



# Natural Wastewater Treatment in Cuenca, Ecuador

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## Introduction

The Churuguzo Wastewater Treatment Plant in Cuenca, Ecuador serves approximately 500 people in an area of 100 hectares. The site currently uses a septic tank as primary treatment followed by a constructed wetland of *Schoenoplectus californicus* as secondary treatment. However, due to a high level of pathogens, the final effluent does not meet the standards for discharge.

## Objectives

The goal of this project is to design an all-natural disinfection system to add to a decentralized wastewater treatment plant in Cuenca, Ecuador. The current discharge from the system does not meet Ecuadorian standards for discharge into freshwater bodies due to the high content of bacteria.

## Methods

We developed a variety of potential solutions after a comprehensive literature review. Preliminary designs were presented to ETAPA, our client, and we collaborated with the students of the University of Cuenca to design a final comprehensive design that is cohesive with the current system.

## Design Specifications

Hydraulic Loading Rate	2.5 m <sup>3</sup> /m <sup>2</sup> per day
Daily Flow Rate	86.4 m <sup>3</sup> /day
Tank Dimensions	3.8 m diameter 1 m height
Tank Surface Area	11.52 m <sup>2</sup> surface area

## Design Solution

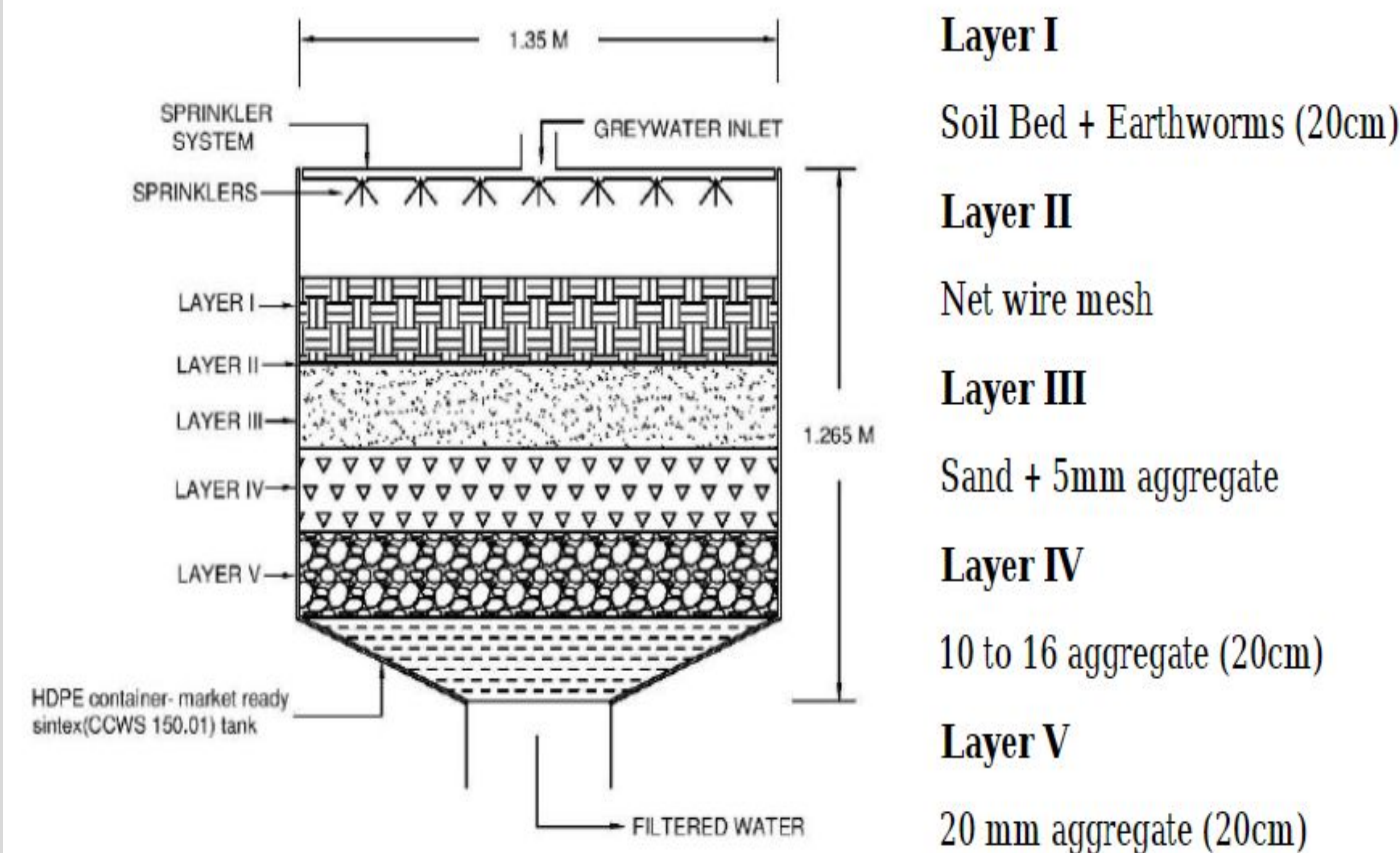
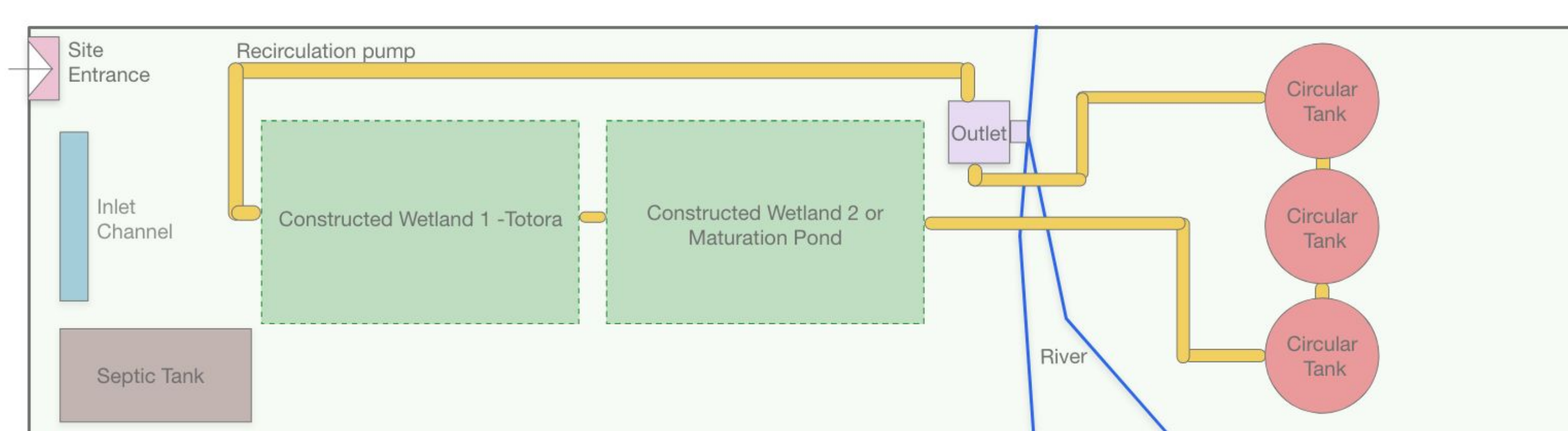


