9.0 STORMWATER WETLANDS

Example of Stormwater Wetland

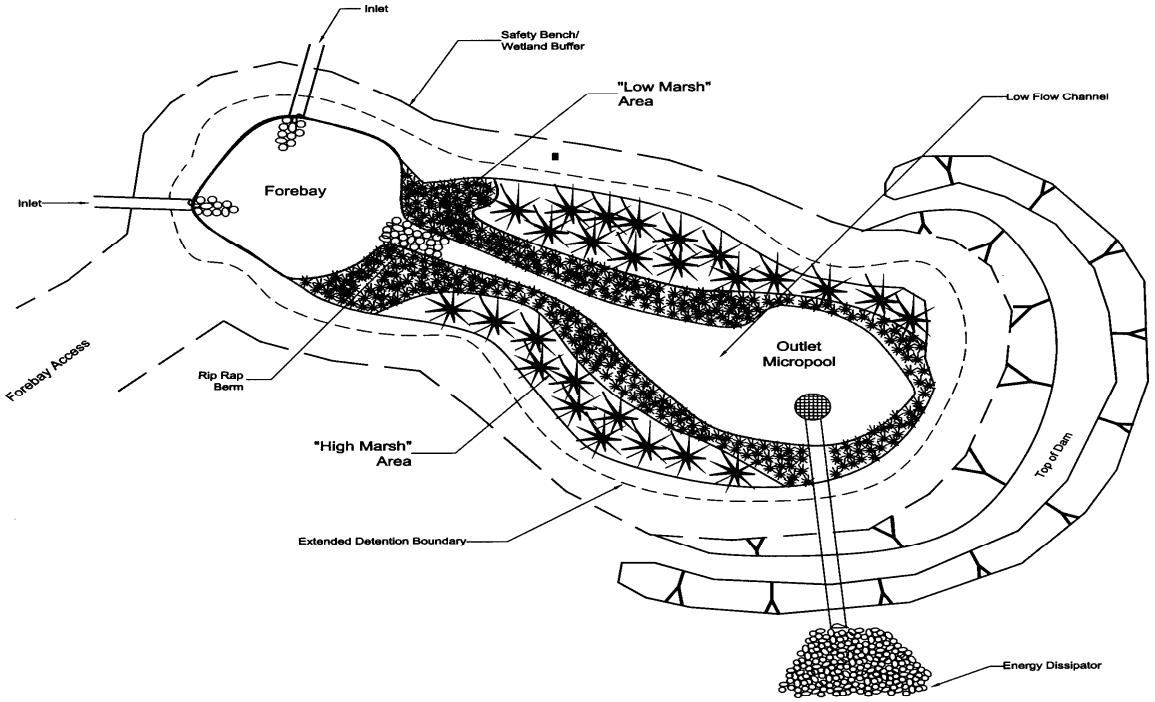
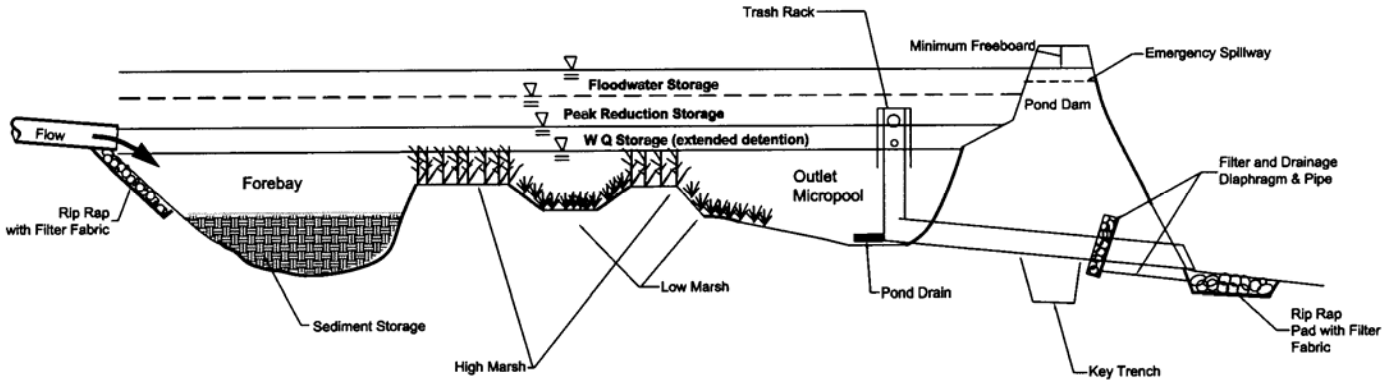


Figure Adapted from Schueler 1992

PLAN



PROFILE

9.3 Design

9.3.1 Understanding Basic Layout Concepts

Siting Issues

Stormwater wetlands shall not be placed in jurisdictional wetlands, on intermittent or perennial streams. Also, Stormwater wetlands used to meet water-supply watershed regulations will be required to be designed to treat the total drainage area to the wetland, on-site and off-site, per the City's water-supply watershed ordinance.

