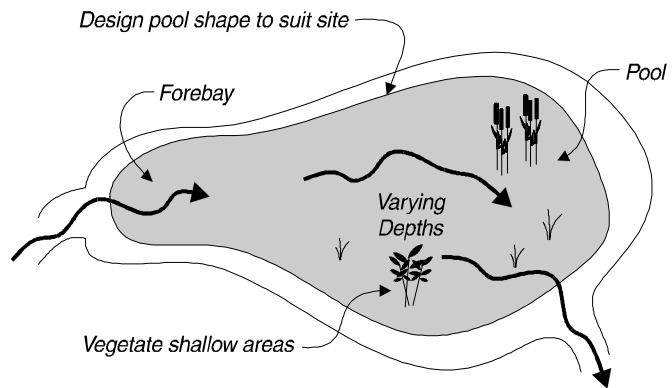

BMP CW: Constructed Wetland

Definition and Purpose

A constructed wetland is a single-stage treatment system consisting of a forebay and micro pool with aquatic plants. A constructed wetland removes high levels of particulates, as well as some dissolved contaminants.

Therefore, it is likely to have a significant impact on sediment, nutrients, heavy metals, toxic materials, floatable materials, oxygen demanding substances and oil and grease.



Appropriate Applications

Constructed wetlands (Figures CW-1 and CW-2)

are ideal for large, regional tributary areas where space is available to provide shallow water conditions. Constructed wetlands offer passive recreation, a wildlife site and an aesthetic alternative for stormwater management. Land uses for which this BMP is appropriate include large residential developments, and commercial, institutional and industrial areas where incorporation of a green space and a wetland into the landscape is desirable and feasible.

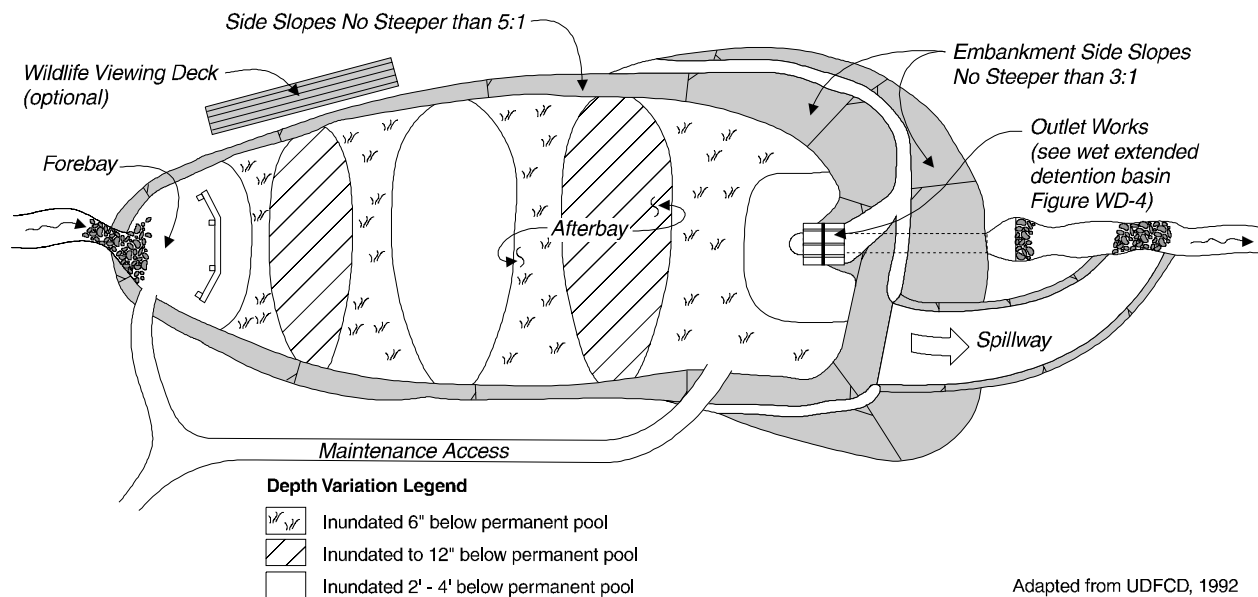
Limitations

- # Need base flow or supplemental water to maintain water level.
- # Not appropriate for steep unstable slopes or densely developed areas.
- # May attract and breed mosquitoes.
- # Potential for nutrient release in winter.
- # Hydraulic capacity may be reduced with plant overgrowth.

Design Guidance, General

Constructed wetlands offer an attractive, effective means for improving stormwater quality. As part of a landscape design, a constructed wetland can offer the beauty of water and vegetation in a predominantly dry area, if base flow is available or provisions are made to maintain the permanent pool. This BMP offers the potential for wildlife habitat and passive recreation. A constructed wetland could be used in a park-like area where housing development residents stroll or conduct bird watching, for example. A constructed wetland could also provide a shady green space where employees at a commercial or industrial site could enjoy a lunchtime outdoors.

