CONCEPT NOTE; A CONSTRUCTED WETLAND TO MINIMIZE THE POLLUTION CAUSED BY KARADIYANA SOLID WASTE DUMP

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INTRODUCTION

Municipal solid waste (MSW) consists of different organic and inorganic fractions like food, vegetables, paper, wood, plastics, glass, metal, construction debris etc. MSW has a considerable impact on ecosystems, and poses threats to human health and well-being. Waste also threatens the integrity of habitats that are essential to biological diversity. Uncontrolled open dumping of MSW in environmentally sensitive places, due to non-availability of required investment to construct and operate engineered solid waste management processes, is causing a considerable damage to the environment, specifically to neighbouring natural water sources. Karadiyana solid waste dump, situated in Thumbovila Village close to Piliyandala, is a perfect example for this.

Two Municipal Councils and two Urban Councils dump their daily collection of MSW at the Karadiyana dump site occupying 25 acres of land. A substantial portion of leachate generated by the dumped MSW flows directly to a stream which bisects the dump site as depicted in Figure 1 and the rest infiltrates in to the ground polluting the ground water. This stream flows directly to Weras Ganga, which is a tributary of Bolgoda Lake, presumed to be the largest natural lake in Sri Lanka. The Bolgoda Lake has an eco system, which is rich in bio diversity. Leachate originating from the dump site thus ends up in the Bolgoda Lake endangering this eco system thereby threatening the livelihood of the community depending on the leisure industry, fishing and all other activities associated with the lake.

Plans to establish a composting plant and to generate power utilizing MSW are in the pipeline. However, the pollution caused by leachate goes unabated. This study presents a low cost solution to improve the effluent quality of stream water by passing contaminated water of the stream through a constructed wetland to reduce the levels of pollutants.

PROBLEM IDENTIFICATION

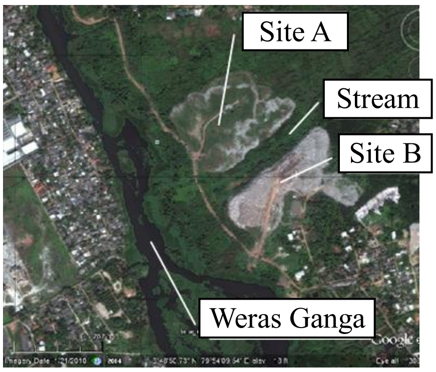

Figure 1 – Ariel view of the site

Operated initially by a private company, unsorted MSW had been dumped on a flat land without proper mechanisms to prevent mixing of generated leachate with surface and ground water. No control other than covering the waste with soil from time to time to minimize the smell and to reduce the nuisance caused by disease vectors had been done. Conditions have improved since the current operator of the site, Waste Management Authority (WMA), has taken over the operations of the site. They have sub-divided the site into several cells and the dumping takes place in a controlled sequence. Licensed operators are permitted to collect recyclable waste like plastic bottles, glass, scrap metal etc. which reduces the amount of non bio-degradable waste.

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However, part of leachate generated by the MSW infiltrates in to the ground and the remainder flows to the stream and no measures have been taken to contain the pollution caused by leachate. Ideally, at the initial stage before dumping MSW, an impervious barrier should have been provided to prevent contamination of ground water from infiltrated leachate. Now, that MSW has been dumped up to 10m high in some locations, it is almost impossible to completely contain the infiltration of leachate to ground water. However, measures can be taken to minimize the contamination of surface water and to reduce the degree of leachate infiltration.

METHODOLOGY

A "constructed wetland" is proposed as the solution which requires a nominal cost to construct and utilizes natural materials available from the vicinity to remove pollutants through a biological process without consuming expensive energy.

Logic used in the study methodology

"Constructed wetlands are either free water surface systems (FWS) with shallow water depths or subsurface flow systems (SFS) with water flowing laterally through sand or gravel. Water hyacinth (Eichhornia crassipes) has been studied extensively for use in improving the wastewater effluent from oxidation ponds and as the major component in an integrated, advanced wastewater treatment system. The major characteristics of water hyacinths that make them an attractive biological support media for bacteria are their extensive root system and rapid growth rate" (Design Manual, 1998).

