



# Homeowner Cost Cutter: Build Your Own Constructed Wetland

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Constructed wetlands to treat wastewater from single-family residences is a rapidly emerging bio-engineered technology that provides low-cost, natural treatment for sites not suited for conventional onsite systems. With some technical assistance from state and local agencies, a homeowner can install the system himself and save some money.

"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, Santa Fe, New Mexico, said.

## What are constructed wetlands?

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. Pollutants are reduced by a factor of 16, or more. (Biological Oxygen Demand and suspended solids are reduced by 94 percent and nitrates are almost completely eliminated.)

There are two types of constructed wetlands: surface flow, where wastewater flows on top of the existing soil, and subsurface flow, where wastewater flows through a porous medium, for instance, gravel or tire chips.

## Constructed Wetland Components

A constructed wetland system consists of a septic tank; a pump if the wastewater is unable to travel by

gravity through the system; wetland cell(s), which are beds lined with an impermeable liner and filled with graded medium and aquatic plants; and a drainfield, polishing lagoon, or wildlife habitat pond for returning the wastewater back to the environment.

"Wetlands are a great addition because they have no moving parts, and since they rely on natural systems (wetlands), they are basically self-maintaining and self-regulating. Even if you need to leave your home for extended periods of time, the plants will survive," Ogden said.

## Is your area permitted for constructed wetlands?

Beginning construction without first getting a permit and knowing exactly what the permit requires is asking for trouble. "The problem is not that the homeowner is not capable of putting in a constructed wetland, the problem is the regulatory process," Ogden said.

"If county/state regulations do not permit for constructed wetlands, then the local sanitarian doesn't know what to do. He may think constructed wetlands are a wonderful idea, but he doesn't have a 'recipe' for writing a permit. Check with your local regulators before installing a constructed wetland.

In some cases, permits are for experimental systems, and the permit might have special requirements. For example, two homeowners in Louisiana recently put in constructed wetlands under an experimental permit. "One of the requirements was that the homeowner would pay a certified testing lab to periodically test the influent and effluent of the

wetlands for one year to prove that the wetlands were doing the job," Robert Crawford, engineer IV, Department of Environmental Quality, Baton Rouge, Louisiana, said.

"Although the homeowners were able to easily complete construction, they were unable to pay for testing. There weren't any grants or loans available to help them pay for it, so they had to take the systems out and replace them with approved treatment systems."

According to Crawford, most homeowners in Louisiana don't even know that constructed wetlands are an available technology. "We only have data for municipal wetlands, and they haven't done well in Louisiana," Crawford said. "We were a testing ground for the early municipal constructed wetlands. There just wasn't enough research done in the beginning to get the data we needed and to get the design criteria right."

Of the sixty subsurface municipal wetlands Louisiana put in, only four or five operate at their permit levels. "Many have been taken out in the last 10 years because they can't meet their permits," Crawford said.

"Even though we haven't had much luck with municipal constructed wetlands, our chief engineer at the Department of Health and Hospitals, the agency that permits systems, supports residential constructed wetlands to treat wastewater, but he doesn't have the money to pay for the testing either. Unless we get some homeowners who are willing to pay all costs (installation and testing), we won't be able to get the data we need to approve the system."

“Although your particular county may not permit constructed wetlands, there are numerous sources of information—the U.S. Environmental Protection Agency *Onsite Treatment Manual* (see EPA, 2002) and the National Environmental Services Center, for instance,” Ogden said. “These two resources will help introduce the technology to the local sanitarian. He may still balk, but often a local registered professional engineer specializing in onsite wastewater treatment systems can help. An experienced engineer will often be able to remove any concerns that the regulatory agency may have. Fortunately, most states have the necessary regulations and guidelines in place.”

### Skills Needed

Design and planning are done by professionals. Construction, however, can be done by the homeowner. “The only skill you need is the ability to move large amounts of dirt,” Bill Grant, administrator, LaGrange County Health Department, LaGrange, Indiana said. “It’s not rocket science to put one of these in.

“I helped a resident who didn’t have any special engineering or construction skills. Together we choose a design, and I gave him all the technical assistance he needed.

“We’ve had residential constructed wetlands since 1992 and only two had problems—bad construction.”

### General Materials Needed

In addition to the design plans and a backhoe, the homeowner will need safety gloves and boots, a septic tank, a dosing pump if effluent doesn’t flow to the wetland cell by gravity, an impermeable liner for the

wetland cell, plastic pipe (usually PVC), gravel or some other type of approved porous material for the wetland cell, wetland plants, and plant fertilizer if effluent is not immediately available after planting.

Wetland plants are specially adapted to withstand the stressful conditions characteristic of wetlands, for instance, periodic saturation with water, fluctuating water levels, and little available oxygen. Bulrushes, cattails, reeds, rushes, and sedges are common types of vegetation used in constructed wetlands.

It’s best to use native wetland vegetation since they are adapted to the local climate and pests. Wetland vegetation can be found at local nurseries in all regions of the country.

