4.4-a WET BASIN

Alternative Names: Wetland Basin, Retention Pond, Wet Extended Detention Basin, Wet Pond, Treatment Wetland, Constructed Wetland

BMP DESIGN APPROACH
☐ Pollutant Source Control
☐ Hydrologic Source Control
■ **Stormwater Treatment**
SCALE OF APPLICATION
☐ All SFR and MFR < 1 acre
■ **MFR 1-5 Acre and CICU < 5 acres**
■ **MFR and CICU > 5 acres and all WQIPs**
TYPE OF APPLICATION
☐ Temporary
■ **Permanent**

DESCRIPTION

Wet basins consist of a permanent or seasonal pool of water (typically called a wet pool) surrounded by wetland plants growing on a shallow submerged shelf. While there are several different versions of wet basin designs, the most common design in the Lake Tahoe Region is an extended detention wet basin, which provides some amount of stormwater storage above the wet pool (typically called surcharge storage).

Wet basins are typically defined to differ from constructed wetlands in that wet basins have a greater average depth for the wet pool and a smaller percent of vegetative cover. For typical Lake Tahoe Region practice, wet basins are usually constructed with relatively shallow wet pools that approach the definition of a constructed wetland. In general, the guidance provided herein is applicable to both wet basins and constructed wetlands.

This wet basin reduces pollutants by allowing sediment to settle out of the water column.

APPLICABILITY

- Wet basins require a baseflow to maintain the wet pool.
- Applicable in soils with low infiltration rates.
- Should be sited on relatively flat terrain (less than a 5% slope).
- Wet basins may be particularly appropriate in locations where high nutrient loads are of concern (e.g., golf courses).

- Should generally be constructed in uplands rather than natural wetlands.[1]

Advantages

- Wet basins can provide substantial aesthetic value and wildlife habitat.
- Can provide effective removal of pollutants of concern to lake clarity.
- Can provide effective final treatment to stormwater runoff within a treatment train.

Disadvantages

- Limited applicability in highly urbanized settings and in arid climates because of a lack of a consistent baseflow. Siting is frequently constrained due to the need for a relatively large footprint combined with the need for a consistent baseflow.
- The permanent wet pool has the potential to breed mosquitoes and may be a public safety concern.
- May export nutrients during the dormant season without adequate maintenance.
- May result in an increase in biologically available phosphorous when anaerobic conditions occur.
- May contaminate groundwater or damage natural wetlands if they are not properly located.

DESIGN CONSIDERATIONS

The following guidelines are water quality design considerations for wet basins. Refer to applicable drainage design manuals within the responsible jurisdiction for requirements associated with structural integrity, drainage design, public safety, and other factors.

- Wet basins have various design elements defined as follows in this Handbook.
  - Wet pool – Typically ranges from 1½ feet to 4 feet deep. This zone supports little emergent wet basin vegetation but may support submerged or floating vegetation.
  - Low marsh zone – From 6 to 18 inches below the water surface elevation of the wet pool. This zone is suitable for the growth of emergent wet basin plant species.
  - High marsh zone – From 6 inches below the water surface elevation of the wet pool. This zone will support a greater density and diversity of wet basin species than the low marsh zone.
  - Surcharge storage above the wet pool – Areas above the wet pool that are inundated during storm events. This zone supports a number of species that can survive intermittent inundations, similar to vegetation found in a dry basin. When designing surcharge storage, minimize fluctuations in the water surface elevation to 2 feet or less to limit stressing vegetation.

