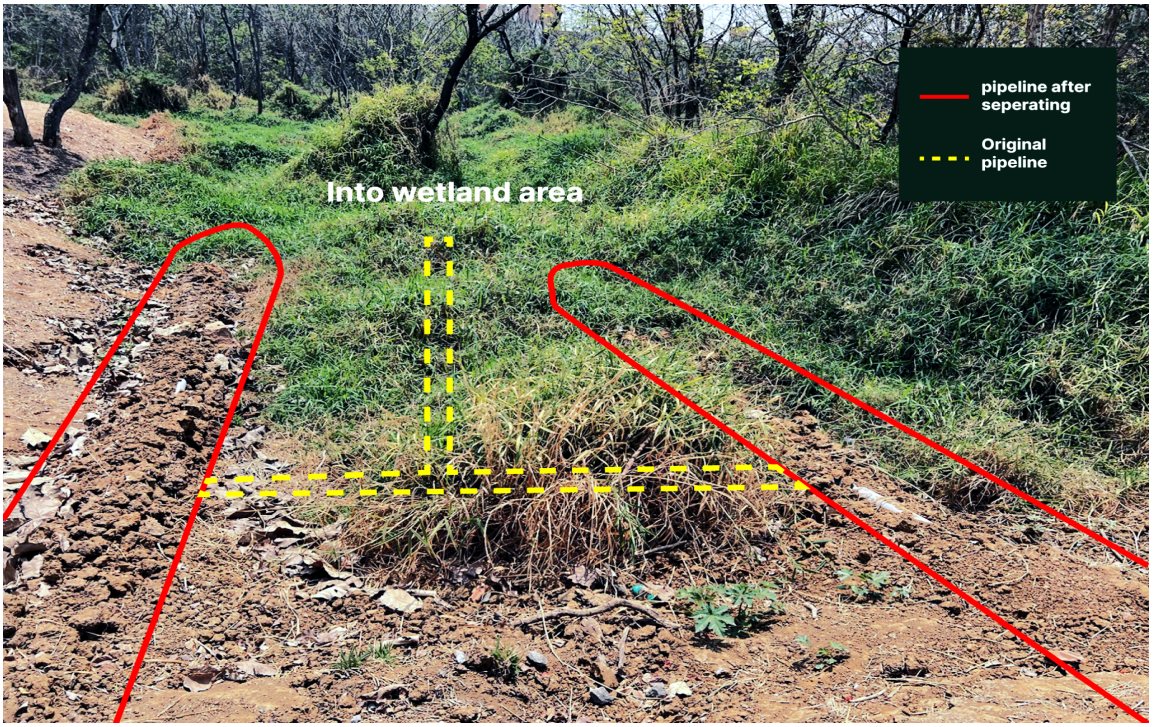

Fig 11: pipeline structure before and after intervention

2.5 Assessing the quality and quantity of water

After all the maintenance activities and enhancements to the system were completed, the input flow rate of the STP was measured. The highest input flow rate of the system was estimated to be approximately 45 KLD, which is well below the capacity of the STP.

The microbial population is the driving engine of this STP and it has been observed that the system can work optimally even with zero inflow for at least 3 to 4 months. Hence, the reduced inflow rate is not expected to affect the optimal functioning of the DTS.

The perceived quality of the outlet water was clear and odourless. The lab report can be found in Fig 13.

Fig 12: Water from the outlet

Parameters	Unit	Acceptable limits	Before maintenance (7/2/22)	After maintenance (2/3/22)		Comments on the Acceptable limits
			From Outlet	From Inlet	From Outlet	
pH		6.5-8.5	6.8	6.2	7.25	
Oxygen reduction Potential (ORP)	mV	300-500	-332	-354	-298	DTS, being an anaerobic system, will have a negative value for ORP at its outlet. This can be corrected by tertiary treatment (wetland in this case) - Ref
Total Dissolved Solids (TDS)	mg/l	< 1500	118	709	81	For class C (drinking water with conventional treatment) - Ref
Total Suspended Solids (TSS)	mg/l	< 100	57	220	32	For discharge into coastal waters - Ref
Turbidity	FAU	< 5	69	158	28	For drinking water - Ref
Dissolved Oxygen (DO)	mg/l	> 4	3.1	2.8	5.8	Ref

Fig 13: Water test report

As seen in Fig 13, there is a significant improvement in the outlet water quality after the

maintenance activities for the STP were carried out. This points to the importance of the prescribed frequency (once every year) of maintenance for the system.

2.6 Marking Pipeline

Marking the location of the pipes that were covered with soil was necessary to help identify their location for future maintenance. This was also done to avoid any damages to the concealed pipes that might occur due to other work undertaken in the area. Pipes with painted tops were used as markers along the length of the concealed piping at regular intervals to identify the location.

Fig 14: Pipe markers along pipeline

3. Outcome

The project was meant to demonstrate the effectiveness of a self-sustaining and low-maintenance STP that is capable of treating wastewater from various sources in the city and making it life-sustaining for lakes. The DTS that was designed and installed by Eco Paradigm serves this purpose well by treating 100 KLD of water in one step.

The outcome of the maintenance activity has resulted in satisfactorily clean water with an increased flow rate (see Fig 13 and Fig 14).

