Wet Detention Ponds

Description

A wet or permanent pool detention pond is one of the most commonly used BMPs to meet water quality protection requirements. The advantages of permanent pool ponds have over other water quality treatment controls are:

- Ponds are durable and require less maintenance than other applicable water quality controls.
- Ponds required for water quantity control are easily modified to treat storm water runoff for water quality.
- Well designed ponds are effective in treating storm water runoff for water quality control.

Wet storm water detention ponds are classified as being:

- Wet Detention Pond. Wet ponds have a permanent (dead storage) pool of water equal to the water quality volume. Temporary storage (live storage) may be added above the permanent pool elevation for larger flows.
- Wet Extended Pond. A wet extended pond is a wet pond where the water quality volume is split evenly between the permanent pool and extended detention storage provided above the permanent pool. During storm events, water is stored above the permanent pool and released over 24-hours. The design has similar pollutant removal efficiencies as traditional wet ponds, but consumes less space.
- Micropool Extended Pond. The micropool extended pond is a variation of the wet extended detention pond where only a small "micropool" is maintained at the outlet to the pond. The outlet structure is designed to detain the water quality volume for 24-hours. The micropool prevents resuspension of previously settled sediments and prevents clogging of the low flow orifice.

When and Where to Use It

Permanent pool ponds improve storm water quality by detaining storm water runoff for an extended period of time to allow pollutants that are suspended in the runoff to settle out. During any given storm event, runoff enters wet ponds and replaces the "treated" water in the permanent pool that has been detained from the previous storm event. As runoff enters the pond, the velocity is significantly decreased, allowing suspended pollutants to settle out of the runoff. Many pollutant particles suspended in storm water runoff are very small in size, therefore the pond must be designed to provide adequate detention time to allow the smaller particles to settle out.

Design Criteria

The components of wet detention ponds that help increase the pond's pollutant removal efficiency are:

- Permanent wet pool
- Temporary pool or overlaying zone
- Aquatic bench
- Forebay
- Flow length
- Low flow orifice
- Emergency spillway.

Permanent Wet Pool

A permanent wet pool is the design feature with the single greatest effect on water quality. Permanent pools have the following design requirements:

- For Wet Detention Ponds, the design permanent pool volume is equal to 1-inch of runoff per impervious acre on the site to reliably achieve moderate to high removal rates of storm water pollutants.
- For Wet Extended Ponds with an Aquatic Bench, the design permanent pool is equal to ½- inches of runoff per impervious acre on the site to reliably achieve moderate to high removal rates of storm water pollutants.
- For Micropool Extended Ponds, the design permanent pool volume is equal to 0.1-inches of runoff per impervious acre on the site to reliably achieve moderate to high removal rates of storm water pollutants.
- An average pool depth of 4 to 6 feet is optimal for water quality treatment. The depth of the permanent pool prevents particles that have settled to the pond bottom from re-suspending when runoff enters the pond.

Temporary Pool

The temporary pool is the designed storage above the permanent pool that controls the designed water quality volume. Consider storm water quantity management when designing the temporary pool volume. To increase the detention time of the runoff, the temporary pool is slowly released through a low flow orifice.

Aquatic Bench

Aquatic vegetation can play an important role in pollutant removal in a storm water pond. Vegetation can enhance the appearance of the pond and stabilize side slopes. The selection of the proper plant species and planting locations is an integral part in designing a successful aquatic bench in the wet detention pond. Prepare a planting plan by a qualified landscape architect or wetland ecologist for the aquatic bench.

Forebay

Provide a forebay for all inlets to a wet water quality pond and place the forebay upstream of the main wet pond area. Design the forebay to trap the majority of the coarse fractions of the suspended solids in the runoff before it enters the main wet pond area. The forebay is separated from the larger wet detention pond area by barriers or baffles that may be constructed of earth, stones, riprap, gabions, or geotextiles. Design the top of the forebay barrier ranging from foot below the normal pool elevation up to an elevation above the permanent pool. A forebay may be designed using manufactured treatment devices.

Flow Length

Optimizing the wet pond flow shape and flow distance through the pond promotes better water quality treatment. For maximum water quality benefits, design the ratio of flow length to flow width in the wet pond at least 3L:1W. Due to site constraints, the minimum allowable design ratio of flow length to flow width is 1.5L:1W. To increase the pond's flow length, the pond may be configured with baffles.

Low Flow Orifice

Design a low flow orifice to slowly release the water quality volume over a period of 24-hours or longer depending upon the design criteria for the water quality structure. These structures are prone to becoming clogged. Protect the low flow orifice from clogging by designing appropriate trash guards. Acceptable trash guards include:

- Hoods that extend at least 6-inches below the permanent pool water surface elevation.
- Reverse flow pipes where the outlet structure inlet is located below the permanent pool water surface elevation.
- Trash boxes made of sturdy wire mesh.

Emergency Spillway

Design emergency spillways to safely pass the post-development 100-year 24-hour storm event without overtopping any dam structures. Design the 100-year water surface elevation a minimum of 1-foot below the top of the embankment.

Inspection and Maintenance:

Regular inspection and maintenance is critical to the effective operation of storm water ponds as designed. Maintenance responsibility for a pond and its buffer should be vested with a responsible authority by means of a legally binding and enforceable maintenance agreement that is executed as a condition of plan approval. The agreement may contain but is not limited to the following items:

- Mow side slopes of the pond monthly.
- Since decomposing vegetation captured in the wet pond can release pollutants, especially nutrients, it may be necessary to harvest dead vegetation annually. Otherwise the decaying vegetation can export pollutants out of the pond and also can cause nuisance conditions to occur.
- Clear debris from all inlet and outlet structures monthly.
- Repair all eroded or undercut areas as needed.
- Place a sediment marker in the forebay to determine when sediment removal is required.
- Monitor sediment accumulations in the main pond area and remove sediment when the permanent pool volume has been significantly filled and/or the pond becomes eutrophic.

Average Pollutant Removal Capability

Total Suspended Solids:	65-80%	Metals:	35-75%
Copper:	40-65%	Lead:	60-85%
Zinc:	50-75%	Total Phosphorus:	50-70%
Total Nitrogen:	30-45%	Pathogens/Bacteria:	45-75%

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Summary of Maintenance Requirements

Required Maintenance	Frequency
Clean and remove debris from inlet and outlet structures.	Monthly, or after large storm events
Mow side slopes.	Monthly, or as needed
Removal of invasive vegetation.	Semi-annual
Inspect for damage to control structure.	Annual
Inspect sediment accumulation in the facility and forebay.	Annual
Inspect for operational inlet and outlet structures.	Annual
Repair embankment, side slopes, undercut or eroded areas.	Annual, or as needed
Perform wetland plant management and harvesting.	Annual
Remove sediment from the forebay.	Per design cycle, as needed, after 50% of total forebay capacity is filled
Remove sediment accumulations in the main permanent pool.	5 to 10 year cycle, after 25% of the permanent pool volume is filled