### Construction Costs

Costs to build a constructed wetland vary with site conditions, the design, and local requirements.

Grant built a constructed wetland in his backyard in 2002. “The total materials for my wetland were \$1,498.24 retail,” Grant said. “I already had a septic tank, but had I needed one, my costs would have increased approximately \$900. Since water from a constructed wetland system is fairly clean, I only needed a 450-square foot absorption field, adding another \$1,000 to my final costs. The total cost for my constructed wetland was \$2,498.24. Contractors will increase the costs of materials to cover overhead and make a profit.

“My soils are real sandy, so I didn’t need as much of an absorption area. If you get into the heavier clay, you will need a larger absorption area and that will increase your

costs.

“The most expensive residential constructed wetland we have ever put in was \$5,600 and that was because it was a difficult site with clay and high water. It needed a perimeter drain and a large absorption field. For this particular system, the installer said material costs were \$2,800. The contractor pointed out that had he needed to install a conventional septic system, he would have had to charge the homeowner \$7,500.”

In LaGrange County, constructed wetland plans cost \$50. The county purchased standard plans from Michael Ogden. “The wetland was sized based upon the number of bedrooms in the home and on how big the disposal field needed to be,” Ogden said.

“So, for instance, a homeowner will know exactly the size for his tank and disposal field based on the number of bedrooms in his home and the percolation rate of his soil. The homeowner had everything he needed when he bought the plans; the information is all there. Once the standard set of drawings, specifications, and guidelines are in place, there is no reason for an engineer to get involved. The rest of it is a hand-holding process that can be readily done by the county sanitarians.”

### Preconstruction Steps

All utilities must be located and flagged, and temporary fences should be placed around the absorption field to prohibit traffic and avoid compaction.

Where necessary, vegetation should be removed. Any soil that is removed should be kept for later use. Fill soil should be free of all debris.

## Some Common Wetland Plants

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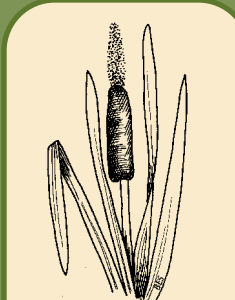
Common reed  
*Phragmites australis*



Lake sedge, Ripgut  
*Carex lacustris*



River bulrush  
*Scirpus flaviatilis*



Broad-leaved cattail  
*Typhya latifolia*



Salt rush, Baltic rush  
*Juncus balticus*



Wetland

Water Garden is for landscaping. It is not part of the treatment system.

The wetland cell area should be graded and leveled. Fill should be mechanically compacted to required elevations to ensure proper base preparation. Maximum compaction occurs when the soil is moist (Taylor et al., 1998).

### Construction

Construction should begin only after all permits are in place. Steps for constructing a wetland vary geographically because of local regulations, but the steps below provide a general outline of the various stages involved in building the wetland (Big 8 RC&D Website, [www.big8rcd.org](http://www.big8rcd.org), 2004).

1. Excavate with a backhoe for the septic tank (1,000 to 1,500 gallons depending on the number of bedrooms).
2. Level the floor of the excavation.
3. Carefully lower the septic tank and, if needed, the pump tank. (This can generally be accomplished with the crane on the

back of the truck that delivers concrete tanks or with a backhoe if HDPE plastic or fiberglass tanks are being used.)

4. Backfill with soil.
5. Excavate the wetland cell.
6. Cover the bottom of the cell with a plastic liner (30 mil PVC and 40 mil HDPE).
7. Dig a ditch for wastewater piping.
8. Lay the inlet pipe to the cell.
9. Pour and evenly spread gravel or tire chips into the cell.
10. Dig a ditch for the drainage line, and insert and connect the pipes.
11. Dig trenches for the drainfield.
12. Connect the pipes.
13. Fill with water and check for leaks.
14. Add wetland plants.

### Maintenance

Constructed wetlands are typically low-maintenance systems. As with a conventional system, the septic tank should be pumped every three

to five years to prevent the overflow of solids. Also, the water level should be periodically checked to ensure the correct level.

For a subsurface system, the homeowner can install a small observation tube in each cell to monitor the water level, which normally should be two to four inches below a gravel surface to improve treatment and control mosquitoes. Finally, dead plants (not dormant vegetation), weeds, or saplings that have taken root should be periodically removed.

It is important to wear protective waterproof gloves when performing maintenance tasks to minimize exposure to wastewater, and to avoid any contact with the wastewater if you have open wounds or sores.

### Getting Your County Involved

When Ogden first started teaching workshops about constructed wetlands, he sometimes taught homeowners. "An interested homeowner would get a group of neighbors together, and we would teach a work-

## Constructed Wetlands Survey Project

shop on a weekend," Ogden said. "We also tried to sell homeowners a set of plans as a self-help project, but this proved to be very time consuming because the homeowner needed help in getting the permit. It required me to spend considerable time on the telephone answering questions from local county health officials."

Ogden no longer teaches constructed wetland workshops for homeowners alone. "It makes more sense to do it on a county-wide basis, since the county has the overall responsibility because it issues the permits," Ogden said.

