CONSTRUCTED WETLAND WASTEWATER TREATMENT SYSTEMS MADE EASY

“It’s harder to change spark plugs on your car than it is to put in a constructed wetland.”

Michael Ogden, President, Natural Systems International, USA.
Constructed wetlands are an alternative wastewater treatment method that mimics natural processes to cleanse water. Microorganisms that naturally live in water, on rocks, in soil, and on the stems and roots of wetland plants feed on organic materials and nutrients, removing pollutants from the wastewater. Constructed wetlands are created to similarly filter the waste (grey or black).

Wastewater remains below the surface. This controls mosquitoes and offers little chance of human contact with the wastewater. Cattails, bulrushes, reeds, and other aquatic plants are planted in the cell. Microorganisms living on the surface of the gravel and plant roots break down organic materials in the wastewater. The plants in turn provide oxygen and remove some of the nutrients from the wastewater. Some of the wastes settle out and attach to particle surfaces.

After treatment, the water is released, most often into the main drain. However, the water can be reused on lawns or gardens through a drip system, once the effluent quality is good. Other uses include evaporating the water in a pond or watering livestock.

A properly designed, installed and maintained constructed wetland wastewater treatment system is a great way to treat the wastewater coming from your home, while also reducing risks to human health and damage to the environment and improving the appearance of your property. Wastewater flows through the wetland, where plants, bacteria, and other beneficial microorganisms consume the waste, making the water safer once it is released back into the environment. Because the wastewater is treated underground, there is no smell, it doesn’t attract bugs, and is safe to have around your family.

The plants that grow in the system thrive on the nutrients in wastewater and help to beautify both the environment and your homes. The system is more efficient than a soak-away in cleaning the water before it is released in the environment either above ground or in the soil. This means that your family, your neighbours and the environment are safer and better protected. Less pollution results in less illness which results in happier people! Don’t forget about the flowers which attract birds, butterflies and good vibrations!
“HOW”... should I use a constructed wetland wastewater treatment system?

Siting
1. It should be downhill from your septic tank. If you don’t have a septic tank you will need to install one with a minimum capacity of 1,000 gallons.
2. If your land is flat (and the wastewater from the septic tank cannot flow by gravity), you will need to connect a pump from the septic tank outlet to the inlet of the wetland system.

Materials needed:
- Cement (for building the concrete structure)
- Water sealant (to be mixed into the concrete for waterproofing)
- ½-inch steel (for reinforcing the concrete)
- Wire (to tie the steel rods together)
- PVC Piping (different lengths of 4” and 2” for the inlet/outlet of the system and for cleaning the system)
- PVC fittings (water level control, flush lines, inlet, outlet, reducers)
- Glue (for PVC)
- Gravel (filtering the sewage)
- Rotting coconut fibre compost (filter, growing plants)
- Septic tank filter (can be constructed from PVC and netting)
- Water level indicator (plastic bucket)
- Outlet tap
- Plastic drum or barrel (for filtering black- and grey-water)
- Plywood (for building casing for casting the concrete)

Advice:
“While you may be able to build an artificial wetland yourself, it is always best to get some advice and help if you need it. You should contact your local Public Health or Environmental Health Department for guidance advice and assistance, especially if special permission is required to install a wetlands system.”

“BUILDING”... a tank or cell for the artificial wetland

Step One:
Dig a pit to accommodate a concrete structure approximately 4 feet by 10 feet. Essentially, the length should be two and a half times the width. Make sure that you divert the surface rain water from getting into the wetland. Large families or combined households with more than one septic tank can build a larger wetland provided that they keep the dimensions in proportion. The wetland should be about 4 feet deep. You should use plywood or cheap lumber as the frame for casting the concrete. The walls should be built of pure concrete with reinforced steel (3/8 or 1/2 inch). The concrete mixture should include a water sealant. In constructing the frame for casting the system, you would need to identify where the water outlet should be and insert a piece of 2 inch PVC where the hole should be – almost 18 to 24 inches above the base of the system. The outlet pipe should be on the opposite end of the structure from the inlet pipe (4 inch pipe from the septic tank).

Step Two:
This outlet pipe must be connected to the base of the water level control. While you can buy a water-level control device, a simple covered plastic bucket will suffice. In the middle of the section of the wetland system and below the outlet pipe, you need to run a length of 4inch PVC pipe which has an elbow joint at the inner end (the part within the tank) that projects above the level of the water in the system. The other end leads out of the concrete tank. Both have screwed on covers that can be removed for flushing out the system. The part of the pipe within the tank is perforated so that water can enter the pipe and get into the water-level control bucket.
Step Three:
In the middle of the pipe, where the bucket would be placed, a T-junction is connected facing upward. When that is done, put a 2 inch reducer and pass it through the bottom of the bucket ensuring that the bucket is tightly sealed and only water from the pipe gets into it. You would need silicone or plumber’s glue to ensure that the seal is tight.