[1] EPA, October 2000, *Guiding Principles for Constructed Treatment Wetlands* EPA 84-B-00-003

- Consider including an underdrain pipe with a manual valve to completely or partially drain the wet pool for maintenance, such as for vegetation harvesting or material removal. The submerged drain pipe should be protected, with the valve located where it can be operated in a safe and convenient manner.
- Consider designing an accessible forebay at the inlet of a wet basin for removal of coarse sediment and debris. A forebay sized at roughly 10 percent of the wet pool volume is typically sufficient. The size of the forebay should be increased if significant sediment loading is anticipated. While the inclusion of a forebay may not be aesthetically pleasing, a forebay can markedly improve the ease of routine maintenance and contribute to extended effectiveness.
- The length to width ratio of a wet basin should be at least 2:1, but preferably 3:1 or greater.
- Conduct a water budget analysis to ensure available baseflow will support the design volume for the permanent or seasonal wet pool.
- To promote pollutant removal, maximize the density of vegetation and reduce the area of open water pools and channels.
- Prepare a landscaping plan that indicates the methods used to establish and maintain wetland vegetation. Include selection of plant species, planting plan, sequence for preparing wet basin bed (including soil amendments, if needed), and sources of plant material.
- Provide easy access (typically 8 feet wide) to the basin perimeter to promote routine maintenance activities.
- The following are cold climate considerations for wet basins:
  - Use inlet and outlet structures resistant to freezing, including weirs and pipes with a minimum diameter of 6 inches. If a perforated riser pipe is used at the outlet, the minimum diameter for weep holes should be ½ inch.
  - Inlet pipes should not be submerged, since freezing conditions may restrict flow from entering the wet basin. Inlet pipe inverts should be located at the top of the wet pool.
  - Configure the wet basin on-line with a continuous baseflow through the system to help prevent freezing.
  - Incorporate extended detention into the design to retain usable surcharge storage above the wet pool when it is frozen.
  - Where possible, pipe slopes should be a minimum of 1 percent to prevent standing water in the pipe.

INSTALLATION CONSIDERATIONS

- Before construction begins, stabilize the entire area draining to the facility with sediment and erosion control measures to keep runoff and sediment from entering the basin.
- Remove and stockpile any native topsoil for use after grading basin dimensions.
- After completing basing grading activities till back in topsoil and soil amendments to help facilitate vegetation growth. In areas with porous soils, an impermeable liner or amendments to the soil may be required to reduce

infiltration and maintain an adequate wet pool and prevent potential groundwater contamination.

- Wet basin vegetation should be placed along aquatic benches or in the marsh zones of the wet basin. The optimal elevation for planting of wet basin vegetation is within 6 to 18 inches of the normal wet pool elevation.
- Side slopes should be 3:1 (run to rise) or flatter to encourage growth of vegetation and slope stability.
- Install energy dissipaters at all outlets and inlets to reduce the potential for scour.
- To enhance vegetation diversity, create or enhance micro-topography in the wet basin (small irregular variations in bottom topography).
- The planting schedule should consider the short growing season in the Lake Tahoe Region for vegetation establishment.

INSPECTION AND MAINTENANCE

See Wet Basin Inspection and Maintenance Table on following page.

