Using Constructed Wetlands for Recycling Waste Water to Protect Surface and Ground Water

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URBAN RUN OFF
URBAN RUN OFF
NATURAL RUN OFF WITH VEGETATION
CONSTRUCTED WETLANDS ARE MORE THAN A SWAMP WITH GATORS
WHY CONSTRUCTED WETLANDS?

- WATER CONSERVATION
  Runoff, gray and black water can be recycled and used on site

- REUSE NURSERY WATER RUN OFF, PARKING LOT RUN OFF

- ENERGY CONSERVATION
  Reduces pumping between customers and suppliers; gravity feed and solar power
ENVIRONMENTAL PROTECTION

- FEWER CHEMICALS USED TO CLEAN WASTE WATER
- LESS AIR POLLUTION FROM OIL/COAL GENERATION PLANTS
- LESS WATER CONTAMINATION
• CREATION OF WETLAND HABITAT FOR WILDLIFE

• LOW TECH

• LOWER COST

• EASY AND LESS EXPENSIVE TO MAINTAIN
ANNUALLY, MORE THAN 4 MILLION CHILDREN DIE FROM WATERBORNE DISEASES WORLDWIDE.

ANNUALLY, 1.2 BILLION PEOPLE SUFFER FROM DISEASES CAUSED BY UNSAFE DRINKING WATER OR POOR SANITATION.

UNSAFE WATER IS RESPONSIBLE FOR 80% OF ALL DISEASES AND 30% OF DEATHS IN THE DEVELOPING WORLD.

BY U. N. ESTIMATES, 2/3 OF HUMANITY WILL FACE SHORTAGES OF CLEAN FRESHWATER BY 2025.
USES OF CONSTRUCTED WETLANDS

- INDIVIDUAL HOMES AND SMALL BUSINESSES (DIVERTING FROM SEPTIC AND SEWER SYSTEMS)
- SMALL TO MEDIUM SIZED COMMUNITIES
- LARGER BUSINESSES, INCLUDING FACTORIES AND SCHOOLS
Constructed wetlands work as biological filters in tandem with a multi-part treatment system to reduce pollutants from a property's wastewater without odor, standing water, or mosquitoes. The pollutants include Biological Oxygen Demand (BOD), Total Suspended Solids (TSS), nitrates, metals, and petroleum hydrocarbons, as well as fecal coliforms or pathogens such as viruses. Subsurface flow wetlands (SF) are one of two types of wetlands used to meet State Environmental Department criteria of pollutant removal/levels. The advantages of using constructed wetlands vary, but primarily they consistently meet design parameters established by regulatory agencies. Unlike mechanical systems, they are able to treat low flow volumes as well as those approaching 50 million gallons per day. Also, they consume much less energy yielding a lower operating cost. In addition to the practical advantages, constructed wetlands add to the beauty of a property's landscape and also serve as wildlife habitats. Many are incorporated into parks and golf courses for this very reason.

(see web link: http://www.natsys-inc.com/systems/about_wetlands.php)
BUILDING A SMALL CONSTRUCTED WETLAND
BUILDING A SMALL CONSTRUCTED WETLAND
BUILDING A SMALL CONSTRUCTED WETLAND
BUILDING A LARGE CONSTRUCTED WETLAND
BUILDING A LARGE CONSTRUCTED WETLAND
SOME IMPORTANT FACTS

- EACH CELL IS 30 ft. X 130 ft. X 38 ins.
- FROM 7,500 gals. TO 25,000 gals. OF WASTE WATER CAN BE CAN PROCESSED PER DAY (DEPENDING ON THE NUMBER OF CELLS).
- COST FOR INSTALLATION DEPENDS ON SIZE.
SOME IMPORTANT FACTS

- MOST MAINTENANCE INVOLVES THE AERATION PUMPS
- CHECK EVERY 6 MONTHS ($18 PER PUMP)
- AERATION 1 hr. 15 min. 3 TIMES PER 24 hr. PERIOD
PLANT SELECTION