When designing the dam and spillways, existing and potential future downstream development should be considered. Avoid placing the dam upstream of highly developed or traffic areas whenever possible. The discharge from the spillways should be directed to a conveyance system that can adequately handle the flow or if no conveyance is present, the discharge should be directed away from existing development.

Pretreatment and Inflow

Inverts for inlet pipes should be at the elevation of the normal (permanent) pool to allow the pool to dissipate the energy of the inflow to prevent erosion along the embankment slope. Inlets should be designed to discharge to the pond perpendicular to the pool surface to minimize potential erosion problems to the adjacent embankment. Riprap pads should be underlain with a gravel/sand filter or geotextile fabric and extend from the pipe invert to the pond bottom. For pond inlets that carry public runoff the invert must be designed to discharge above normal pool elevation to prevent water from backing up within the public storm sewer system.

9.3.2 Step 2: Determine the Volume to Treat

The minimum volume of 3630 ft^3 (1 ac.-in.) shall be based upon the runoff from a one inch (1") rainfall.

9.3.5 Step 5: Select the Appropriate Overflow Bypass

9.3.5.1 Outlet Design

Principal Spillway Capacity: 10 year 24 hour rain storm event

Emergency Spillway Capacity: Minimum 100 year 24-hour rain storm event (design to be consistent with the NC Dam Safety Requirements).

Dam freeboard: NC Dam Safety requires a one (1) foot minimum freeboard above the maximum flood pool elevation during the spillway design flood. The City encourages the designer to maximize the freeboard to the extent practicable.

An access to the forebay for future sediment cleanouts is to be provided. Access should have a maximum slope of 15-20% extending from the top of the embankment to the toe. This access

will allow construction equipment to get down in the forebay and will minimize disturbance to the vegetation.

Key trench should be installed and designed according to the requirements stated on section 5.6 of this supplement.

Principal Spillway

The principal spillway should be a riser/barrel, concrete free overfall weir, or concrete chute, with capacity to handle the 10-year, 24-hour rain storm event at a minimum. The riser/barrel material of construction shall be either reinforced concrete, ductile iron, PVC, HDPE, or corrugated aluminum piping. The use of aluminized steel or other type of corrugated metal is not allowed. Reinforced concrete (where the joints are sealed and specified watertight) and ductile iron pipes (being rigid pipes) are preferred for this application. To prevent distortion of flexible conduit, such as corrugated aluminum piping, special care (including construction oversight) must be taken during compaction of the soil around it and result in internal soil erosion problems potentially leading to failure of the embankment around and above the conduit

The spillway should be equipped with a trash rack and an anti-vortex device.

Emergency Spillway

The emergency spillway should be designed to safely convey discharges resulting from storms up to the 100-year, 24-hour storm, at a minimum. The spillway should be located where it will not adversely affect downstream property such as roadways and building structures. The emergency spillway may be incorporated into the principal spillway where accommodating the emergency spillway elsewhere is not feasible for the given site characteristics.

The emergency spillway should be cut into existing soils outside the fill section of the dam. Where this placement requirement cannot be met, the emergency spillway shall be designed to meet the chute or free overfall spillway requirements as listed in Section 5.8.6 of this supplement. The emergency spillway may be grass lined, when velocities permit, or lined with rip rap, concrete, or other erosion resistant materials. **Grass lined spillways are to be planted with a dense cover of erosion resistant grasses,** preferably incorporating turf reinforcement matting (TRM).

Wetland Pond Drain

A pond drain should be provided to drain the wetland for routine maintenance or structural repairs in an emergency situation. It is recommended that the pond drain be designated to have the discharge capability to completely drain the pond in less than 48 hours, in the event of an emergency posed by impending failure of the dam. The upstream slope of the pond dam should be designed to be flat enough to prevent slope failure due to "quick drawdown" of the pond (NC Dam Safety Code specifies a factor of safety of 1.25) in an emergency. Care should be taken to minimize transport of settled sediment from the pond during draining.

9.4 Construction

A concrete retaining wall may be used for the pond's dam provided the requirements listed under Section 10.3.2 of the State's Stormwater Best Management Practices Manual are met.

For earth dams, the top width of the dam shall be 10 feet minimum. A key trench shall be excavated under the entire length of the dam and located at or upstream of the centerline of the dam. The key trench should be filled with highly impervious and well compacted clay material. The key trench should have a bottom width adequate to accommodate the equipment used for excavation, backfill, and compaction operations, with a minimum width of 4 feet. Side slopes should be no steeper than one horizontal to one vertical. The minimum recommended depth of fill material is 3 feet below the stripped grade (or shallower should bedrock be encountered). The fill material should be placed in lifts not to exceed 8 inches in loose thickness and compacted to at least 95% standard proctor. The fill material and compaction specification for the key trench shall be specified on the BMP design plans. Incorporating a drainage blanket (preferably with a chimney drain) should be considered to reduce the potential for seepage problems. Also refer to Section 5.6.1 of this manual.