Water hyacinth, ranked as one of the world's worst invasive water weeds, could be put to good use due to the above mentioned properties under a controlled constructed wetland system. Bacteria attached to plant roots, stems and leaf litter are the major factors for BOD_5 removal. FWS system is the suitable constructed wetland system to make best use of this advantage.

Treatment process proposed for the stream water contaminated with leachate is shown in Figure 2.

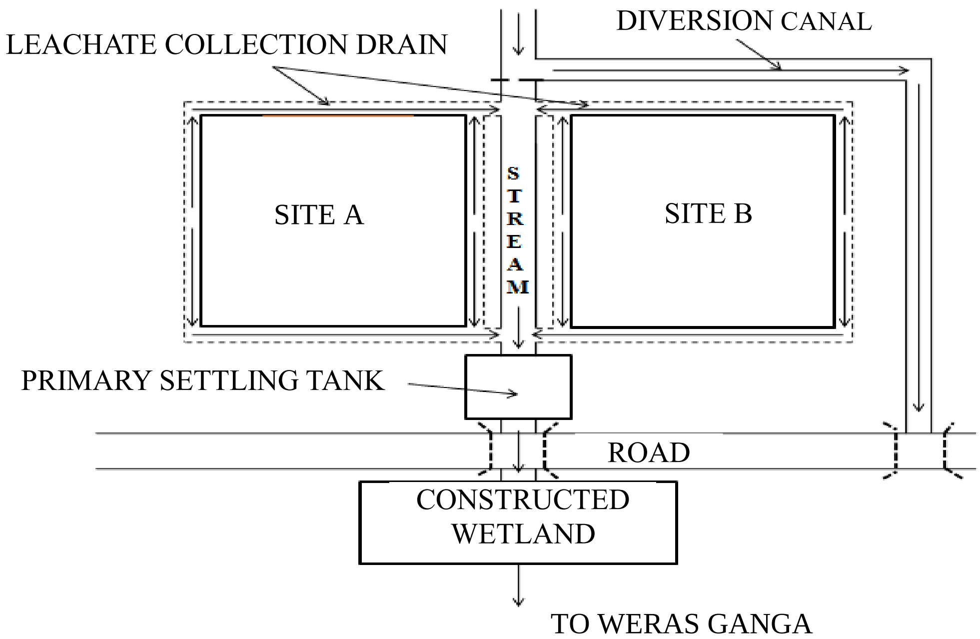

Figure 2 – Proposed treatment process

Proposed Treatment Process

1. Construct a weir on the upstream side of the stream and a diversion canal to regulate the flow of water through the stream so that the flow through the stream is constant throughout the year. Excess water will flow directly to Weras Ganga through the diversion canal without coming into contact with leachate.
2. Construct surface drains around the two sites to collect as much leachate as possible to minimize the infiltration.
3. Send the stream water mixed with leachate through the primary settling tank to reduce the load of Total Suspended Solids (TSS). This improves the efficiency of the constructed wetland.
4. Scrape off the settled solids in the primary settling tank from time to time and dispose together with MSW to recycle.
5. Send the effluent from the primary settling tank through the constructed wetland (Figure 3).
6. Send the effluent from the constructed wetland to Weras Ganga.

Length of the constructed wetland is governed by the available distance between the road and the Weras Ganga which is approximately 80m. Hydraulic loading rate was evaluated to match this constraint in order to have the required levels of pollutants in the effluent and the design required five fully vegetated FWS cells. Step feeding method was employed to maximize the efficiency (Design Manual, 1988) since the pollutant removal percentage is higher within the initial part of the wetland. Recycling was not considered to minimize initial and operating costs of the process. Design process of the proposed constructed wetland (Deepika, 2012) is not covered here due to space limitations.

