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CONSTRUCTED WETLANDS:
A NATURAL WATER FILTERING SYSTEM FOR CONSERVATION

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ABSTRACT

- Natural wetlands such as marshes, swamps and bogs have long been known to protect water quality. Constructed or artificial wetland systems mimic the treatment that occurs in natural wetlands 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. Constructed wetlands are a less energy intensive and more environmentally sound way of treating wastewater and conserving potable water. A small (20' x 20' x 4') constructed wetland can clean all black, gray and other runoff water for the average home or small business. Water harvested from homes and small businesses including black and gray water, rainwater and other run off water (such as irrigation) can be cleaned using constructed wetlands. This water can be used for flushing toilets, sub irrigation and other uses. The demonstrated effectiveness of constructed wetlands for wastewater treatment provides useful lessons to create buffer zones for various types of contaminated water. Constructed wetlands not only reclaim water but provide needed habitat for wildlife. Even a small one (20' x 20') will serve as a lush oasis, attracting birds, butterflies, toads and other animals.
- This presentation will concentrate on the first single-family home constructed wetland in southern Nevada, whice was completed eight years ago. This wetland has been regularly monitored since then and has shown excellent filtering capabilities. Two larger constructed wetlands, part of the school grounds and science projects in the Albuquerque, New Mexico School District, have had similar success and will also be discussed.

NEVADA FACTS

- STATE BIRD
- STATE TREE
- STATE BUG

WHY CONSTRUCTED WETLANDS?

