WETLAND RESTORATION:

An Alternative Way To Treat Nonpoint Source Pollution

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EPA

CHARLESTON HARBOR PROJECT

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South Carolina Department of Health and Environmental Control

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Introduction

Water quality in the United States is of special concern today. With increased population growth, the demands on our lakes, rivers, and coastal waters are becoming overwhelming. By the year 2015 the Berkeley, Charleston, and Dorchester county area is projected to grow by over 22% to a population of 619,000. Related development and pollution can lead to poor water quality which may cause fish kills, prohibitions on shellfish harvesting and the closure of beaches and waterways to recreational activities. Sources of pollution can be grouped into two main categories: **point source** (**PS**) and **nonpoint source** (**NPS**) pollution. Point source pollution can be traced to a specific source such as a discharge pipe from an industrial plant which leads directly into a body of water. This type of pollution is relatively easy to pinpoint and monitor. With today's strengthened state and federal standards, point source pollution has been greatly reduced. Another culprit of degraded water quality is nonpoint source pollution. As a matter of fact, the Environmental Protection Agency (EPA) says that from one-third to two-thirds of our nation's water quality problems are due to nonpoint source pollution. This type of pollution comes from rainwater which runs over lawns, parking lots, city streets, and forests, picking up and carrying pollutants into our rivers and oceans. NPS pollution includes fertilizers, pesticides, animal wastes, fluids from our cars and boats, and sediment from erosion. Because this type of pollution comes from many different sources, it must be dealt with on a broad basis. With this in mind, South Carolina has developed and implemented a Nonpoint Source Management Program. This program incorporates several different federal and state regulations which all contribute to the same goal—the improvement of water quality through the reduction of pollution caused by stormwater runoff (NPS pollution).

Important regulations contributing to the South Carolina NPS Management program are:

- **The South Carolina Pollution Control Act of 1976**
  Declares that "(it is) the policy of the State to maintain reasonable standards of purity of air and water...(furthermore) DHEC shall have the authority to abate, control, and prevent pollution." This act also establishes official classified uses and standards for the state's waters. These standards are used in the 401 certifications. (*below)*
- **Section 401 of Federal Water Pollution Control Act of 1972**
  Provides for state certification of federal permits to ensure that projects do not contravene state water quality standards. Any project in federal navigable waters requires a permit, and therefore a certification.
- **Section 319 of the Federal Clean Water Act of 1987**
  The Federal Clean Water Act establishes the goal that all waters of the U.S. be fishable and swimmable. Section 319 states that, "It is the national policy that programs for the control of nonpoint sources of pollution be developed and implemented…so as to enable the goals of this Act."
- **Section 6217 of the Federal Coastal Zone Act Reauthorization Amendments (1990)**
  Requires any state with a federally approved coastal zone management program to develop a nonpoint source pollution management program. The purpose is to "reduce NPS pollution (in order) to restore and protect coastal waters, working in conjunction with other state and local governments."
- **The South Carolina Stormwater Management and Sediment Reduction Act 1991**
  Establishes the procedures and minimum standards for a statewide uniform stormwater management and sediment reduction program. These regulations encourage management of stormwater (NPS) on a watershed basis.
- **The South Carolina Coastal Zone Management Act of 1976**
  Provides for "The protection and where possible, the restoration of the resources of the state's coastal areas." To do this, the act establishes rules and regulations for beaches and saltwater wetlands permitting. It also allows for management of stormwater (NPS) impacts and freshwater wetlands in the states eight coastal counties.

The NPS programs that have resulted from these regulations attempt to manage NPS pollution by applying different **management measures**. These measures generally require new developments to maintain predevelopment runoff rates. In addition, the first inch of stormwater runoff should be caught and stored in a retention basin for at least 24 hours. This improves water quality by slowing runoff which helps to prevent erosion. It also allows sediments and pollutants time to settle out before entering receiving waters. Once these pollutants settle out, they can then be reduced through storage, decomposition, and assimilation. To accomplish this goal, regulatory agencies have created standards, developed practices, and encouraged planning on both a large and small scale. Some specific management measures are:

New Development Management Measures

This measure is intended to mitigate the effects of new development on water quality by requiring that…

1. The majority of sediment from land disturbance activities be contained on site during construction.
2. To the extent practicable, post-development peak runoff rates be maintained at or below predevelopment levels.