Figure 2. Schematic Diagram of Vermifilter showing different layers

The implementation of 3 vermifilter tanks composed of sand, gravel, and earthworm layers in addition to recirculation of the effluent will allow for sufficient disinfection. The worms will require a wet and dry period, typically 1 hr wet and 3 hr dry. This final recommendation will provide low-cost and chemical free treatment for the water.

## Proposed Site Diagram



## Sources

Arora, S., Rajpal, A., Bhargava, R., Pruthi, V., Bhatia, A., & Kazmi, A. (2014). Antibacterial and enzymatic activity of microbial community during wastewater treatment by pilot scale vermifiltration system. *Bioresource Technology*, 166, 132–141. doi: 10.1016/j.biortech.2014.05.041

Guruprasad, A. (2015). Design and Suitability of Modular Vermifilter for Domestic Sewage Treatment. 3, 44-51.

Kumar, T., Rajpal, A., Bhargava, R., & Prasad, K. H. (2014). Performance evaluation of vermifilter at different hydraulic loading rate using river bed material. *Ecological Engineering*, 62, 77–82. doi: 10.1016/j.ecoleng.2013.10.028

Patel, J. M., & Gajera, Y. M. (2017). Treatment of Sewage by Vermifiltration: A Review.

## Cost Analysis

Vermifilter Cost	Quantity	Unit Price	Total Price
Tanks	3	\$830.25	\$2,490.75
Outlet Screen	3	\$1.52	\$4.56
Sand Layer	3	\$16.41	\$49.23
Gravel Layer	3	\$54.06	\$162.18
Dirt Layer	3	\$15.01	\$45.03
Worm Layer	9	\$90.00	\$810.00
Pump to filter	1	\$150.00	\$150.00
Piping to filter	3	\$3.08	\$9.24
Valve for filter	3	\$63.72	\$191.16
Installation Labor (hrs)	20	\$3.85	\$77.00
<b>Recirculation Cost</b>			
Piping	1	\$3.01	\$3.01
Pump	1	\$150.00	\$150.00
Elbows	2	\$5.55	\$11.10
Valve	1	\$120.71	\$120.71
Installation Labor (hrs)	20	\$3.85	\$77.00
<b>Total Cost:</b>			<b>\$4,350.97</b>

The total cost of installation for this project is under \$5,000 USD. This cost was determined using prices for material and labor in Ecuador. Estimated installation time is less than a week. The replacement of the worm layer every 7-8 months is the most pressing. This layer can be used as vermi-compost and be applied to crops as a fertilizer. Other ongoing costs include the replacement of the clay and sand every 4-5 years and regular pump and pipe maintenance.

## Conclusion

The final design solution vermifilter and recirculation meets all of the project objectives, including:

- ✓ Low Cost
- ✓ Pathogen Removal
- ✓ All Natural System

We hope this design will be a lasting solution that will improve the Churuguzo waste treatment site and benefit the community for years to come.