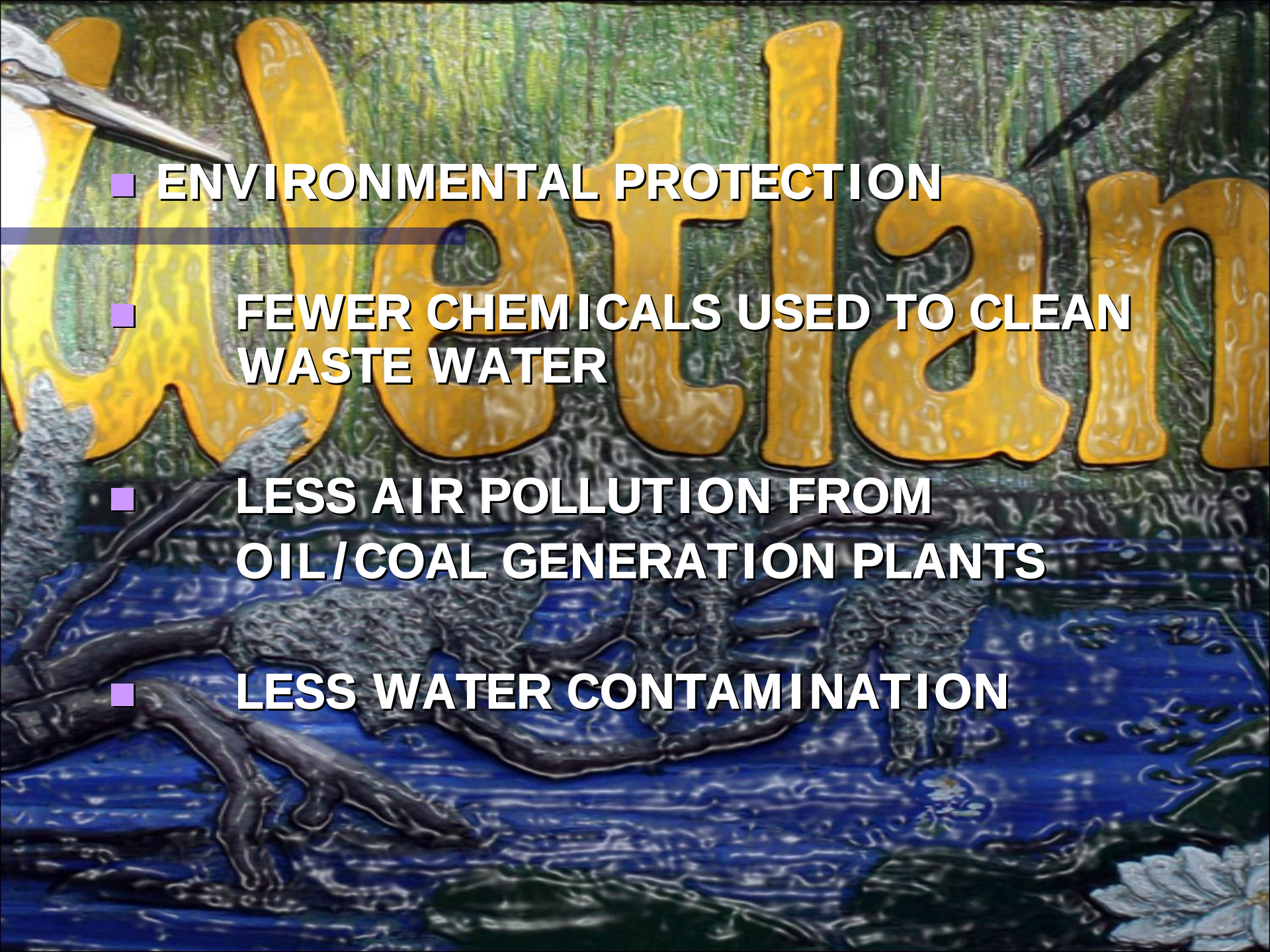
- WATER CONSERVATION

  RUNOFF, GRAY AND BLACK WATER CAN BE RECYCLED AND USED ON SITE
- ENERGY CONSERVATION

  REDUCES PUMPING BETWEEN

  CUSTOMERS AND SUPPLIERS

  GRAVITY FEED AND SOLAR POWER USED



- 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 TO MAINTAIN

Chart 2B – Water Prices – Desalinated vs. Freshwater [30]

	Freshwater (per acre ft)	Desalinated (per acre ft)
U.S. - Carlsbad, CA	$531	$794*
U.S. - Tampa, FL	$488 - $570	$811
Cyprus	$234 - $530	$900
Saudi Arabia	$321 - $1,974	$592 - $2,714
Canary Islands	$1,172**	$1,998
Malta	$1,172**	$1,630

*Estimate for proposed plant **Price for consumption exceeding 80,000 gallons.

Currently, 13,600 desalination plants worldwide produce a total of 6.8 billion gallons of water daily, less than 1% of all the world's water needs.[29]