Site Development Management Measure

This measure recommends that local governments plan and design small scale site development in an effort to…

1. Protect areas that provide important water quality benefits and/or are particularly susceptible to erosion and sediment loss.
2. Limit increases of impervious areas.
3. Limit land disturbance activities such as clearing and grading, and cut and fill to reduce erosion and sediment loss.
4. Limit disturbance of natural drainage features and vegetation.

Watershed Protection Management Measure

This measure encourages comprehensive planning for development on a watershed basis. EPA recommends this measure in order to...

1. Avoid conversion to the extent practicable of areas that are particularly susceptible to erosion and sediment loss.
2. Preserve areas that provide important water quality benefits and/or are necessary to maintain riparian or aquatic biota.
3. Develop sites, including roads, highways and bridges, consistent with the natural integrity of water bodies and natural drainage systems.

In order to implement these general management measures, **Best Management Practices** (or **BMPs**) are applied to specific sites. What is a BMP?

A BMP is a practice or combination of practices that are determined to be an effective and practical means of controlling NPS pollution (taking into account technological, economic, and environmental considerations). BMPs are generally required for new construction, development, and land disturbance activities. They are designed to alleviate the effects of NPS pollution on ground and surface waters.

Why are BMPs necessary?

When man alters the land through construction or other activities, he changes the established "hydrology" of the area. In most natural undisturbed areas, stormwater typically enters the groundwater by percolating through the soil. As it enters the ground, it is cleansed through physical filtration and biochemical processes. The root systems of established vegetation also help prevent erosion by holding the soil together. When this natural flow of water is interrupted or diverted, it can cause water quality problems. Construction activities (i.e. paving and land clearing) cause pollutants such as sediments, nutrients, heavy metals, petroleum, and bacteria to flow directly into receiving water bodies without first being filtered or treated through natural processes. In order to recreate this natural hydrology and lessen the effects of man's activities, the use of BMPs has been encouraged.

The coastal NPS program established by the National Oceanic and Atmospheric Administration (NOAA) and EPA address several different NPS areas of concern. They are hydromodification (dams, canals, etc.), wetlands alterations, forestry, agriculture, marinas, and urbanization. These activities can have a significant impact on water quality. Of these however, special concern is focused on **urbanization** in rapidly growing areas like the Charleston Harbor watershed. This area consists of the Harbor, the Ashley, Cooper, Wando, Stono, and North Edisto Rivers and the land that adjoins them. The effects of urbanization in areas like this have been linked to the degradation of urban waterways.

Wetland BMP—outfall pipe regulating water level in urban wetland system.

How does urbanization affect water quality?

It can increase the area of impervious surfaces (concrete, asphalt, etc.) from roads, bridges, parking lots, sidewalks, and driveways. This decreases the filtration capacities of the ground which results in more runoff.

It can change the physical, chemical, and biological characteristics of the watershed through land disturbance (i.e. excavating, filling, and grading for construction). This destroys natural wetlands and depressions which could have held water and removes stabilizing vegetative cover.

It can increase pollutants from human activities. Some of these pollutants include nutrients, pesticides, toxic metals, road salts, etc.

Major pollutants stemming from urban runoff are:

- **Sediments** (sand/silt) – Sediments can have an adverse effect on riparian habitat. Excessively high sediment loads can smother submerged aquatic vegetation, cover shellfish beds/tidal flats, fill in riffle pools and contribute to increased levels of turbidity which decreases the amount of light reaching photosynthetic organisms. Increased turbidity can also decrease ambient water temperature which stresses some aquatic and marine organisms.

  Sources Erosion from construction sites and other land disturbing activities, usually due to the removal of stabilizing vegetation.
- **Nutrients** (phosphorus/nitrogen) – Nutrient loading can cause excessive plant and algal growth. When these organisms die and decay, they are consumed by oxygen demanding bacteria. These bacteria can use much of the available oxygen in lakes, rivers, and streams. This deprives fish and other animals of oxygen and can lead to fish kills. Also, excessive plant growth can choke off waterways and cause eutrophication.