A "filter and drainage diaphragm" shall be used to prevent piping along the barrel within the earth fill. Refer to Section 5.6.1 of the BMP Design Supplement for seepage control requirements for conduits that extend through an embankment dam.

9.5 Maintenance

9.5.1 Common Maintenance Issues

The wetland should be easily accessible for maintenance. A 20' wide access easement shall be provided from the public street right-of-way to the wetland's DMUE. A drainage maintenance and utility easement (DMUE) shall be paced over the wetland and extend 15' beyond the top of embankments and outside edges of erosion protection structures (energy dissipators concrete or riprap pads, etc). The access easement should be kept easily accessible for maintenance.

9.5.3 Reduction of Pollutants Entering Wetland

Stormwater Wetlands are not 100% efficient in removing pollutants; therefore, when the amount of pollutants into the wetland is higher, the amount of pollutants discharged from the wetland will be higher. Also, increased amounts of pollutants entering the wetland will increase the maintenance required to keep the wetland functioning properly.

To assist the stormwater BMP in removing pollutants, every effort should be made to reduce the initial pollutant load entering the wetland. Pollution prevention activities described elsewhere in this manual should be implemented along with the following efforts:

- ⇨ Outside trash dumpsters should be kept covered, and the area around the dumpster should be kept neat and clean.
- ⇨ Chemicals, petroleum products and other pollution sources (such as machinery) should be stored in a covered area away from possible stormwater contact. Spent chemicals are to be properly disposed or recycled.

- ⇨ Fertilizers and pesticides should be used conservatively on the property grounds. Excessive amounts of these chemicals can be washed away with stormwater runoff increasing the nutrient load to the pond.
- ⇨ Chemicals such as copper sulfate used to inhibit algae growth in the water quality pond degrade water quality. Since the pond's main function is to enhance water quality, these chemicals should not be used. Rather, reducing the amount of fertilizer application and ensuring that the pond outlets are properly functioning so the pool is flushed periodically will help to deter algae growth.
- ⇨ Trash and vegetative floatables (grass clippings, leaves, limbs, etc.) should be cleaned from the pond surface and surroundings periodically to promote a healthy, aesthetically pleasing environment, and to prevent blockage of the pond outlets. Studies have shown that people are less likely to litter ponds that are aesthetically pleasing and support wildlife.

9.5.4 Stabilization of BMP drainage area

The area draining to the BMP should remain stabilized to prevent excessive sediment from entering the BMP facility. When the bare soil is directly exposed to precipitation the sediment concentration in runoff is much higher than for soil that is stabilized. A stabilized area is covered by impervious surfaces (pavement, buildings), grass cover, landscaped cover (mulch, pine straw), etc.

Erosion Concerns
The inlet and outlet areas, side slopes (swales), and the rest of the conveyance area should be inspected for erosion problems.

Where water discharges from a pipe and where the stormwater runs off impervious area onto pervious area, there may be erosion problems. The BMP should have riprap protection at the end of pipes and a gravel trench at the edge of impervious areas to help prevent erosion. These devices should be inspected to ensure they are functioning properly. If erosion is noticed in within the rip rap pad or along the edges of the pad, more rock may be needed or it may have been improperly placed (no geotextile liner or improper placement of liner, rip rap not well graded, etc.) If the rock or gravel is displaced downstream, a larger size rock or gravel should be used.

Rill erosion (small channels or gulleys in the ground) is a common problem found in these control devices where the water runoff is naturally trying to channelize. Rill erosion can be repaired by filling in the rills with suitable (clayey) soils and reseeding. It may be necessary to use a temporary erosion resistant matting or to use sod to repair these areas.

9.5.5 Blockage of Outlets

Extended wetlands are designed for the ponded water to exit through the low flow orifice(s), the principal spillway, and the emergency spillway. It is important to check all three outlets for blockage that would impair the wetland's water quality and hydraulic functionality.

Low Flow Orifice(s)

Unless an inverted orifice is used, some type of trash guard is to be maintained over the low flow orifice(s) to prevent clogging. When the orifice becomes clogged the water level rises to the principal spillway elevation and the benefits associated with temporary storage and its gradual release are lost. To preserve "extended detention" the low flow orifice should be inspected for blockage **twice a month and after large storms.**

9.5.6 Principal and Emergency Spillway

Principal and emergency spillways are designed to safely convey larger than one inch storms that produce runoff which exceed the water quality volume of the BMP. If these spillways are blocked so they do not operate at full capacity, the risk of dam overtopping or other uncontrolled releases may result. To ensure the hydraulic capacity of the spillways, the spillways should be inspected for blockage **twice a month and after large storms.**

If a riser/barrel is used for the principal spillway, a trash rack is to be maintained on the riser. Vegetative growth in the riser should be removed promptly so that the design capacity of the spillway is maintained. Also, the outlet area where the barrel projects from the fill should be clear of tree limbs, sediment accumulation, etc.