FROM "IRRIGATION FOR A GROWING WORLD" RAIN BIRD CORPORATION

WATER FACTS

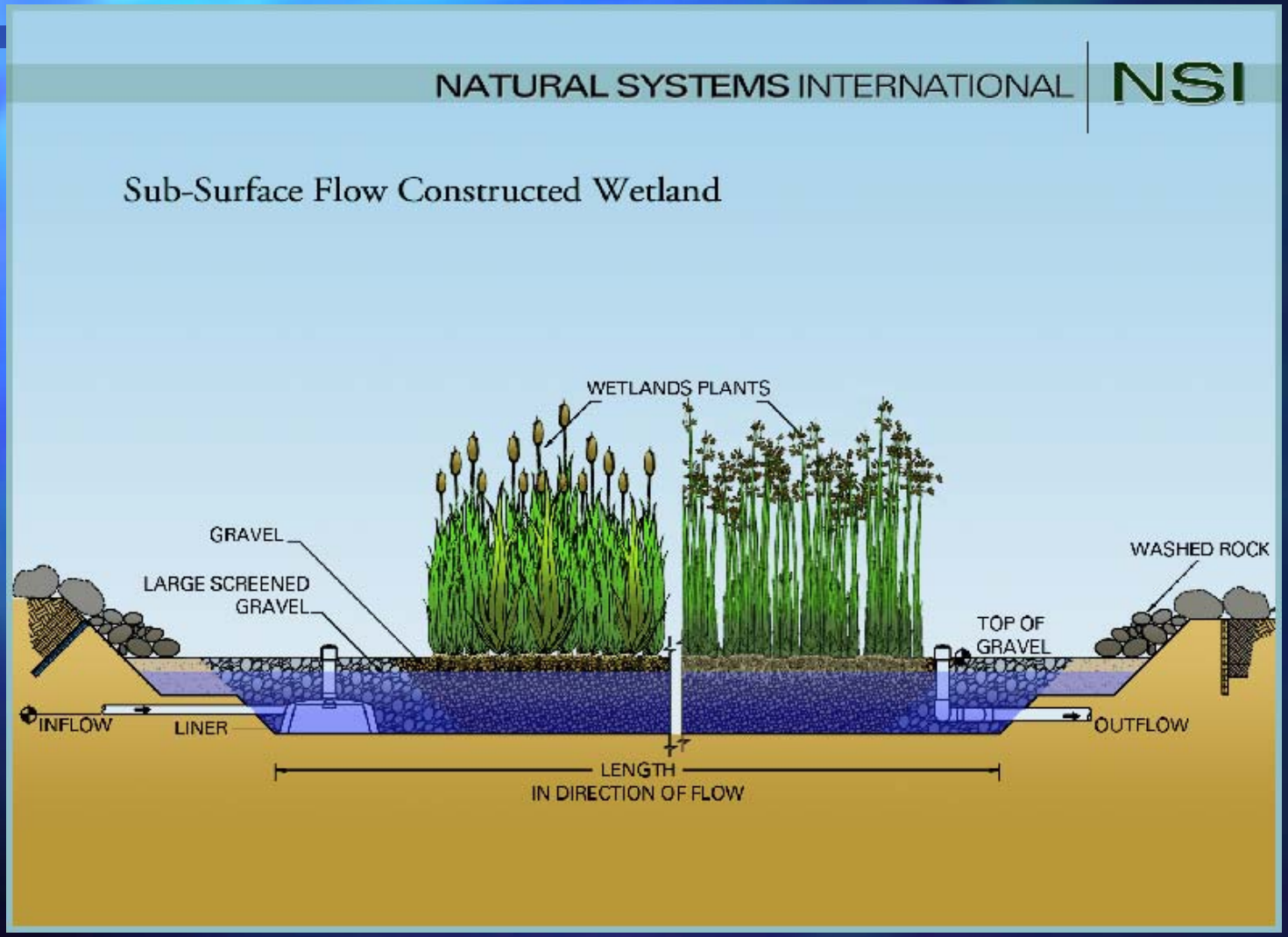
- ANNUALLY MORE THAN 4 MILLION CHILDREN DIE FROM WATERBORNE DISEASES WORLDWIDE
- ANNUALLY 1.2 BILLION PEOPLE SUFFER FROM DISEASES CAUSED BY UNSAFE DRINKING WATER OR POOR SANITATION
- UNSAFE WATER IS RESPONSIBLE FOR 80% OF ALL DISEASES AND 30% OF DEATHS IN THE DEVELOPING WORLD
- BY U. N. ESTIMATES, 2/3 OF HUMANITY WILL FACE SHORTAGES OF CLEAN FRESHWATER BY 2025

FROM "CLEARWATER ONE WOMAN'S PRAYER" NATIONAL DOCUMENTARY PBS

USES OF CONSTRUCTED WETLANDS

- INDIVIDUAL HOMES AND SMALL BUSINESSES
- SMALL TO MEDIUM SIZED COMMUNITIES
- LARGER BUSINESSES, INCLUDING FACTORIES AND SCHOOLS

