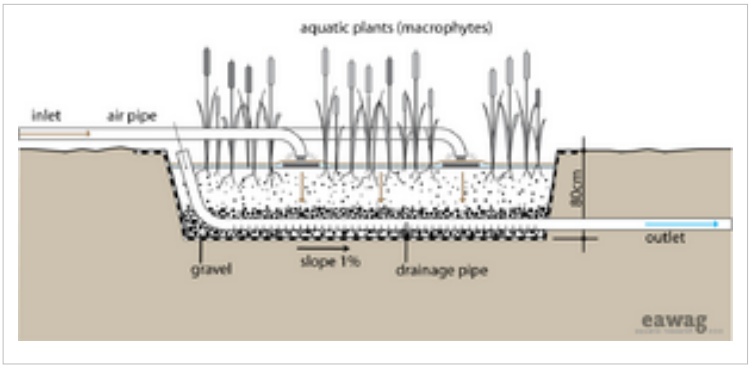
Vertical_Flow_Constructed_Wetland

Application level		Management level	
Household	X	Household	X
Neighbourhood	XX	Shared	X
City	XX	Public	XX



Applicable to systems:	Languages / langues / idiomas
1, 5 , 6 , 7 , 8	

Inputs: Blackwater , Greywater

Outputs: Effluent

A Vertical Flow Constructed Wetland is a filter bed that is planted with aquatic plants. Wastewater is poured or dosed onto the wetland surface from above using a mechanical dosing system. The water flows vertically down through the filter matrix. The important difference between a vertical and horizontal wetland is not simply the direction of the flow path, but rather the aerobic conditions.

By dosing the wetland intermittently (four to ten times a day), the filter goes through stages of being saturated and unsaturated, and accordingly, different phases of aerobic and anaerobic conditions. The frequency of dosing should be timed such that the previous dose of wastewater has time to percolate through the filter bed so that oxygen has time to diffuse through the media and fill the void spaces.

The Vertical Flow Constructed Wetland can be designed as a shallow excavation or as an above ground construction. Each filter should have an impermeable liner and an effluent collection system. Vertical Flow Constructed Wetlands are most commonly designed to treat wastewater that has undergone primary treatment. Structurally, there is a layer of gravel for drainage (a minimum of 20cm), followed by layers of either sand and gravel (for settled effluent) or sand and fine gravel (for raw wastewater).

The filter media acts as both a filter for removing solids, a fixed surface upon which bacteria can attach and a base for the vegetation. The top layer is planted and the vegetation is allowed to develop deep, wide roots which permeate the filter media.

Depending on the climate, Phragmites australis, Typha cattails or Echinochloa Pyramidalis are common options. The vegetation transfers a small amount of oxygen to the root zone so that aerobic bacteria can colonize the area and degrade organics. However, the primary role of vegetation is to maintain permeability in the filter and provide habitat for microorganisms.

During a flush phase, the wastewater percolates down through the unsaturated bed and is filtered by the sand/gravel matrix. Nutrients and organic material are absorbed and degraded by the dense microbial populations attached to the surface of the filter media and the roots. By forcing the organisms into a starvation phase between dosing phases, excessive biomass growth can be decreased and porosity increased. A drainage network at the base collects the effluent. The design and size of the wetland is dependent on hydraulic and organic loads.

Pathogen removal is accomplished by natural decay, predation by higher organisms, and sedimentation.

Advantages	Disadvantages/limitations
- Does not have the mosquito problems of the Free-Water Surface Constructed Wetland. - Less clogging than in a Horizontal Flow Constructed Wetland. - Requires less space than a Free-Water Surface Constructed Wetland. - High reduction in BOD, suspended solids and pathogens. - Construction can provide short-term employment to local labourers.	- Constant source of electrical energy required. - Not all parts and materials may be available locally. - Requires expert design and supervision. - Moderate capital cost depending on land, liner, etc.; low operating costs. - Pre-treatment is required to prevent clogging. - Dosing system requires more complex engineering.

Adequacy

Clogging is a common problem. Therefore, the influent should be well settled with primary treatment before flowing into the wetland. This technology is not appropriate for untreated domestic wastewater (i.e. blackwater).

This is a good treatment for communities that have primary treatment (e.g. Septic Tanks or WSPs but are looking to achieve a higher quality effluent. This is a good option where land is cheap and available, although the wetland will require maintenance for the duration of its life.

There are many complex processes at work, and accordingly, there is a significant reduction in BOD, solids and pathogens. In many cases, the effluent will be adequate for discharge without further treatment. Because of the mechanical dosing system, this technology is most appropriate for communities with trained maintenance staff, constant power supply, and spare parts.

Vertical Flow Constructed Wetlands are best suited to warm climates but can be designed to tolerate some freezing and periods of low biological activity.

Health Aspects/Acceptance

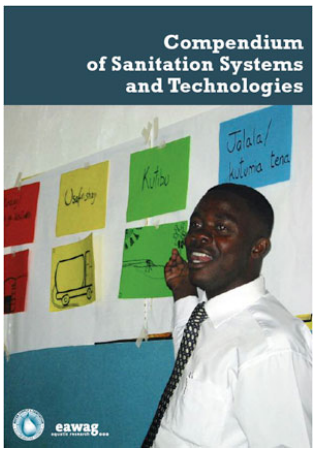
The risk of mosquito breeding is low since there is no standing water. The system is generally aesthetic and can be integrated into wild areas or parklands. Care should be taken to ensure that people do not come in contact with the influent because of the risk of infection.

Maintenance

With time, the gravel will become clogged with accumulated solids and bacterial film. The material may have to be replaced every 8 to 15 or more years. Maintenance activities should focus on ensuring that primary treatment effectively lowers organics and solids concentrations before entering the wetland. Testing may be required to determine the suitability of locally available plants with the specific wastewater. The vertical system requires more maintenance and technical expertise than other wetland technologies.

Acknowledgements

The material on this page was adapted from: Tilley, E. et al. (2008). Compendium of Sanitation Systems and Technologies [2], published by Sandec [3], the Department of Water and Sanitation in Developing Countries of Eawag [4], the Swiss Federal Institute of Aquatic Science and Technology, Dübendorf, Switzerland. The publication is available in English, French, and will be made available in Spanish. Available in the IRC Digital Library [5]



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References and external links

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[1] http://www.eawag.ch/organisation/abteilungen/sandec/publikationen/compendium_e/index_EN
[2] http://www.eawag.ch/organisation/abteilungen/sandec/publikationen/publications_sesp/downloads_sesp/compendium_high.pdf
[3] http://www.eawag.ch/organisation/abteilungen/sandec/index_EN
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