Wet Basin Inspection and Maintenance Table

INSPECTION AND MAINTENANCE ACTIVITIES	SUGGESTED FREQUENCY	INSPECTION EQUIPMENT	MAINTENANCE EQUIPMENT
Inspect for signs that runoff is properly accessing the basin. ▪ Repair any blocked or diverted conveyances.	Before and During Major Storms		Trash Bag Shovel
Inspect for trash and debris. ▪ Remove trash and debris from basin.	Annually in Spring and after major storms		Trash Bag
Inspect for erosion and undercutting, especially along the side slopes, and at the inflow and outflow areas. ▪ Stabilize eroded slopes and undercut and eroded areas at inflow and outflow structures.	Annually in Spring and after major storms		Erosion Control Blanket, Coir Logs
Inspect for mosquitoes. ▪ Control mosquitoes as needed for public health concerns.	Monthly (April–Oct)		Mosquito Tablets or Treatment
Inspect for invasive weeds[2]. ▪ Remove invasive weeds monthly during the first growing season. Thereafter, weed annually, or as needed.	Monthly During First Growing Season and Annually Thereafter	Invasive Weeds Inspector	Tools as needed to control infestation
Measure depth of sediment in forebay (if applicable) and main basin following BMP RAM protocols to determine accumulated depth[3]. ▪ If accumulated material has decreased forebay or basin storage volume capacity by 50%, removal of accumulated material is needed. ▪ Lower water level of basin, scrape bottom (shovel or backhoe) to remove sediment and excess vegetation and restore original cross-section. Dispose of sediment at a stable on-site location or out of the Tahoe Basin. Compost or otherwise dispose of vegetation.	Spring and Fall	Staff Plate	Shovel or Backhoe Pickup or Dump Truck
Inspect site for unusual or unsafe conditions (snow plow damage, structural damage, dumping, vandalism, etc.). ▪ Repair structural components as necessary.	Annually in Spring		Tools as needed
Inspect in-basin vegetation and measure percent cover per BMP RAM protocols[4]. ▪ Analyze inspection results. Percent cover of riparian and wetland species should be between 40 and 75%. ▪ If percent cover of riparian and wetland species is greater than 75%, vegetation removal is necessary. o Pull vegetation (including the roots) to attain desired percent cover and species composition. o Remove and compost material or otherwise dispose of cut vegetation. ▪ If percent cover of riparian and wetland species is less than 40% vegetation recruitment is necessary. o Consult with wetland ecologist for advice on supplementing additional wetland and riparian cover. ▪ If necessary, mow and remove terrestrial vegetation (uplands and/or access road) to 6" height in the fall.	Spring and Fall	Vegetation inspector	Clippers Loppers Mower/Backhoe Trash Bag Pickup or Dump Truck

[2] Lake Tahoe Basin Weed Coordinating Group. http://www.tahoeinvasiveweeds.org/.
[3] The Lake Tahoe Stormwater Community and Environmental Improvement Program, 2009, *BMP RAM Users Manual V.1. Material Accumulation. pg 55-57*
[4] The Lake Tahoe Stormwater Community and Environmental Improvement Program, 2009, *BMP RAM Users Manual V.1. Vegetation Cover. pg 63-64*