  Sources Fertilizers, sewage, and animal excrement.
- **Petroleum hydrocarbons** (oil/gas) – Hydrocarbons can smother aquatic, marine, and bird life. Hydrocarbons can also be toxic to these organisms. Some polynuclear aromatic hydrocarbons (PAHs) can mimic reproductive hormones and consequently disrupt reproduction. Hydrocarbons may also collect in bottom sediments where they have adverse impacts on benthic communities.

  Sources Automobiles, boats, hydraulic machinery, etc.
- **Pesticides** (insecticides/herbicides) – Pesticides, despite their documented benefits, can be detrimental to water quality. Because they are not always target specific, they may harm the environment by reducing or eliminating populations of desirable organisms. Some pesticides are resistant

to degradation and may accumulate in aquatic ecosystems.

Sources Lawns, gardens, golf courses, etc.

- **Heavy metals** (lead/mercury) – Heavy metals can be very toxic to organisms. They can kill and/or impair the reproductive cycle by disrupting enzyme function. Also, heavy metals tend to accumulate in fish and shellfish and persist for long periods of time in the environment.

Sources Car exhaust, metals used in soldered pipes, gutters, downspouts, flashings, etc.

- **Pathogenic bacteria** (fecal coliform, etc.) – Bacteria from animal excrement and decaying organisms can cause diseases and illness in humans. Some severe infections caused by bacteria are dysentery and cholera. They usually infect the intestinal tract and often result in pain, diarrhea, vomiting, cramps, and dehydration.

Sources Faulty sewer and drainage systems, pet waste, decaying plant/animal material, etc.

Structural BMPs for urban (and other) areas

Structural BMPs are designed to reduce NPS pollution. They accomplish this by maximizing the process of pollutant removal through**:**

a. physical filtration
b. retention/settling
c. adsorption
d. plant uptake/assimilation
e. microbial decomposition

Some specific structural BMPs are:

- detention/retention ponds
- porous pavement
- vegetated buffer strips
- grassed swales (shallow ditches)
- urban forests
- infiltration basins
- constructed wetlands

While these particular structural Best Management Practices are beneficial to water quality, they are not always the most effective. In areas where nearby natural wetlands exist, routing and/or restoration are sometimes a better solution as an alternative BMP. This is because natural wetlands have an inherent ability to purify rainwater and associated stormwater runoff. With this in mind, the ***Charleston Harbor Project*** decided to conduct a pilot project using this type of under utilized BMP.

Charleston Peninsula

What is the Charleston Harbor Project?

The ***Charleston Harbor Project***, or CHP, is a Charleston Harbor watershed research and planning project which covers much of Berkeley, Charleston, and Dorchester Counties. It's area is defined by the Charleston Harbor estuary system which includes the Harbor, Ashley, Cooper, Wando, Stono and North Edisto Rivers and the surrounding land area. These rivers drain into the Charleston Harbor and with their adjoining land area, form the Charleston Harbor watershed. It covers more than 1900 square miles and contains over 140 miles of rivers. The CHP area is home to nearly one half million people and numerous marine organisms. The Charleston Harbor regional watershed is not only a self-contained and manageable ecosystem, but a unique economic community as well. With it's port, tourists, and fisheries industry, Charleston is a vital part of the State's economy. As a place of early European settlement and significant involvement during the Civil War, Charleston also has a unique heritage and culture. The CHP mandate is to identify potential threats to the environmental, economical, and cultural resources of the area. It's goal is to maintain and enhance the quality of the environment, while also maintaining the many uses of the areas waters and natural resources. The CHP relies on federal, state, and local governments to work with all interested parties (public & private), in order to develop management programs for the harbor and river systems.