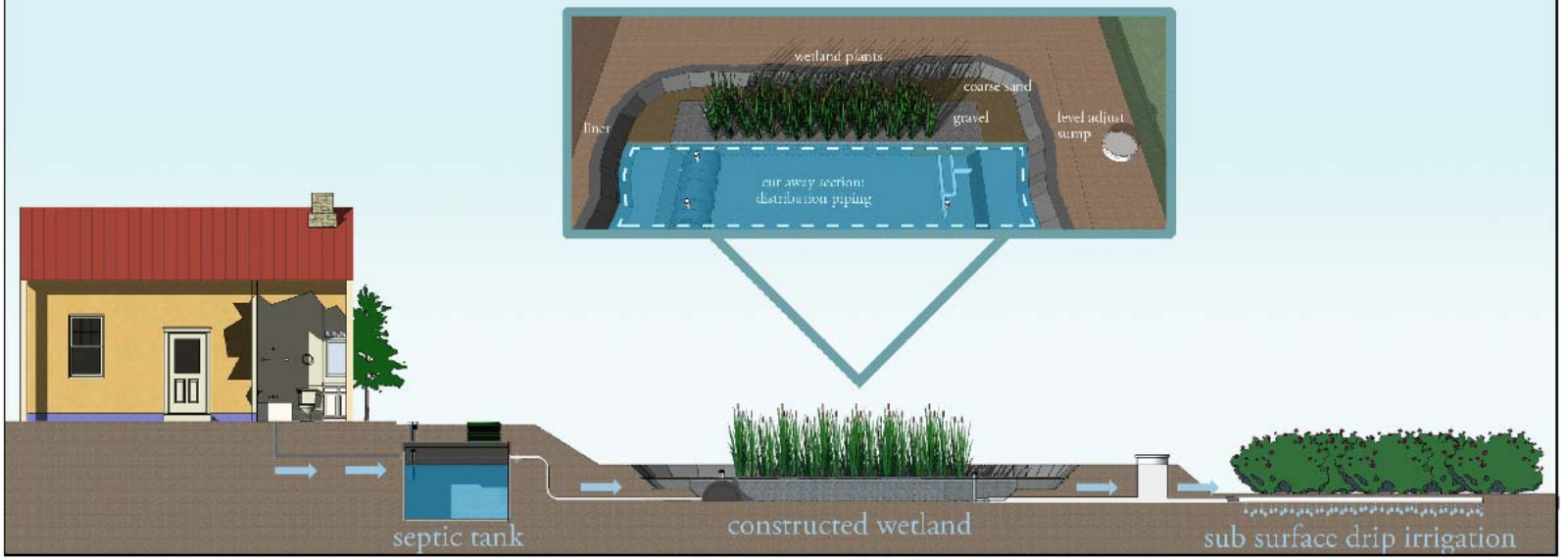
BASIC DESIGN



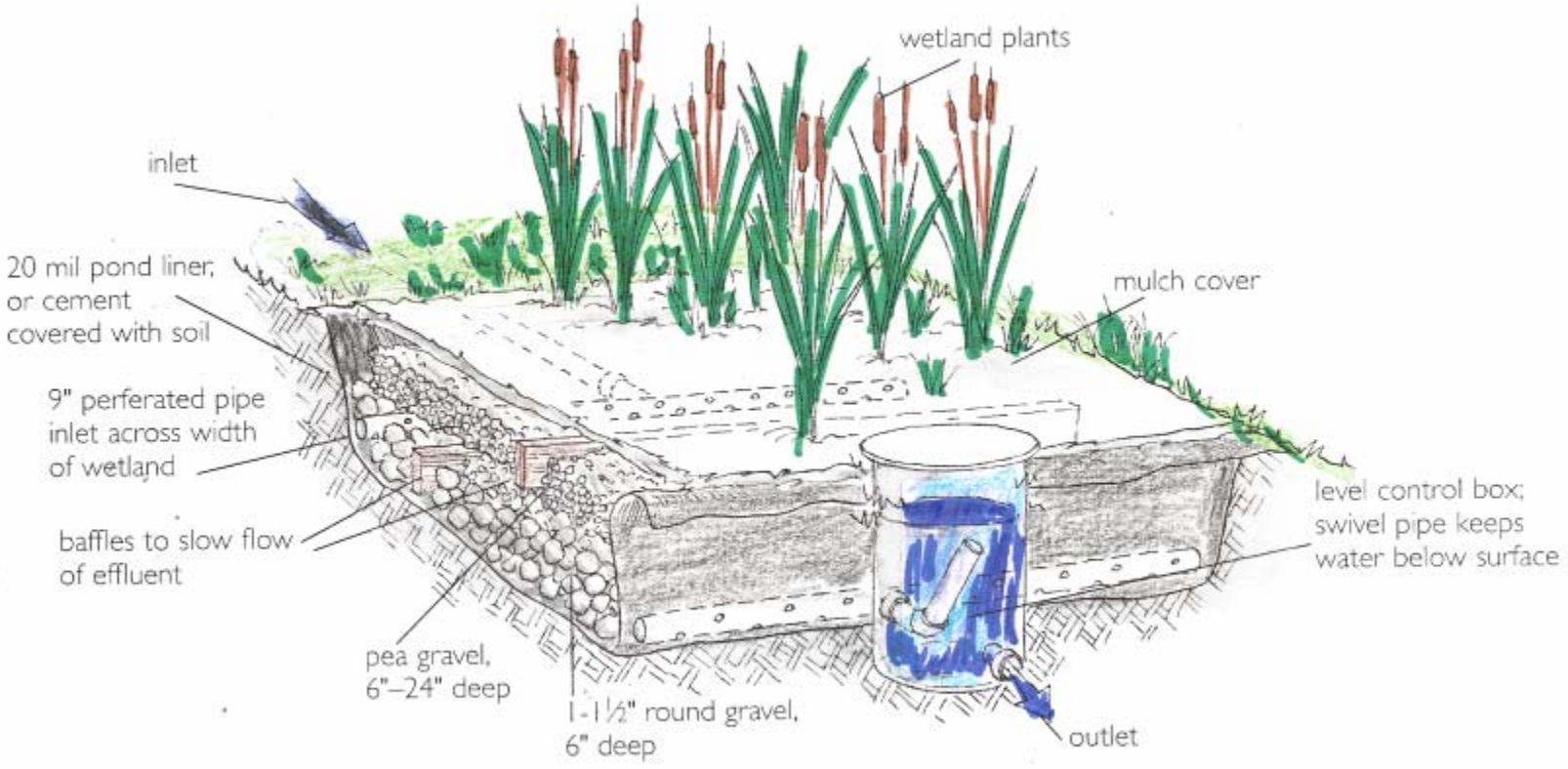
BASIC DESIGN

NATURAL SYSTEMS INTERNATIONAL NSI

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)



BASIC DESIGN



A greywater wetland.

BUILDING A SMALL CONSTRUCTED WETLAND

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

BUILDING A LARGE CONSTRUCTED WETLAND

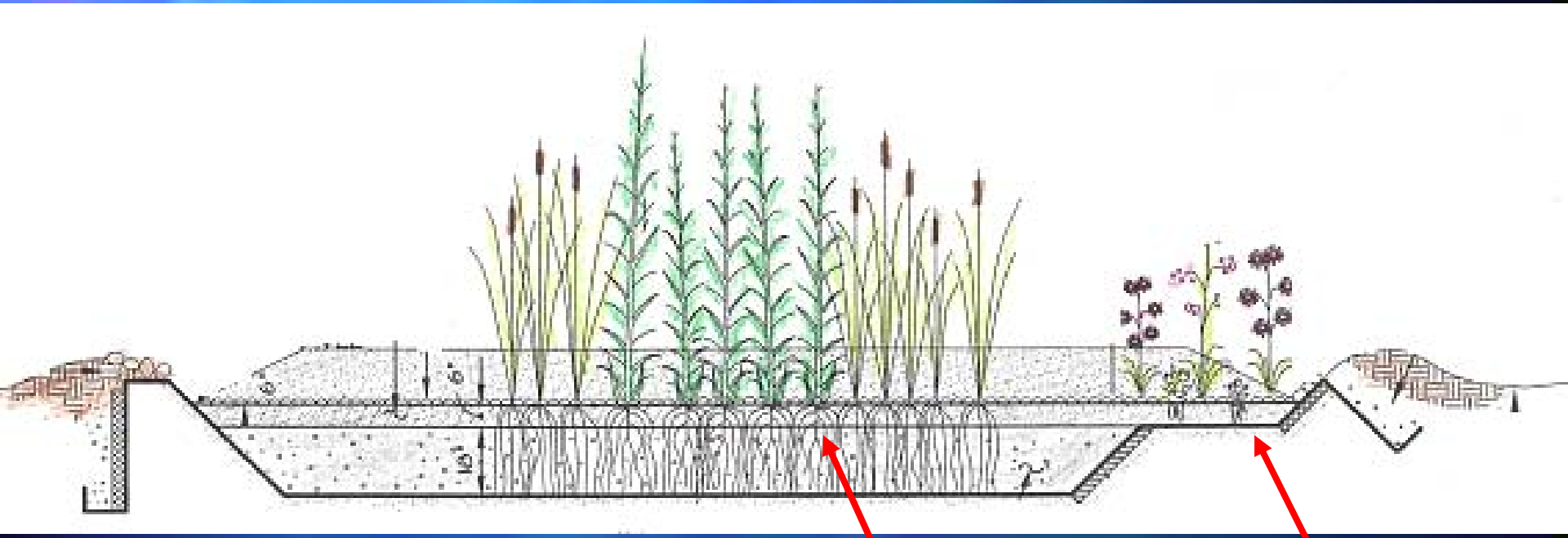
SOME IMPORTANT FACTS

- 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 PROCESS PER DAY (DEPENDING ON THE NUMBER OF CELLS)
- COST FOR INSTALLATION $175,000 TO $195,000

SOME IMPORTANT FACTS

- MOST MAINTENANCE INVOLVES THE 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


PLANT ROOTS FILTER THE WATER
WATER SHOULD ALWAYS BE SUBSURFACE
1/4 IN. PEA GRAVEL FORMS 2/3 OF THE FILTER BED
3/4 TO 2 IN. ROCK FORMS 1/3 OF THE FILTER BED
WATER IS PUMPED TO THE BOTTOM OF THE FILTER BED
IMPERMEABLE LINER
UNDERLINER
STORAGE OF FILTERED WATER TO BE REUSED LATER

