

STORMWATER WETLANDS REGIONAL CONTROL



Stormwater Wetlands

DESCRIPTION

Stormwater wetlands are similar to retention ponds but with more emergent aquatic vegetation and a smaller open water area (less than 25% of the water surface area).

Stormwater Wetlands are shallow pools that create growing conditions suitable for the growth of marsh plants. They typically have less bio-diversity than natural wetlands. Because wetlands are heavily vegetated, they serve as a natural filter for urban run-off.

Stormwater wetlands detain urban run-off, remove pollutants through biological treatment and settlement and provide habitat and aesthetic benefits. Wetlands can be integrated into developments as a community water feature.



A Stormwater Wetland in Scotland

PRIMARY CONSIDERATIONS	
Construction Cost	HIGH
Maintenance Requirements	MEDIUM
Land Take	HIGH

BENEFITS	
☑ Water Quality Control	YES
☑ Water Quantity Control	YES
☑ Amenity Value	YES
☑ Habitat Creation Value	YES
☑ Biological Treatment	YES

DESIGN

General Design Criteria / Features

- ◆ Design to retain water for 14 days during the wettest months to allow for biological treatment and for settlement of solids.
- ◆ Design to have a minimum permanent pool of 3 x Vt (Wallingford Procedure).
- ◆ The simplest form of a constructed wetland comprises of a basin with a forebay and wetland vegetation area.
- ◆ An adequate water flow is required to ensure a permanent pool of water.
- ◆ Wetlands should have a length-to-width ratio of at least 5:1, which helps prevent short-circuiting (US EPA Factsheets).
- ◆ The distance between inlet and outlet should be maximised. The use of islands and peninsulas will ensure this.
- ◆ The drainage area should be greater than 5 hectares.
- ◆ Sediment forebays are recommended to decrease the velocity and sediment loading. Forebays should be a separate cell. It is suggested that they should be 2 to 3m deep and contain at least 10% of the wetland's treatment volume. Coarse particles remain trapped in the forebay and maintenance is performed in this smaller pool, eliminating the need to dredge the entire wetland. Alternatively a detention basin may be placed before the wetland, to remove settleable solids and protect the wetland from extreme fluctuations in water levels during large storms.
- ◆ Effective wetland design displays "complex microtopography"; wetlands should have zones of both very shallow and moderately shallow wetlands using underwater earth berms to create the zones. This design will provide a longer flow path through the wetland to encourage settling and plant diversity and to discourage undesirable plant monocultures.

◆ The average depth of the wetland should be 0.5 to 0.75m. The depth of open water should not exceed 2 metres. Water deeper than 2m inhibits rooted plant growth, thus providing areas of open water. However, wetlands can be designed for flood control by providing flood storage of up to 2m, above the level of the permanent pool.

◆ The open water area should be less than 25% of the water surface area.

◆ Shallow side slopes should be gradual (e.g. 1 in 4), as in natural wetlands and should not exceed 3:1 (Horner et al, 1994) to reduce safety hazards and enable maintenance.

◆ Wetlands should be constructed to have no lateral slope perpendicular to the flow path to avoid concentrating the flow in preferred channels.

Habitat Enhancement

◆ A wetlands ecologist should be consulted about planting so that plants are selected which are capable of pollutant removal, adapted to saturated soil conditions, tolerant of periodic inundation by run-off and which can withstand the dry periods that naturally occur in the local area. A diverse native selection should be planted shortly after constructing the wetland. Mostly perennial species should be selected with priority to those that establish rapidly. Vegetation reduces the effect of wind which can cause short circuiting of the wetland.

◆ If possible, stormwater wetlands should be located close to natural waterbodies, to enhance colonisation. However, existing important habitat areas should be avoided.



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DESIGN

Volumetric Design Criteria

The volume required is defined by a matrix of parameters, which are summarised as:

1) Depth / Area Storage Relationship:

◆ This is largely dictated by topography and outfall levels. Volumetric allowances for vegetation of up to 25 percent should be provided.