A Wetland Restoration/ Routing Project

In 1987, the S.C. Dept. of Health & Environmental Control, the S.C. Coastal Council, and the U.S. Geological Survey conducted a water quality study in the Ashley River sub-basin. This study area included six creeks and was experiencing significant urban and suburban development. The findings of this study indicated elevated levels of pollutants resulting from stormwater runoff. Cumulatively, NPS pollution can lead to the degradation of water quality. By 1994, the CHP recognized that the Ashley River was still experiencing water quality problems due to development and related NPS pollution from stormwater runoff. Application was made to the U.S. Environmental Protection Agency for funds from Section 319 of the Clean Water Act to conduct a wetland restoration project along a tributary of the Ashley River. After receiving funding, the CHP in cooperation with Dorchester County, the Town of Summerville, the U.S. Army Corps of Engineers (USACOE), the U.S. Fish & Wildlife Service, the National Marine Fisheries Service, the S.C. Dept. of Natural Resources, and the S.C. Dept. of Health & Environmental Control chose a site on approximately 9.5 acres of wetlands adjacent to the Sawmill Branch Canal. This area had been altered by the USACOE during the 1960's in an effort to control flooding in Summerville, South Carolina. The methods used by the USACOE to prevent flooding included channelizing and deepening local creeks through dredging. Unfortunately the spoil, or dirt, from the dredging was often placed between healthy wetlands and the newly created canals (*Figure 2*). This spoil isolated the wetlands from the canals and caused the degradation of the wetlands and poor water quality in the canals. The

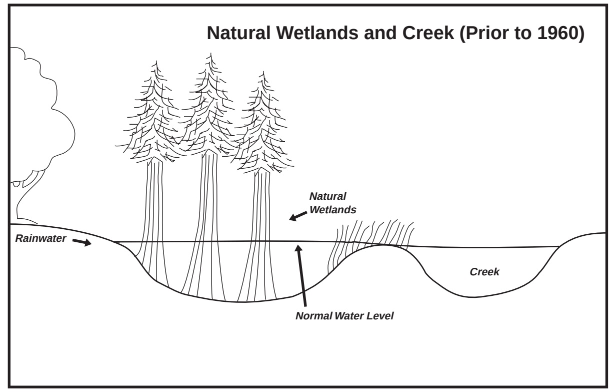

Figure 1

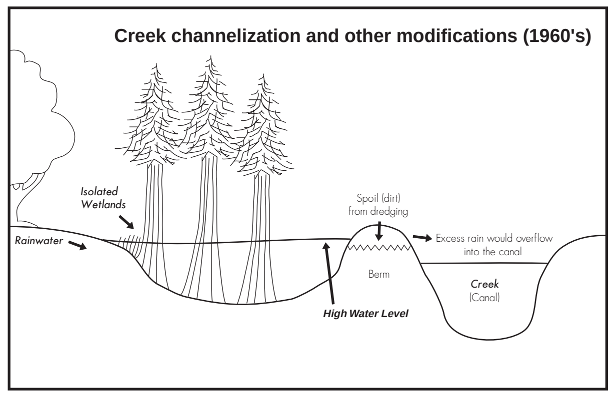

Figure 2

upper reaches of Dorchester Creek, now called the Sawmill Branch Canal, was one such creek altered by the USACOE. As a result of this activity, wetlands that had been isolated alongside the canal would retain rainwater instead of releasing it gradually into the creek as it normally would. During heavy rains this water would build up and eventually overflow into the canal, thus dumping unfiltered stormwater and sediment into the canal . This resulted in poor water quality in the canal and consequently the Ashley River to which it flowed. In and effort to remedy the problem, flow pipes were placed beneath the berm created by the spoil. This connected the wetlands to the canal once

Sawmill Branch Canal

again. Unintentionally however, these pipes were placed too low and served to drain the wetlands of valuable water (*Figure 3*).

Another problem in the area resulted from developments along the canal. Stormwater pipes draining nearby subdivisions had been installed in ditches which completely bypassed the wetlands and directly entered the Sawmill Branch Canal (*Figure 3*). This not only deprived the wetlands of valuable water, but caused a high volume of unfiltered water to enter the canal at one time. Consequently, this heavy flow of water caused streambank erosion and sedimentation along the canal. The cumulative effects of these problems resulted in inadequate water supply to the wetlands and poor water quality in the canal.