PLANT SELECTION

- IF PLANTS ARE NOT PRIMARILY FOR AERATION, ANY PLANTS CAN BE USED
- USE NATIVE AND NATIVE LIKE PLANTS
- CHOOSE PLANTS FOR BEAUTY
- CHOOSE PLANTS THAT ARE LESS AGGRESSIVE SUCH AS STERILE HYBRIDS

CATTAILS IN THE DESERT
JUST ADD WATER

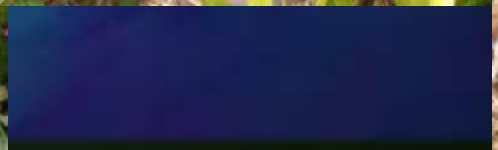
PLANT SELECTION

- 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



PICKERELWEED

CANNAS

NON AQUATICS CAN BE USED

ROSEMARY

BEACH SUNFLOWER

AND

SWEET POTATO

AGGRESSIVE PLANTS NEED TO BE HARVESTED OFTEN

OVER 6 FT.

REEDS, CATTAILS ETC.

WHERE TO FIND INFORMATION

East Piedmont Resource Conservation & Development Council

Constructed Wetlands Fact Sheet

Lake Murray Demonstration Site

Site Location

Newberry County
(near Prosperity, SC)
Homeowners: Charles and Mildred Tyler

Sewage water was seeping into Lake Murray because of the failed septic system.

Pre-Installation Site Conditions

A conventional septic system was installed in 1994 and malfunctioned within eight months. The soil is a tight clay with a restrictive layer. Slope ranges from 5-17 percent. The soil is unsatisfactory for conventional septic systems because of steep slope and slow water infiltration rates. The septic system is within 100 feet of Lake Murray and sewage water surfaced and entered the lake.

Design Considerations

- This design is based on a 3-bedroom house allowing for 360 gallons of water use per day.
- A 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 water from septic tank to the treatment cell which is located up-slope.

Cost

Materials	$4,034
Labor & Equipment	$2,260
TOTAL	**$6,294**

Construction

- The treatment cell is lined with 45 mil synthetic rubber which prevents seepage into ground water.
- In the lined treatment cell, the sewage water flows through gravel and the roots of aquatic plants. The water is maintained at a depth of 12-inches. The top 3-inches of the gravel surface remains dry.
- Sewage water is pumped into the treatment cell. Micro-organisms that grow in the gravel bed digest the organic material and the aquatic plants absorb nutrients and assist with water disposal through transpiration into the atmosphere. Some of the water will pass into the atmosphere through evaporation. Any remaining treated water is released into the underground disposal cell which consist of 18 inches of sand and gravel.
- Aquatic vegetation consists of canna lily, blue and yellow flag iris, elephant ear, pickerelweed, giant bulrush, and giant cutgrass.

Maintenance

- Property owners agree to--
  - -maintain designated water level in treatment cell
  - -care for aquatic vegetation in treatment cell
  - -perform periodic pump-out of septic tank and cleaning of sewage filter

Septic systems with drainage field lines are commonly utilized to handle sewage discharge from households in South Carolina. These septic systems may fail when water infiltration rates into the soil are inadequate for drainage filter field lines to work properly. In extreme cases, the sewage water will actually surface, possibly causing a public health risk. One method to reduce this problem is to treat the sewage water prior to in-ground disposal. This can be done with a subsurface flow constructed wetlands system.

In a constructed wetlands system, sewage water flows from the septic tank into a treatment cell containing gravel and aquatic plants. Micro-organisms that grow in the gravel bed digest the organic material and the aquatic plants absorb nutrients and assist with water disposal through transpiration into the atmosphere. Some of the water will pass into the atmosphere through evaporation. Any remaining treated water is released into an underground disposal cell or drainage field.

In the spring of 1999, eight constructed wetlands demonstration sites in South Carolina were installed on failed septic systems by Resource Conservation & Development (RC&D) Councils. These demonstration sites will serve as an evaluation of constructed wetlands as one alternative for malfunctioning conventional septic systems, as well as offer opportunities to utilize and evaluate current technology in adapting this innovative system in South Carolina.

