EXTENSION
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CONSTRUCTED WETLANDS FOR WATER FILTRATION

An Introduction to Constructed Wetlands

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Natural wetlands have been recognized for a long time as an efficient way to clean water. Wetlands may consist of large sandy or rocky areas water slowly flows through or more traditional, swampy wetlands with peat-like soils. Natural wetlands have the following essential components in common:

- Plant roots filter the nutrients and facilitate oxygen in the soil for better microbial growth.
- Flowing water aids in oxygenation and prevents stagnation.

Fig. 1 Natural Desert Wetland

Constructed or artificial wetland systems mimic natural wetlands by relying on plants and a combination of naturally occurring biological and physical processes to remove pollutants from water. Constructed wetlands can be large or small and are built to clean water from many different sources.

- Runoff water from hard-scapes such as parking lots and roofs
- Nursery irrigation water and other agricultural runoff
- Grey water (water from washers, showers, sinks, etc.)
- Black water (any water containing fecal matter)
- Any combination of the above

Fig. 2 Beginning to dig a small home wetland

Correctly designed and maintained constructed wetlands should not have any surface water. This prevents such problems as mosquitoes, disease and foul smells. The first residential constructed wetland built in Las Vegas was a simple 20 x 20 x 4-foot-deep hole in the ground with an impervious liner containing various sizes of gravel. It was planted to facilitate the introduction of oxygen into water by plant roots and to filter nutrients from the wastewater. Oxygen is essential for the microbial breakdown in the filter bed. This first test wetland did not have an aeration tub system, something highly recommended in any system, to facilitate both plant and microbial growth. The aeration system helps the microbial filtering process to be more efficient and to stimulate plant growth for faster uptake of nutrients. During construction, tubing is placed in the wetland that will be used for aeration.

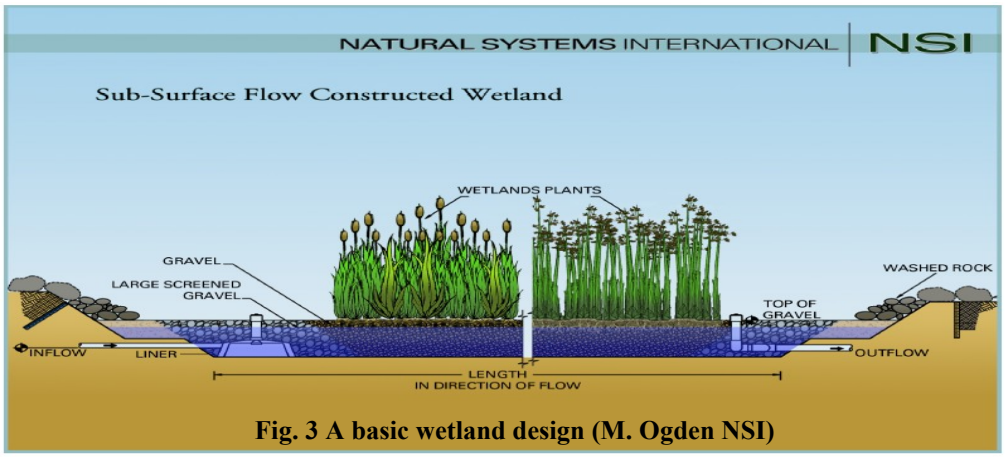
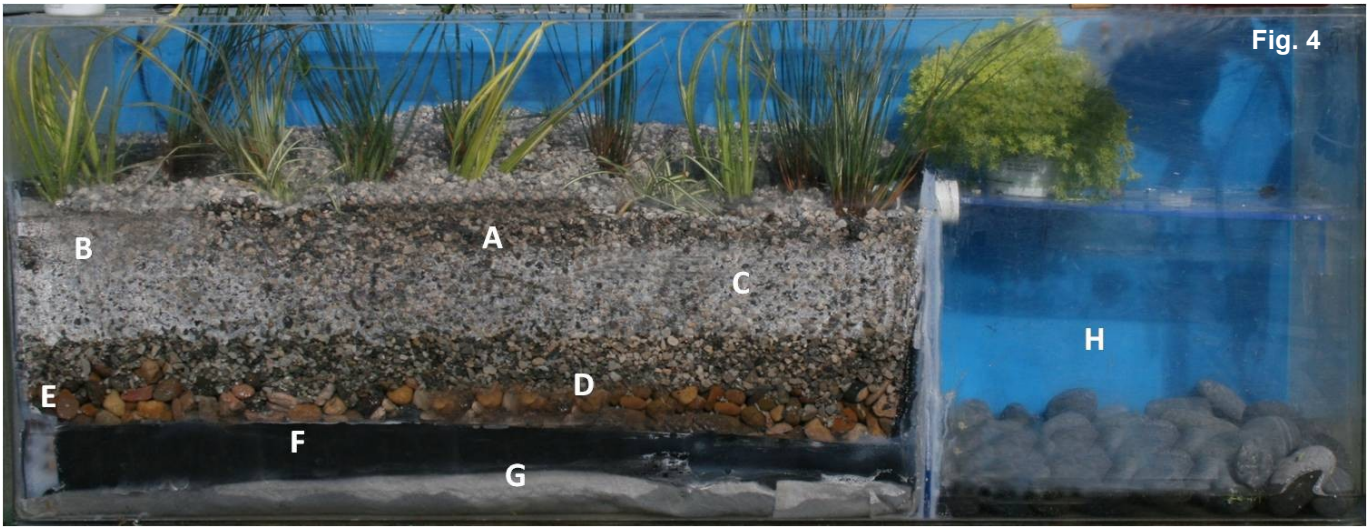