This way, Ogden has available to him all the information he needs about what a particular county allows for onsite systems. The best audience, according to Ogden, is a combination of sanitarians, contractors, and homeowners.

### For More Information

For more information on constructed wetlands to treat residential wastewater, contact your local and state health agencies; the National Environmental Services Center at (800) 624-8301 for technical information and free and low-cost information materials; Purdue University, West Lafayette, Indiana, (765) 494-4773, for a copy of *Constructed Wetland Design Manual for Individual Residences*; Michael Ogden, Natural Systems International, (505) 988-7453; Bob Crawford, Louisiana Department of Environmental Quality, (225) 219-3465; and Bill Grant, LaGrange County, Indiana, Health Department, (260) 499-6341.

### References

- Big 8 Conservation and Development (RC &D) Web Site. Accessed 2004. Programs section: Constructed wetlands for wastewater treatment. [www.big8rcd.org](http://www.big8rcd.org).
- Taylor, Catherine, Don Jones, Joe Yahner, Michael Ogden, and Alan Dunn. 1998. *Individual residence wastewater wetland construction in Indiana*. A joint publication of Purdue University and the Indiana State Department of Health as part of the onsite wastewater disposal project. Purdue University, West Lafayette, Indiana.
- U.S. Environmental Protection Agency (EPA). 2002. *Onsite wastewater treatment systems manual*. Office of Research and Development. Office of Water. (Available from NESCS on CD-ROM. NESCS Item #WWBKDM99. [800] 624-8301.)

In 2002, the Water Environment Research Foundation (WERF) funded a project to research and establish the feasibility, design criteria, and operations and management requirements for small-scale constructed wetland wastewater treatment systems.

"We set up a Web site and encouraged people to register their wetlands," said Scott Wallace, P.E., a principal for the research project and vice president, North American Wetland Engineering P.A., Forest Lake, Minnesota. "We gathered information from 19 countries on 1,789 small-scale wetlands. The final report will be published fall, 2004."

The original subsurface flow wetland technology was developed in Germany in the early 1960s, according to Wallace. At that time, many small, rural villages there didn't have conventional septic systems. Instead, homeowners just straight piped their wastewater into the ditch. The first full-scale wetland systems in Germany went online in 1974.

Wetland technology was brought into the U.S. in the early 1970s, but it was used for large systems. In the early 1990s, when constructed wetland technology was adopted by Denmark and the United Kingdom, members of the Tennessee Valley Authority (TVA) went to Europe to investigate the technology. In 1993, the Tennessee Valley Authority published a book on design of single-home, subsurface-flow wetland systems, titled *Constructed Wetlands Wastewater Treatment Systems for Small Users Including Individual Residences*. This book was the first major document published in the U.S. that focused on single-home wetland systems.

"The TVA publication accelerated the use of wetlands in the U.S.," Wallace said. "Our published report will be the first to address small-scale wetlands since TVA's publication."

"Constructed wetlands are popular with the Amish because they don't use electricity and modern equipment, which is forbidden in their religion. I have seen this pattern in southern Iowa and eastern Ohio. Those areas have soils that are not suitable for a standard sep-

tic tank drainfield. Prescriptive code would require either installing a mound system, which requires a pump, or installing an aerobic system, which requires a blower. So if you are looking for a system that doesn't have any mechanical treatment components, that is going to be a constructed wetland, since its treatment systems runs 100 percent by gravity flow. This is perfect for the Amish because it allows them to put in a modern system that the county will approve, yet the technology does not go against their religious beliefs."

Constructed wetlands for single-family homes have been a wastewater treatment option for only the past 10 years, according to Wallace. "Before then, most codes were prescriptive, and constructed wetlands didn't fit the criteria for prescriptive code. Now, the onsite industry places more emphasis on performance-based systems, so constructed wetland technology has grown."

For more information about the constructed wetlands research project, contact Scott Wallace at [swallace@nawe-pa.com](mailto:swallace@nawe-pa.com) or Jennifer Simmons, project manager, WERF, at (703) 684-2470.

To view wetland information from the WERF research project, go to [www.wetlandsurvey.org](http://www.wetlandsurvey.org). The final report can be purchased through WERF at [www.werf.org](http://www.werf.org) (inside the U.S.), and through IWA at [www.iwapublishingl.com](http://www.iwapublishingl.com) (outside the U.S.).

### For Further Reading

- East Texas Plant Materials Center et al. 1998. *Constructed wetlands for onsite septic treatment: a guide to selecting aquatic plants for low-maintenance micro-wetlands*. (Available from National Environmental Services Center (NESCS), Item #WW-BLOM37. [800] 624-8301.)
- Steiner, G.R., and J.T. Watson. 1993. *General design, construction, and operation guidelines: Constructed wetlands wastewater treatment systems for small users including individual residences*. 2nd ed. Tennessee Valley Authority, Water Management Resources Group. (Available from NESCS, Item #WW-BLDM65. [800] 624-8301.)

**See the list beginning on page 55 for more related resources.**