Paradigm Environmental Strategies Ltd		
Inspection plan/Report	**Report No.**	**Date**
	1	**02-02-2022**

Project No.			
Project title	Sowl Kere	**Capacity**	
Location	Bengaluru, Karnataka		
Date of Visit	07/02/2022 ,08/02/22, 02/03/2022		
Stage of inspection / verification	Maintenance		
Inspection carried out by Name / signature	Sarath S		

Work carried out

- Desludging of all chambers is done as per Operation Maintenance Manual
- Inlet chamber is cleaned and cleared of debris and silt
- Two numbers of PVC Outlet pipe 150mm of 9m each laid
- 900mm square new manhole cover fixed for Inlet chamber

  The maintenance was started from 08/02/2022 to 02/03/2022
- Flow check has been carried out before and after maintenance

  Before maintenance on 08/02/2022 – 1KLD

  After maintenance on 02/03/2022 – 45 KLD

Kindly note all the incoming sewage from the main line is diverted to the DTS Bio STP after the maintenance

Fig 14: Inspection report

4. Learnings and Future Steps

4.1 Learnings

4.1.1 Maintenance Frequency

Like many other STP systems, minimum maintenance is required once every year to clear out the sludge under ideal conditions.

4.1.2 Regular maintenance of the inlets

Since the DTS is designed to handle only sewage and not other solid waste, regular cleaning and general maintenance of the inlet system will have to be undertaken based on its design. In this case, for example, the solid waste trap and the inlet manhole (mentioned in section 2.1) need to be cleaned and the inlet pipeline maintained regularly.

4.1.3 Sludge and solid waste disposals

Identifying organizations/farmers/vendors to whom the sludge from the STP can be sent is essential. A closer end destination should be preferred. It is also useful to identify organizations that can ensure segregation of the inorganic waste from the sludge (if present) and handle it responsibly.

4.1.4 Raising awareness

People's actions like littering, flushing solid wastes down the toilet, improperly handling solid waste, using harmful chemicals etc directly affects the quality of the lake water. Organizing various awareness programmes can help sensitize locals about the impact of their actions in the lake catchment area. Displaying this information in creative ways on the lake premises can also help in this regard.

4.1.5 Solutions to access the DTS's manholes easily

Currently, the 24 manholes on top of the DTS need to be broken open and cemented back to close them. Since at a minimum, desludging is essential at least once a year, this can be very inconvenient and resource extractive. A lid that could be opened and closed easily would help access the DTS better. This could be a conventional cement lid, an iron lid or an FRP lid similar to the one mentioned in section 2.2.

4.1.6 Safeguarding piping

The STP installed in Sowl Kere is located in an area that is frequented by the general public and other animals and birds. Hence, it is important to keep the piping away from harm and well

supported. A simple solution that was implemented here used soil to pack under the pipes to ensure good support. Soil was also used to cover the pipes from above for their protection.

4.1.7 Marking pipes

Marking covered pipes could help identify their location for future maintenance. This would also avoid any damages that might occur due to other work undertaken in the area. Placeholders like flags, pipes and stones with appropriate labels/markers could be placed along the length of the piping at regular intervals. Marking this on the information board would also be required.

4.1.8 Avoiding or minimising bends in piping

Since effluent rich water is constantly passing through the pipes it is advised to avoid or at least minimize the number of bends in the piping system to avoid blockages.

4.2 Future Steps

The DEWATS system that was installed in Sowl Kere to treat sewage from the eastern diversion drain has served its primary purpose but, it needs some additional consideration and components for the model to be successfully replicated. These are listed below.

4.2.1 Polishing pond / Reed Bed

Since the DTS does not include any tertiary treatment, the TSS values are still quite high. It was recommended (by Eco Paradigm) that a polishing pond or a reed bed be used to correct this issue. Currently, the wetland area might be of some help in this regard. Water testing beyond the wetland area could help determine the need for such a system.

4.2.2 Information board

An Information board explaining the STP system's basic function and design would be helpful to the visitors to the lake. This can include information to raise awareness about the lakes in the city as well as any references that would help replicate the system in other areas.

4.2.3 Solid waste trap

Before sewage can enter the system, a simple trap in the form of a grill/mesh would be useful near the eastern inlet. This can trap any inorganic waste (like plastics that could mix with sewage) from entering the system; hence increasing its efficiency. Inorganic waste thus trapped should be cleared regularly to maintain a smooth flow.
Identifying companies/vendors that can handle this waste and are close by would be useful.

4.2.4 Utilization of Sludge

The environmental impact of the DTS could be made more effective by exploring options for utilizing the sludge produced by the system in situ or in someplace as close to the DTS as possible. For example, some of this sludge could be used as fertilizer for the trees around the lake. The logistics of space to dry and sort the sludge will need to be considered while deciding on the place for the application of the sludge.

4.2.5 Utilization of Biogas

Apart from the sludge, the DTS also produces biogas as a by-product of its operation. Based on its quality and quantity, options to utilize this can also be explored. Some testing of the gas is required to determine its potential purpose.

4.2.6 Metering

Metering would help monitor flow at the inlet and the outlet of the system. Flow meters at the outlet would also help determine the presence of blockages in the system. Special effluent flow meters would be necessary for this. These can be expensive and liable to theft in public places. Based on the scale of the STP the cost would need to be evaluated and appropriately decided.