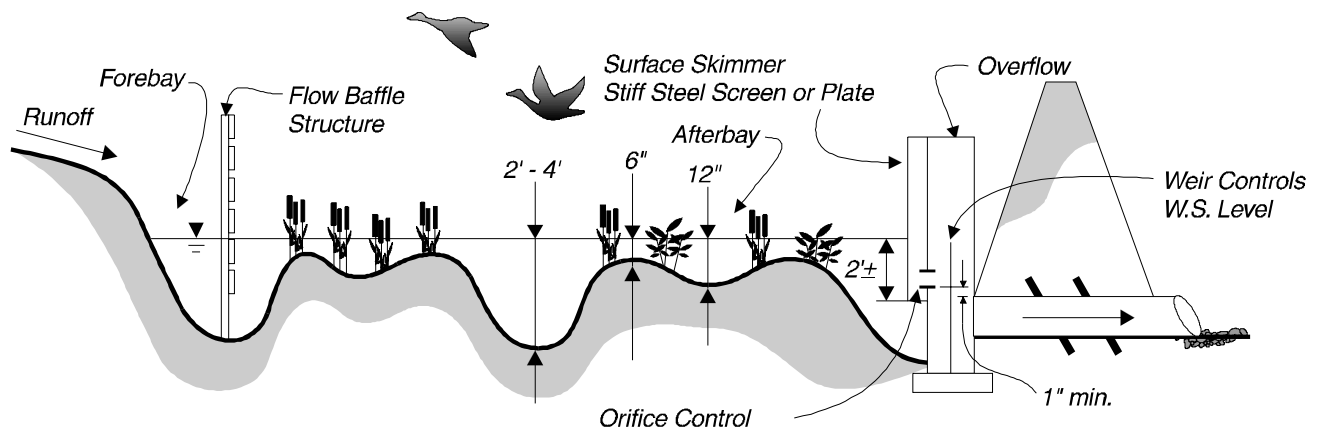




Adapted from UDFCD, 1992

Figure CW - 1

Constructed Wetlands (Plan)



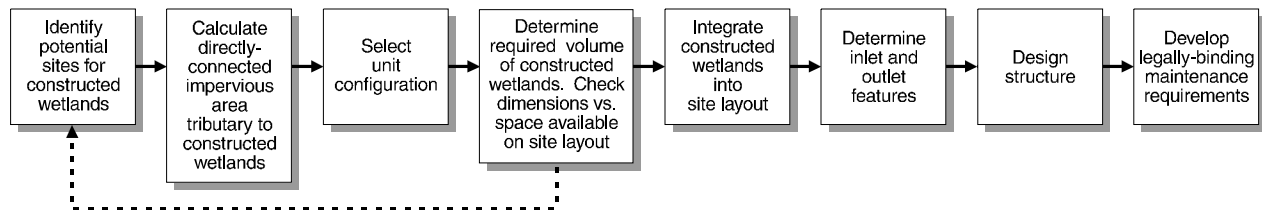
Adapted from UDFCD, 1992

Figure CW - 2

Constructed Wetlands (Section)

The aesthetic advantages of constructed wetlands are complemented by their effectiveness as a stormwater quality management BMP. Wetlands remove a variety of constituents. Some drainage structures, such as flood control channels, function as wetlands if a permanent pool forms. Constructed wetlands may be intentionally incorporated into a design for any land use where space is available and wetland species can be established. The flow chart on the following page provides general guidance for planning a constructed wetland in a site design.





As noted in the above chart, constructed wetlands are designed based on a capture volume, much as wet detention basins (wet ponds) are. Wetlands would be well suited for many sites where a wet detention basin could be used. Constructed wetlands, however, require more land space than wet detention basins for similar drainage areas because part of the constructed wetland must be shallower than a wet detention basin.

The potential for variation in depths throughout the wetlands (see Figure CW-2) and the use of vegetation, however, provide more interest and flexibility for landscape architecture purposes than does a simple wet pond. Variations in depth and irregularly-shaped pools also make a constructed wetland more natural looking.

Vegetation in the wetland decreases the potential for short-circuiting (flow through the basin more rapidly than desired) caused by wind, but can be expensive to establish and maintain.