2) Head / Discharge Relationship:

◆ The pond/basin should be designed to a maximum discharge rate, achieved when the structure is full. Consideration must be given to outfall conditions, e.g. receiving water levels.

3) Throttle Rate:

◆ Throttle sizes are generally a minimum of 150mm. For smaller developments, the volumetric requirement is likely to be achieved by other drainage components such as lined or unlined permeable pavement car parks or soak-aways.

4) Effective Contributing Area:

◆ This is the paved and pervious catchment surfaces, which contribute run-off after various losses.

◆ The relationship between contributing area and throttle rate will define the critical duration of the design rainfall events. Events will be longer for tighter throttle rates and storage volumes larger.

5) Rainfall Characteristics of the Area:

◆ Ireland has been analysed for hydrological characteristics. These have been processed to enable appropriate design storm events to be produced for any location, duration and return period. This is based on the Flood Studies Report work carried out in the 1970's.

6) Level of Service:

◆ Design should be for a range of return periods (1 to 100 years). It is unlikely that one structure will serve the needs of the various criteria. Temporary flooding of car parks and public space areas are likely to be acceptable on occasions. The hydraulic implications for loss of volume due to sediment or vegetation should also be considered.

DESIGN

Other Design Issues

◆ Stormwater wetlands can accept run-off from stormwater hotspots, but need significant separation from groundwater if they will be used for this purpose. Where the potential for groundwater contamination is high, such as in industrial estates, the use of liners is required.

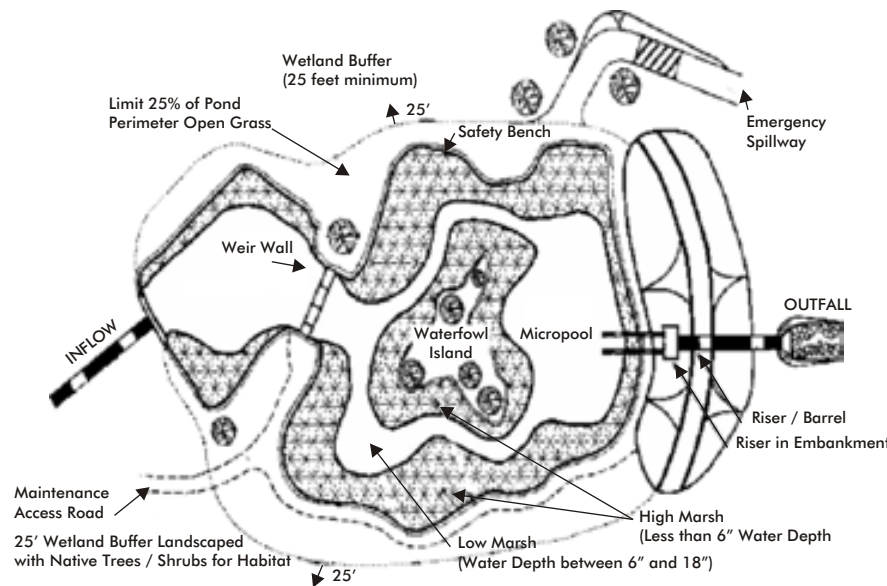
◆ Wetlands can be used in almost all soils and geology. At sites where infiltration occurs, it may be necessary to incorporate an impermeable liner into the design in order to maintain a permanent pool.

◆ Warning signs may be posted during cold periods, to warn of the dangers of ice.