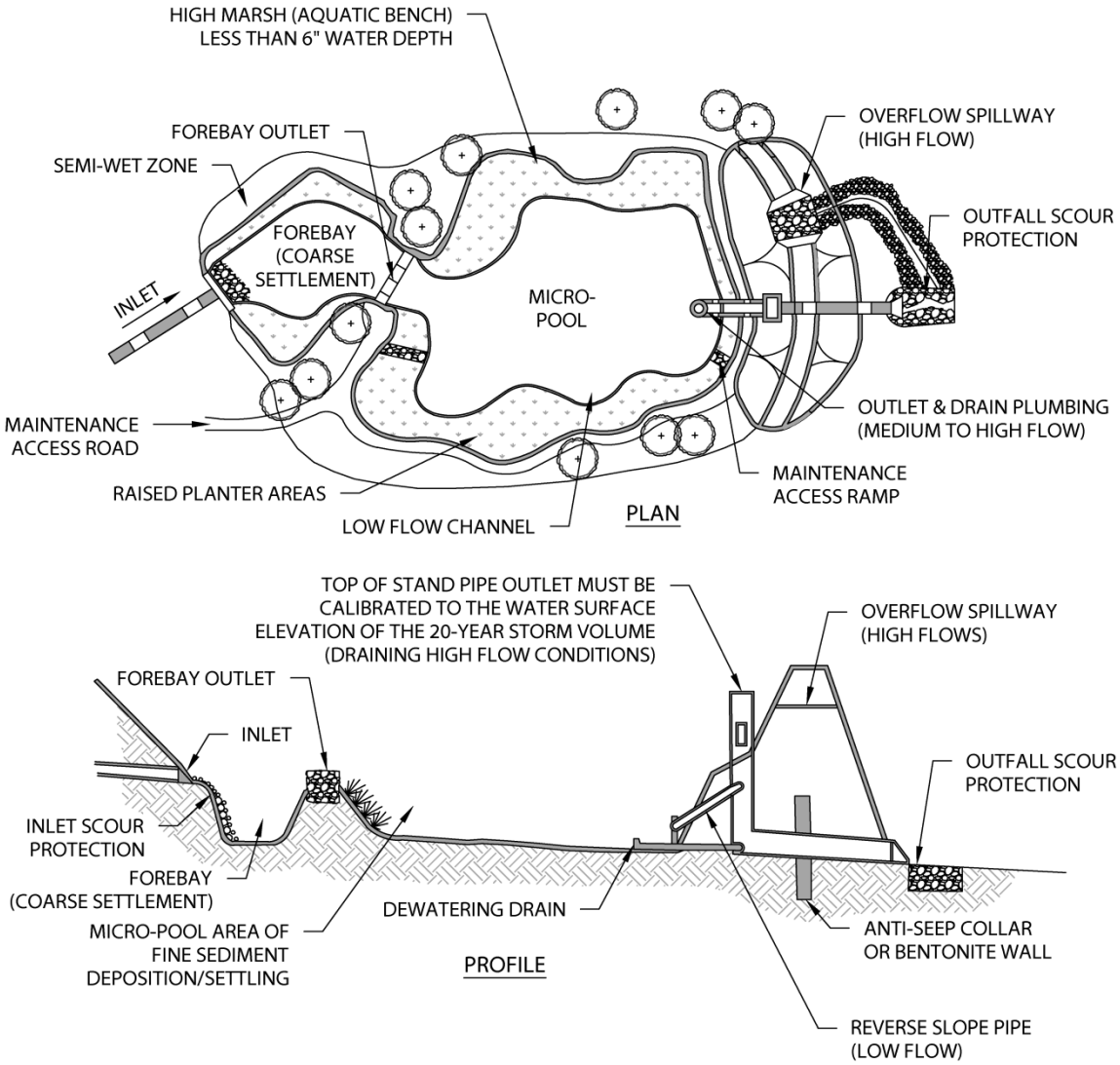
EFFECTIVENESS CONSIDERATIONS

Wet basins are considered one of the most effective stormwater treatment BMPs in the Lake Tahoe Region for removal of pollutants of concern for lake clarity when properly designed and maintained. Three performance monitoring studies conducted on wet basins are cited below.

- *Tahoe City Wetland Treatment System Study* [5] noted the following performance for the wetland system treating stormwater runoff from a portion of Tahoe City.
  - The median removal rate for nitrate-N was about 84% for water year 2003.
  - Soluble phosphorus concentrations were reduced by 57% and by 66% for total dissolved phosphorus and for orthophosphate, respectively.
  - The median removal rate for TSS was about 77% for water year 2003.
- *Assessment of Seasonal Pollutant Loading and Removal Efficiency of Detention Basins*[6] noted nearly complete removal of nitrate concentrations by denitrification but a large increase in the amount of biologically available nitrogen.
- *Water Quality Performance Evaluation of Park Avenue Detention Basins*[7] noted the following for the wet basin treating stormwater from the redeveloped Heavenly Village. This study provides some of the first performance monitoring data for fine sediment particles:
  - Nitrogen and phosphorous loads were reduced on the order of 74-81%.
  - A 64% reduction in the fine particle load (< 10 um) was observed.
  - A comparison of the inflow and outflow EMC values indicated that the wet basin provided an EMC reduction for DIN, TSS and fine particle < 10um. An additional analysis of the inflow and outflow grain size distributions indicated a consistent reduction in the percentage of fine particles (<10 um) contained in surface water outflow from the wet basin.

[5] Heyvaert, Alan et al., 2005, *Tahoe City Wetland Treatment System. Groundwater and Surface Water Assessment*.
[6] Beck, Nicole, 2003, *Assessment of Seasonal Pollutant Loading and Removal Efficiency of Detention Basins.*
[7] 2NDNATURE, 2008, *Water Quality Performance Evaluation of Park Avenue Detention Basins; South Lake Tahoe, CA.*

Wet Basin Figure



NOTES:

1. THIS DETAIL DISPLAYS KEY CONCEPTS FOR A WET BASIN AND IS NOT INTENDED TO BE APPLICABLE TO A SPECIFIC SITE. WET BASINS SHALL BE DESIGNED BY A ENGINEER FOR INDIVIDUAL SITES.