A constructed wetland for stormwater quality management purposes requires:

- # Adequate space (typically 1 to 2 percent of the tributary watershed)
- # Soils suitable for establishment of wetland vegetation
- # A need or desire for landscape interest or a wildlife area
- # Commitment to maintaining the wetlands

Design Considerations

Design constructed wetlands in the same manner as wet detention basins, using a shallower depth. Each constructed wetland shall have a forebay and an afterbay (optional, 3 to 6 feet deep), which collectively make up 25 to 50 percent of the entire wetland area. A shallow pool can extend laterally across the basin.

Side slopes should be at least 10:1 for littoral zone down to a water depth of 2 feet, with freeboard as required by the appropriate agency. Access must be provided for maintenance vehicles to reach the forebay, outlet and perimeter.

Install inlet energy dissipators (flow baffle) and design the wetlands to have a length to width ratio of 3:1 or 4:1 to minimize the occurrence of short-circuiting and dead areas. Length to width ratios of 2:1 can be used if measures to prevent short-circuiting, such as baffling, are incorporated into the design in a manner that will not impede wetlands maintenance. Figure CW-3 illustrates the length to width ratio. Compaction, clayey soils and artificial liners should be used to minimize exfiltration.



Supplemental water may be required to keep vegetation alive in dry periods. If mosquitoes are a problem, the forebay (deep water only) can be stocked with Gambusia fish (mosquito fish), if approved by the Department of Fish and Game and other appropriate agencies.

Table CW-1 shows vegetation species recommended for constructed wetlands. The selection of plant species for a constructed wetland shall take into consideration the water fluctuation likely to occur in the wetland. Some species listed below have other factors affecting their successful growth as well. See Reference NRCS-FOTG for additional information on the species listed below.

Table CW-1	
<i>Vegetation Species Recommended for Constructed Wetlands</i>	
<i>Species Recommended in the Natural Resource Conservation Service Field Office Technical Guide</i>	
<i>Common Name</i>	<i>Scientific Name</i>
Alkali bulrush	Scirpus robustus
Creeping wild rye	Elymus triticoides
Reed canarygrass	Phalaris arundinacea
Barnyard grass	Echinochloa crusgalli
<i>Other Recommended Species</i>	
<i>Common Name</i>	<i>Scientific Name</i>
Cattail	Typha latifolia
Spikerush	Eleocharis species
Tules	Scirpus species
Common reed	Phragmites communis
Sedges	Carex species
Rushes	Juncus species

In summary, the design steps for constructed wetlands are:

- # Determine the constructed wetland volume using same procedure as BMP WD – Wet Detention Basin.
- # Design the constructed wetland shape in accordance with site constraints, slope requirements, required fore/afterbay sizes, and aesthetic objectives.
- # Design inlet and outlet structures.
- # Designate shallow/vegetated areas.

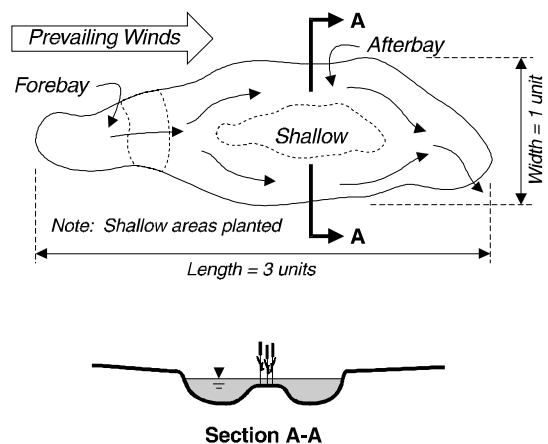


Figure CW – 3
Length to Width Ratio



-
- # Select wetland species and layout planting/stocking scheme (consult wetland ecologist, wetland plant ecologist, or wetlands restoration firm).
 - Require wetland ecologist for construction inspection and vegetation installation.

During design of the wetlands, the designer shall coordinate the design with the local, state, and federal agencies regarding wetlands regulations. It is imperative that the functional purpose of the constructed wetlands as a stormwater quality control BMP be recognized by the agencies to minimize future maintenance issues, such as cleaning deposits out of the forebay and the afterbay.

Maintenance and Inspection Requirements

Constructed wetlands require periodic maintenance and inspection including the following practices:

- # Inspect constructed wetlands a minimum of twice a year, before and after the rainy season, after large storm events, or more frequently if needed.
- # Remove accumulated undesirable debris and repair erosion.
- # Clean forebay every two years at a minimum, to avoid accumulation in main wetland area. Environmental regulations and permits may be involved with the removal of wetland deposits. When the main wetland area needs to be cleaned, it is suggested that the main area be cleaned one half at a time with at least one growing season in between cleanings. This will help to preserve the vegetation and enable the wetland to recover more quickly from the cleaning.
- # Control mosquitoes as necessary.
- # Prepare a maintenance manual and submit it to the appropriate agency.
- # Report on maintenance to the appropriate agency.