TALL PLANTS IN THE CENTER

LOW & MEDIUM PLANTS ON THE PERIMETER
COMMERCIAL WETLANDS
PLANT SELECTION

- If plants are not primarily for aeration, any plants can be used (other than trees).
- Use native and native-like plants.
- Choose plants for beauty.
- Choose plants that are less aggressive such as sterile hybrids.
PLANT SELECTION

- MOST PLANTS WILL GROW IN A CONSTRUCTED WETLAND DUE TO AERATION.
- PLACE LARGER GROWING PLANTS IN THE CENTER OF THE WETLAND, SMALLER PLANTS ON THE PERIMETER.
- IF THE WETLAND IS HIGHLY VISIBLE, PLANT WITH SEASONAL COLOR FOR YEAR ROUND BEAUTY.
- DON’T PLANT LARGE GROWING WOODY ORNAMENTALS, SUCH AS TREES.
PLANT SELECTION

- CHOOSE PLANTS THAT WILL ATTRACT WILDLIFE.
  BUTTERFLIES
  HUMMINGBIRDS
  OTHER BIRDS (SEED PRODUCTION)
  SHELTER AND NESTING SITES
ORNAMENTAL PLANTS CAN BE USED

CALLA LILY

VARI EGATED CATTAIL

PHILODENDRON AND IRIS
NON AQUATICS CAN BE USED

ROSEMARY

BEACH SUNFLOWER AND SWEET POTATO
AGGRESSIVE PLANTS NEED TO BE HARVESTED OFTEN OVER 6 FT.

REEDS, CATTAILS ETC.
WETLAND PLANTS FOR PHYTO-ACCUMULATION OF HEAVY METALS

RESEARCH AT AUBURN UNIVERSITY HAS SHOWN THAT LOTUS ACCUMULATE LARGE AMOUNTS OF HEAVY METALS WITHOUT APPARENT TOXICITY
NEW RESEARCH SHOWS THAT ALYSSUM, SALVIA SCLAREA AND BRASSICA JUNCEA REMOVE HIGH AMOUNTS OF LEAD FROM THE SOIL.

LEAD CONCENTRATION AND REMOVAL FROM LEAD ENRICHED SOIL, HORTSCIENCE 48(12), DECEMBER 2001, 1604-1607

CANNAS WERE THE TOP RECOMMENDED PLANTS FOR REMOVAL OF NITROGEN AND PHOSPHORUS FROM RUN OFF WATER.
OTHER RECOMMENDED PLANTS ARE DWARF PAPYRUS, PICKERELWEED, BULLTONGUE AND ARROWHEAD.

Plants remove Nutrients from Runoff, Louisiana Agriculture 54(4), Fall 2011, 20-21
A LARGE URBAN WETLAND
SPRINGS PRESERVE, LAS VEGAS, NV
HOW MUCH WATER CAN BE HARVESTED?

- SQ. FT. X .6 X INCHES OF RAIN PER YEAR = GALLONS OF WATER PER YEAR
- THE UNCE CAMPUS HAS ABOUT 148,000 (+) SQUARE FEET OF HARD-SCAPE AND ROOF AREA.

148,000 X .6 = 88,800 Gallons

88,800 X 4 INCHES OF RAIN = 355,200 GALLONS OF WATER THAT COULD BE HARVESTED EACH YEAR.
CONSTRUCTED WETLANDS FOR WATER FILTRATION

M. L. Robinson, Area Extension Specialist/Associate Professor
Heike Franzen, Proven Winners Specialty Crops
Frank Williams, Professor Retired
Evan Fulton, State Water Specialist/Assistant Professor

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.