The bucket is above the level of the fill material and the coconut fiber compost so that the cover can be removed to adjust the water level in the system. It is vital to ensure that there is always water in the system.

The bucket or water-level controller will be filled by the 2 inch pipe coming into it. At the side of the bucket you need to make a hole for a 4 inch pipe, reduced to 2 inches which is then connected to the 2 inch outlet pipe. This way the treated water is then released from the system into the drain or for use in irrigation or for a “downstream” lawn or garden.

Step Four:
Cover the entire concrete cell with 2 feet of gravel that is graded, washed, and free of dust, sand, silt, or clay. Rock sizing may range from 3/4 inch up to 1.5 inches.

Step Five:
The inlet or area connected to the septic tank must be opposite the outlet end. Cut a plastic drum or barrel into two equal segments as shown in the diagram. Insert three to four rows of holes at the base in a zig zag pattern to allow water from the distribution zone (septic tank) to flow horizontally. Connect a T-junction to the barrel. This will then be connected to the septic tank. There will be a screw cap at the top projecting above the water level for cleaning out the system. Then insert two 4inch PVC pipes with elbow bends and screwed on caps into the sides. These must also project above the water level and are intended for flushing out the system. Note, water will also percolate through the stones. This is to ensure that the black water is in contact with the coconut fiber, which in turn will maintain moisture for the wetland plants.

Step Six:
Cover the gravel (two feet deep) with a 6 inch layer of coconut compost which insulates the water. The compost will also be planted with specific wetland plants that will aid in the treatment of the wastewater. Roots of the plants will penetrate into the gravel to absorb water in the basin and provide some treatment of the wastewater.

Step Seven:
The concrete septic tank removes settleable and floatable solids from the wastewater before it flows to the system. The septic tank is a two compartment 1,000 gallon tank. The purpose of the filter is to prevent solids from discharging to the system. A single filter is installed for suspended solids protection. Filters can be bought or made using PVC with holes cut in it and wrapped in netting so that the solids are separated out and only liquids go into the artificial wetland. The filter should be taken out and cleaned annually.

Step Eight:
Connect the pipe from the septic tank to the end of the artificial wetland opposite the outlet pipe. The idea is that the water is treated by the plants and filtered through the coconut and gravel until it flows out at the bottom of the wetland much cleaner than when it went in.

Step Nine:
Choose your wetland plants to grow in the coconut compost. They must be able to adapt to saturated condition; the plant species must be succulent in nature; the root system must not cause damage to the wall structure; and the plant must be easy to maintain and won’t regenerate outside the system or become a nuisance.
Other considerations for choosing plant species include root shape, density, and depth. Ideally a wetland plant with deep roots and a great deal of surface area, without clogging the pore space is preferred. These include Blueflags, Bulrushes, Broadleaf Arrowheads, white Ginger Lillies, and Cattails. It is best to use native wetland vegetation since they are adapted to the local environment.

Step Ten:
Monitor and maintain the system including:
1. Periodically cleaning out the sewer line which leads to the septic tank
2. Checking sludge build-up in the septic tank and having it pumped out when it is almost full
3. Cleaning out the outlet filter (to the artificial wetland) at least once a year
4. Making sure there is no water on the surface of the wetland

The St. Lucia Example
In some parts of the Caribbean the soil is too stony to build a soakaway. Some people build septic tanks but then the “black” water runs straight into the drains, rivers or the neighbours’ yards causing not only health problems but a lot of friction in the community.

In the Fond d’Or community of St. Lucia there are many homes which do not have adequate waste storage and treatment facilities. Untreated domestic waste enters into gutters, gullies and rivers, often resulting in effluent contamination of stream water.

The GEF-IWCAM Demonstration Project in Saint Lucia recognized the increasing threat being placed on the streams and rivers by human activity, as well as acknowledged that communities within the project watershed lacked adequate septic tanks and soak-aways to treat black water. The project then worked with the Caribbean Regional Coordinating Unit of the United Nations Environment Program (UNEP-CAR/RCU) and came up with an appropriate technology (Constructed Wetlands) for addressing domestic waste.

This process is best in areas where the soil is too hard or dense to build a soak-away or where the residents want to beautify their surroundings and create a healthier environment.

The GEF-IWCAM St. Lucia Demonstration Project’s Wetland Construction Design Manual and other reference materials are available at: www.iwcam.org

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