RESULTS AND DISCUSSION

Table 1 indicates the current levels of pollutants present in the stream water obtained from laboratory tests, corresponding values of pollutants after going through the proposed treatment process (Design Manual, 1988) and the maximum tolerance limit of each pollutant type (Technical Guidelines, 1990).

Table 1 – Levels of Pollutants

Pollutant Type	Current Pollutant Level	Pollutant Level after Treatment	Maximum Tolerance Limit
Biochemical Oxygen Demand - BOD_5 (mg/l)	171	30	30
Total Suspended Solids – TSS (mg/l)	448	50	50
pH value	7.3	7.3	6.0 to 8.5
Chemical Oxygen Demand – COD (mg/l)	497	247	250
Chromium – Cr (mg/l)	0	0	0.1
Copper – Cu (mg/l)	0.01	0.0025	3.0
Lead – Pb (mg/l)	0	0	0.1
Nickel – Ni (mg/l)	0.015	0.00375	3.0
Zinc – Zn (mg/l)	0.045	0.011	5.0

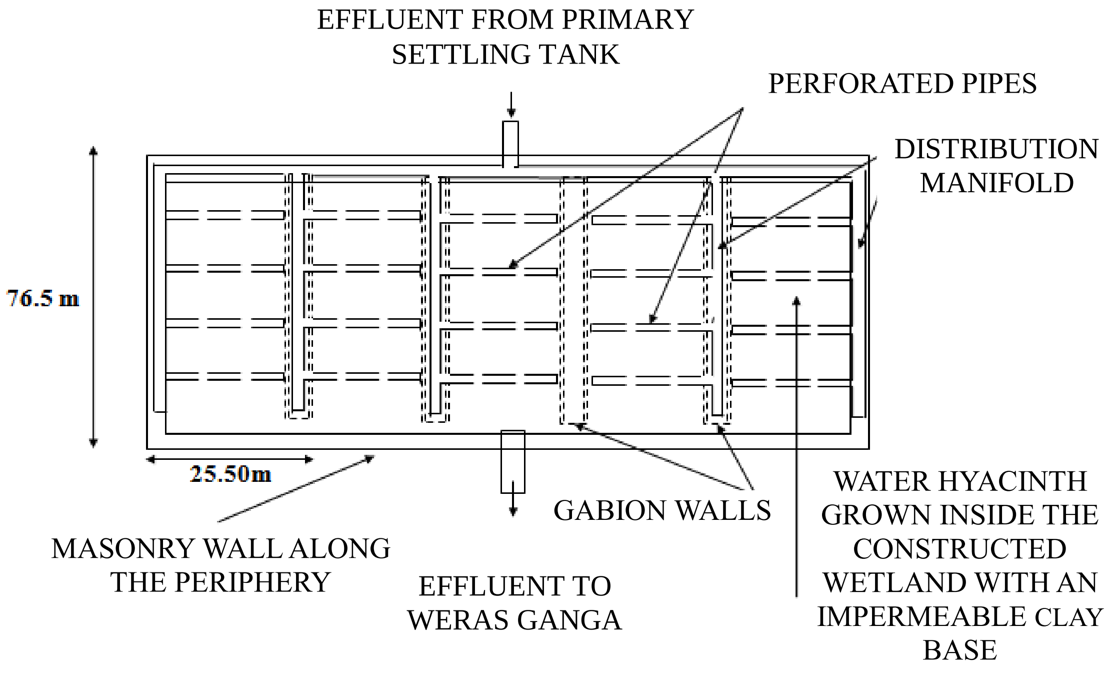

Figure 3 – Constructed wetland

CONCLUSIONS/RECOMMENDATIONS

It can clearly be seen that the levels of all the pollutants of the effluent discharged to the Weras Ganga after the treatment process would decrease to levels much lower than the tolerance limits specified by the Central Environmental Authority (Technical Guidelines, 1990). The process would drastically reduce the levels of BOD_5, TSS and COD to within acceptable limits.

This illustrates that a vast change could be achieved even without going for "concrete and steel' alternatives with sophisticated treatment processes requiring substantial investments and high operating costs due to increasing energy prices.

REFERENCES

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