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

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 aerator 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.
The Decentralization of Private and Municipal Wastewater Treatment Through the Development of a Constructed Wetlands Policy

M. L. Robinson
University of Nevada Cooperative Extension

Rationale and objective for this policy
As the nation’s population continues to grow, development is pushing further from the centralized wastewater treatment plants and more into rural areas. In many areas, the conventional septic tank/field line systems have proven inadequate for wastewater treatment. Various reasons for this are high ground water tables or poor soil percolation rates. (In the United States, there are over 25 million septic tanks in use of which 25,000 are in Southern Nevada. Nationwide septic tank failures run from 36% to 72%.) It has long been recognized that natural wetlands such as marshes, swamps, and bogs, helps protect water quality. Constructed or artificial wetlands systems mimic the treatment that occurs in natural wetlands and by relying on plants and a combination of naturally occurring biological, chemical, and physical processes to remove pollutants from water. As of 1999, there were more than 500 constructed wetlands in Europe and 600 in North America. With many of the centralized wastewater treatment plants aging and in need of upgrading, less energy intensive and more environmentally sound ways of treating wastewater and conserving potable water are needed.

The USEPA publication “Response to Congress on use of Decentralized Wastewater Treatment Systems” lists the following benefits of decentralized systems:

1. Protect public health and the environment, and promote better watershed management by avoiding the potentially large transfers of water from one watershed to another (wetlands have been able to remove 76.8% BODs, and up to 99% fecal coliform)
2. Appropriate for low density communities
3. Appropriate for varying site conditions
4. Protection of ecologically sensitive areas by removal of nutrients (40.2% to nearly 100% of ammonia has been removed from the wastewater by wetlands)
5. Promote cost savings due to lower capital investment and maintenance costs. The Tres Rios pilot project in Arizona cost $3.5 million to build compared to the $625 million estimated to upgrade the existing facility. Only $80 million more was needed to turn the pilot project into a comparable full-scale treatment facility. This reflected a savings of over $542 million over upgrading. In addition, local aquifers were recharged and other water reuse opportunities such as wildlife habitat were provided. The Kingman, Arizona facility was designed without environmental wetlands attractions because of liability concerns. Such features would attract the public. Yet, these wetlands still attract wildlife. This is especially true in desert areas where water is so scarce. Urban residential areas are provided with wildlife and ornamental value without the use of potable water.

References


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WATER HARVEST MORE INFORMATION
### Constructed Wetlands Fact Sheet

**Location:** Newberry County, near Prosperity, SC
**Owners:** Charles and Mildred Tyler

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**Construction**
- Septic tank is lined with 45 mil synthetic rubber which prevents seepage into ground water.
- Septage flows through gravel and the roots of aquatic plants.
- Water is maintained at a depth of 12 inches. The top 3 inches of the gravel surface remains dry.

**Design Considerations**
- This design is based on a 3-bedroom house allowing for 360 gallons of water use/day.
- 1,000 gallon baffled septic tank with a sewage filter was installed to minimize solids and organic loading to the constructed wetlands system.
- Because of site conditions, a submersible pump was used to carry sewage from septic tank to the treatment cell which is located upslope.

**Maintenance**
- Property owners agree to:
  - Maintain designated water levels in treatment cell.
  - Control aquatic vegetation in the treatment cell.
  - Perform periodic pump-out of septic tank and cleaning of sewage filter.

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**For More Information About These Demo Sites:**

**Sites:**
- **Site 1:** Dave Demarest, Foothills RCD Area Tel: (864) 467-0775
- **Site 2:** Keith Cain, East Piedmont RCD Area Tel: (863) 559-2767
- **Site 3:** John Underwood, Lowcountry RCD Area Tel: (843) 549-5994
- **Site 4:** Steve Edwards, Ninety-Six RCD Area Tel: (864) 229-2174
- **Site 5:** Jerry Sanders, Ninety-Six District RCD Area Tel: (864) 353-9809
- **Site 6:** Wally Owen, Pee Dee RCD Area Tel: (843) 353-9809
- **Site 7:**
  - Roy Tedd, Sonset-Wetstone RCD Area Tel: (803) 629-0764
- **Site 8:** Peter Zacks, Edisto-Savannah RCD Area Tel: (803) 641-1154

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**Figures:**
- Constructed Wetlands Sewage Treatment System
- Subsurface Flow Constructed Wetlands Demonstration Sites
- An Environmentally Safe Alternative to Failed Septic Systems
- Constructed Wetlands...
REMEMBER, WE ALL CAN CONSERVE WATER
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