Fig. 3 A basic wetland design (M. Ogden NSI)



A. Water should always be subsurface
B. Plant roots filter the water
C. 1/4 inch pea gravel makes up 2/3 of the filter bed
D. 3/4 to 2 inch rock forms 1/3 of the filter bed
E. Water is pumped to the bottom
F. Impermeable liner
G. Under liner
H. Water storage

The system is very simple. The water that is to be cleaned is either pumped or flows by gravity to the wetland where it moves from one end to the other, taking several days to do so. The microbial action and the plant roots filter the water, which then flows or is pumped to a holding pond, or other storage container, for reuse, or directly to a leach field.

REASONS TO USE CONSTRUCTED WETLANDS FOR WATER FILTRATION

- Water conservation
- On-site recycling and reuse
- Costs less to construct than most traditional water-filtration systems
- Lower operating cost
- Non-technical personnel can operate and maintain
- Energy conservation by using gravity flow and/or solar pumps
- Protection of the environment by eliminating pollutant runoff water
- Provides natural habitat for plants and animals

POTENTIAL PROBLEMS

- Many local and state agencies lack an understanding of how constructed wetlands work, many times envisioning foul-smelling, standing surface water, especially if black water is comingled.
- When water is stored in open ponds after filtration there can be liability concerns.
- Some state and local regulation codes may prohibit or restrict the use of alternative onsite systems. This is becoming less of a problem and is most often related to black-water filtration systems. Check with the county zoning office.
- Fluctuation in seasonal plant growth (winter vs. summer).
- Higher evaporation loss in desert areas.