In order to reestabish a healthy wetland ecosystem, it was necessary to pursue two main goals:

Project Goals

I. Increased Water Supply to the Wetlands

The first goal was to increase water supply to the wetlands in an effort to keep them from drying out. As mentioned earlier, stormwater pipes draining nearby subdivisions had been installed in the area bypassing local wetlands and directly entering the Sawmill Branch Canal; thus, depriving them of a valuable source of water (*Figure 3*). One of these pipes draining a major ditch in the area was chosen to be rerouted to the wetlands. In order to achieve this, a concrete diverter structure was designed to be connected to the drainpipe near the end of the ditch. Once this device was constructed and installed, it effectively redirected the flow of stormwater previously entering the Sawmill Branch Canal to the degraded adjacent wetlands (*Figure 4*).

II. Increased Water Retention in the Wetlands

The second goal was to prevent the unintentional draining of the wetlands. Again as mentioned previously, in an effort to prevent the wetlands from overflowing, flow pipes had been placed under the berm separating the isolated wetlands from the Sawmill Branch Canal. These pipes were originally placed too low, and were actually draining the wetlands (*Figure 3*). Utilizing engineering techniques, the desired holding capacity of the wetlands was calculated. The pipes located beneath the berm were then raised enough

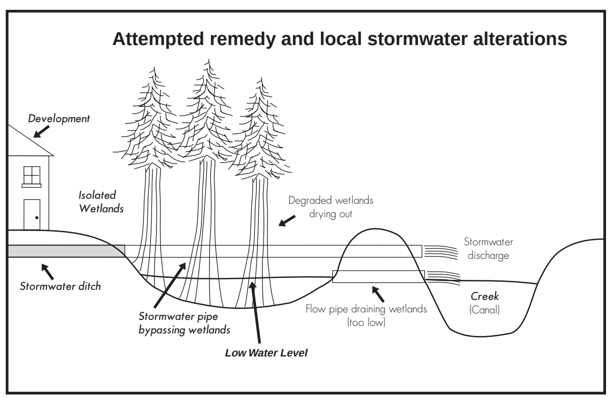

Figure 3

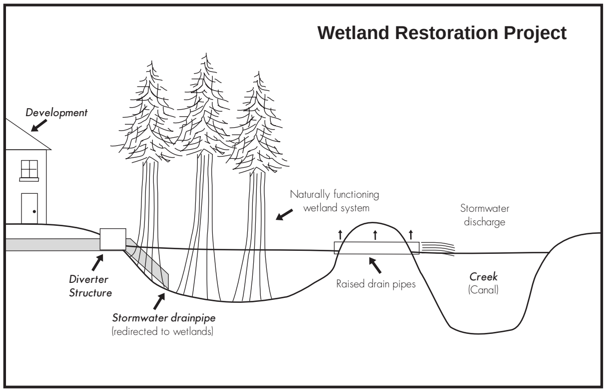

Figure 4

Restored wetland system

to allow the wetlands to hold the optimum amount of water without flooding the system and overflowing into the canal (*Figure 4*).

Upon completion of this project, water supply was restored to the wetlands. As a result of this increased water supply and greater retention, the wetlands are no longer drying out. In addition to this benefit, stormwater draining from nearby subdivisions now has an opportunity to be filtered through natural processes before entering the Sawmill Branch Canal.

Conclusion

This project demonstrates that wetland restoration is a practical and efficient BMP in urban areas with degraded wetland systems. When these areas are returned to their pre-existing state, they serve a valuable NPS pollution control function. Through physical and chemical processes, restored wetlands purify rainwater and help to provide clean habitat for fish and wildlife. Restored wetlands also help maintain a clean source of drinking water and help to reduce flooding by acting as natural drainage basins. With these benefits in mind, it's easy to see why wetland restoration should be considered as an alternative BMP in urban areas.

For more information on the Charleston Harbor Project, NPS pollution, or wetlands restoration, call (843) 744-5838.

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