Each site will be monitored for 12 to 18 months to determine the effectiveness of constructed wetlands in reducing pollutants in household sewage water.

Constructed Wetlands.....

An Environmentally Safe Alternative to Failed Septic Systems

Constructed Wetlands Demonstration Sites
(general locations of eight sites)

For More Information About These Demo. Sites:

Site 1:
Dave Demarest
Foothills RC&D Area
Tel.: (864)467-2775

Sites 2 and 3:
Keith Cain
East Piedmont RC&D Area
Tel: (803) 635-2757

Site 4:
Steve Edwards
Lowcountry RC&D Area
Tel: (843) 549-5596

Site 5:
Jimmy Sanders
Ninety-Six District RC&D Area
Tel: (864) 229-2174

Site 6:
Wylie Owens
Pee Dee RC&D Area
Tel: (843) 393-8809

Site 7:
Roy Todd
Santee-Wateree RC&D Area
Tel: (843) 629-8784

Site 8:
Peter Zeck
Edisto-Savannah RC&D Area
Tel: (803) 641-1554

A project sponsored by the South Carolina RC&D Councils in partnership with:

USDA NRCS · SCACD · Making Things Happen · DHEC · Firestone

All SC RCSD programs are administered in a non-discriminatory manner.

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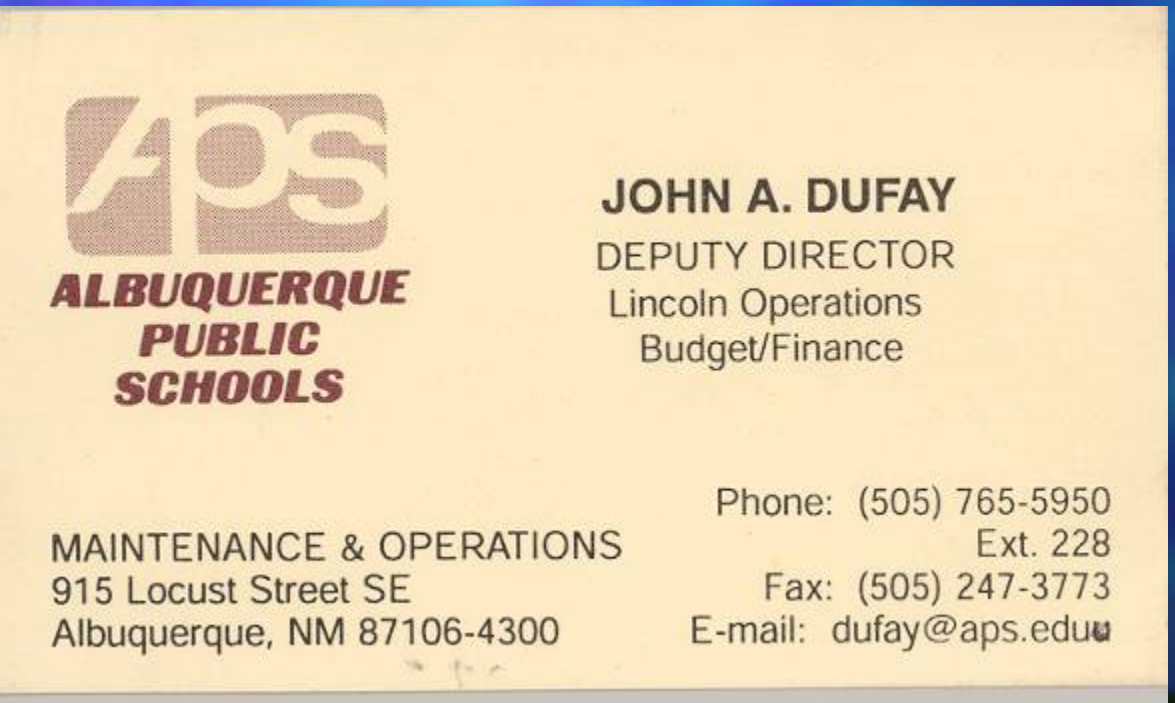

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SP-01-14

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

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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 wetland 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.

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CONSTRUCTED WASHES CATCH RUNOFF

EXAMPLES OF WORKING SYSTEMS

THIS WATER CAN THEN BE FILTERED IN CONSTRUCTED WETLANDS

HIGHWAY WATER HARVEST


REMEMBER WE ALL CAN
CONSERVE WATER

- **FOR MORE INFORMATION CONTACT**

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