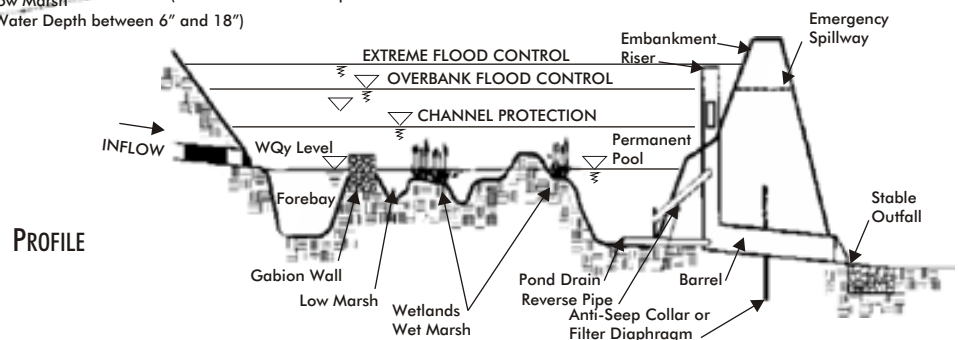
◆ Stormwater wetlands are generally safer than retention ponds but deep zones may still be a hazard. Fencing of wetlands is generally not desirable but may be required in some situations. A preferred method is to manage the contours of the pond to eliminate drop-offs and other safety hazards. Barrier planting around the margins will restrict access.

◆ Groundwater inflows and outflows can have a significant effect on a constructed wetland system. Groundwater chemistry can affect water quality and processes such as sedimentation and vegetation growth.

◆ Construction run-off should be prevented from entering the constructed wetlands as the resulting sediment loading can severely degrade the performance of the system.



PLAN VIEW



PROFILE

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POLLUTANT REMOVAL

Wetlands are the most effective type of SUDS in terms of pollutant removal. As storm run-off flows through the wetland, pollutant removal is achieved through settling and biological uptake within the facility. Stormwater wetlands can provide significant reductions in sediment, nutrient, heavy metals, toxic materials, floatable materials, oxygen demanding substances, oil and grease as well as a partial reduction in bacteria and viruses.

Pollutant	*Removal (%)
Total Suspended Solids	60-80
Oil & Grease	Detail Unknown
Total Phosphorous	20-40
Total Nitrogen	20-40
Bacteria	60-80
Copper	60-80

*Typical Removal Rates based on National US Data Range

Details of other studies which have been carried out world-wide, are available from the National Stormwater Best Management Practices Database.

MAINTENANCE CONSIDERATIONS

Maintenance requirements for wetlands are similar to those of retention ponds:

• Inlets and outlets should be inspected quarterly or after large storms for evidence of clogging or accumulation of debris.

• During the first two years, it is extremely important that the facilities be inspected quarterly for nuisance vegetation and that these be removed; this will insure a healthy and aesthetically pleasing facility.

• Other potential problems that should be checked include subsidence, erosion and litter accumulation. Remedial work should be carried out when required.

• Sediment may have to be removed from the forebay once every 5 to 7 years or when half of the forebay depth is filled with sediment.

• The wetlands themselves may have to be dredged once every 25 years or less.

• Stormwater wetlands require frequent maintenance in the first 3 years to establish the marsh.

Thereafter, maintenance will be that carried out as in other pond systems.

• Aquatic vegetation within the wetland should be cut back after flowering, and thinned when necessary, typically every 7 to 10 years.

COST CONSIDERATIONS

• Wetlands have a long life span, compared to many other types of SuDS. In the US the annual cost of routine maintenance is typically estimated at about 3% to 10% of the capital cost.

• Maintenance costs may be higher in the first few years after construction, until the vegetation becomes established.

• It is anticipated that well designed wetlands, which incorporate additional aesthetic features may provide an economic benefit by increasing property values.

INTERNATIONAL EXPERIENCE

Stormwater wetlands have been used extensively in the US. Further details are available from the National Stormwater Best Management Practices Database. (www.bmpdadabase.org)

ADVANTAGES

- Provide high pollutant removal efficiencies.
- Require relatively low maintenance.
- Can be used in almost all soils and geology.
- Creates habitat.
- Can enhance the aesthetics of an area and provide recreational benefits.
- Can provide an economic benefit by increasing property values.

LIMITATIONS

- Large land requirements.
- Seasonal variations in treatment and pollutant removal efficiencies.
- Wetlands require careful design and planning to ensure that wetland plants are sustained after the practice is in place.
- Delayed efficiency until plants are well established.
- Requires reliable water supply.
- Acceptance influenced by public opinion.
- Topography of the site.

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