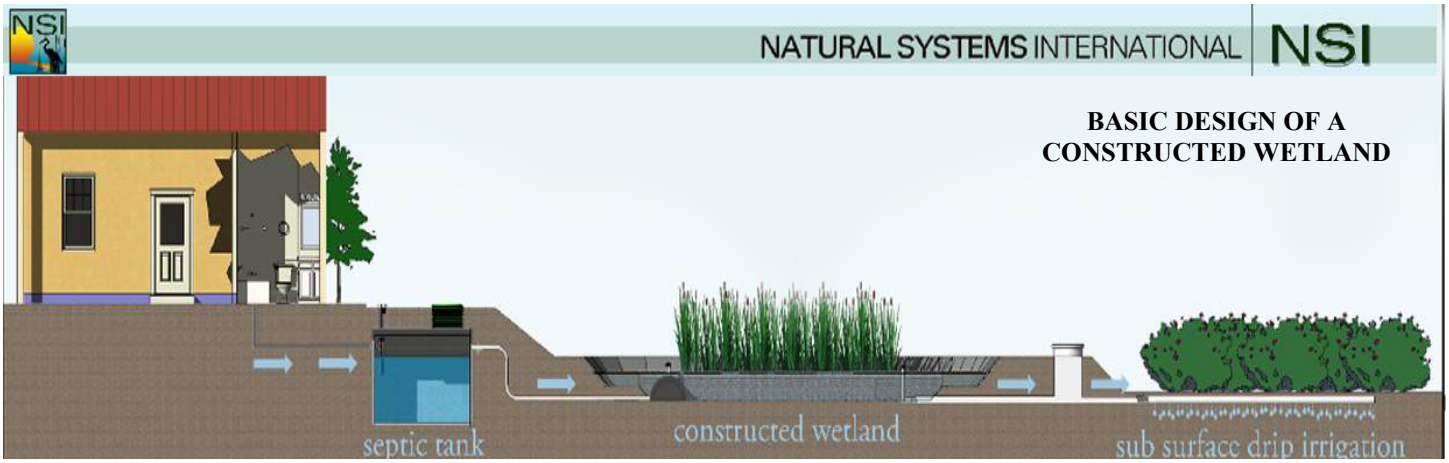


Fig. 5 A basic wetland design for home or business including black water (M. Ogden NSI)

DETERMINING THE COST OF A CONSTRUCTED WETLAND

A 30 x 50 x 2-foot-deep wetland will filter 720 (five to six days retention) gallons of water per day. A wetland that can filter between 2,500 to 7,000 gallons per day would be as large as 30 x 130 x 2 to 4-feet deep. A smaller 20 x 20 x 4-foot home wetland will cost from $10,000 to $15,000 depending on who does the labor; the more the home/business owner does himself, the less the cost.

PLANT SELECTION

Fig. 8 Wetland plants

Plants play an important role in a wetland. They filter nutrients and facilitate the movement of oxygen into the water. Almost any plants, even non-aquatic, including drought-tolerant plants such as rosemary, sunflowers and others, will grow in this hydroponic condition. However, if more aquatic plants are needed for nursery stock plants, then this is the perfect place to grow them. If the area is not being used for growing stock plants, it is recommended that native and native-like plants be used to benefit wildlife that will be attracted to the wetland. Pollinators such as bees, hummingbirds and butterflies will be attracted to seasonal flowering plants. Birds will be attracted to seed-producing plants, and others such as the redwing blackbird, to cattails. However, fast-growing plants such as cattails and rushes need to be harvested and thinned continuously in the warm season. Any plants that might easily spread into other areas should be avoided or cultivars that are sterile should be selected. Never plant large growing shrubs and trees, as they will grow too large and their roots could puncture the liner. Herbaceous plants are best. Plants with seasonal color add beauty to the wetland. Wetlands need not be hidden in the back part of a property. Contact your local Cooperative Extension office for a list of wetland plants that grow best in your area.

Fig. 7 Redwing blackbird near wetland where cattails are growing

Fig. 9 In some areas, tropical plants can be used in wetlands.

WETLAND MAINTENANCE

Wetlands need maintenance, including harvesting and thinning of plant materials, so they do not take over. Equipment, including water and aeration pumps, solar panels (if used), and liners require inspection and upkeep. Inflow and outflow water needs testing on a regular basis (at least once a month) to be sure the filtration is working properly. Regular testing will provide documentation for governmental agencies that the filtered water is safe. This is especially true if black water is comingled.

Important: Before beginning any water-harvesting program, always check with your local and state agencies, such as the health department and the Environmental Protection Agency, to make sure you are in compliance with all laws and regulations governing such construction and use.

FOR MORE INFORMATION

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PHOTOGRAPHS AND OTHER ART WORK

All are by the authors unless otherwise designated.
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