

Sediment Basin

Definition

A sediment basin is a temporary pond built on a construction site to capture eroded or disturbed soil that is washed off during rain storms, protect neighboring properties, and protect the water quality of a nearby stream, river, lake, wetland or bay.

Description and Purpose

Sediment basins collect and store runoff to allow suspended solids to settle out prior to leaving the site. The primary purpose of sediment basins is to prevent sediment laden runoff from reaching lakes, streams and wetlands.

The practice may also be called settling basins, sumps, debris basins, dewatering basins.

Pollutant(s) controlled:

- Suspended solids

Treatment Mechanisms:

- Settling causes coarse and medium size particles to settle out in the basin

Pollution Removal Efficiencies:

- Sediment basins are not effective in controlling fine particles (i.e. silt, clay)
- Sediment basins remove only 70-80 percent of large sized sediment particles and so should be used in conjunction with other erosion control BMP's.

Companion and Alternative BMPs

- Riprap – Stabilized Outlet

Advantages and Disadvantages

Advantages:

- Cost effective measure for treating sediment laden runoff
- Relatively easy to construct

Disadvantages:

- There must be adequate space and topography for the basin to be constructed and for it to function properly.
- Sediment basins must be installed only within the property or special easement limits and where failure of the structure will not result in loss of life, damage to homes or buildings, or interruption of use or service of public roads or utilities.
- Sediment basins are attractive to children and can be very dangerous. Local ordinances regarding health and safety must be adhered to. If fencing of the basin is required, the type of fence and its location should be shown in the SESC plan and in the construction specifications

- Sediment basins are only practically effective in removing sediment down to about the medium silt size fraction. Sediment-laden runoff with smaller size fractions (fine silt and clay) may not be adequately treated unless chemical treatment is used in addition to the sediment basin.
- Standing water may cause mosquitoes or other pests to breed.
- Basins require large surface areas to permit settling of sediment. Size may be limited by the available area.

Location

- Sediment basins are utilized in areas of concentrated flow or points of discharge during construction activities.
- Sediment basins shall be constructed at locations accessible for clean out.
- Site conditions must allow for runoff to be directed into the basin.
- Do not locate sediment basins in perennial streams or wetlands. In-stream sediment basins are only allowed upon permit by the DNRE, Land and Water Management Division.

General Characteristics

- **Sediment basins should be designed by Licensed Professional Engineers**
- Sediment basins are designed to be in place until the contributory drainage area has been stabilized.
- Sediment basins are temporary and serve drainage areas up to 100 acres however other conservation practices are often more economical for smaller drainage areas.
- Sediment basins should be 4 times longer than wide (unless baffles are used to increase the flow length)
- The basin depth should be a minimum of two feet deep and no shallower than the average distance from the inlet to the outlet (length) divided by 200

Materials

- Earth
- Riprap
- Risers
- Collars
- Seed for stabilization of disturbed soil.

Design Specifications

- Conduct a site investigation to determine the size of the drainage area and the best location for the basin or basins.
- Determine soil types. (If the soils are predominantly clay, the basin size required may be larger than practical. However, if soils are sand or silts there will be little structural integrity of the basin if constructed with on-site soils. With clay soils it is particularly important to make the best use of soil erosion control measures, because sedimentation measures, including sediment

- Select the site for the sediment basin based on the natural drainage of the area and the soil type.
 - Determine the number of basins needed. In some cases, it is more effective to have a number of smaller basins rather than on large basin. This is particularly important in areas with larger-grained sediments. In addition, the damage caused by one small basin which fails is much less than the damage caused by one large basin which fails.
 - The area(s) chosen should be such that runoff can be easily diverted to the basin. The most logical location is usually at the lower end of the drainage area.
 - The discharge from basins should approximate the pre-development runoff from the site.
 - Where necessary, the site(s) should also easily accommodate periodic clean-outs.
 - Determine the ultimate fate of the basin. If the basin is to become part of a stormwater runoff "treatment train" upon completion, then the design of the basin must be coordinated with the design of the "future use" of the basin. If the ultimate fate of the basin is an infiltration basin, avoid using heavy equipment in the area so as not to compact the soils. Soils compaction will decrease the ability of the soil to infiltrate water. If the basin is to be a temporary structure which will be filled and stabilized upon completion of the project, then proceed with the design criteria below.
- Select the appropriate type of basin based on the information below:
 - There are three classes of sediment basins. Classification is based on:
 1. The maximum drainage area a basin serves
 2. The height of the dam
 3. The extent of the mechanical control devices provided with a basin
 - If the basin is to be a temporary structure, choose between Class 1 and Class 2 basins. If the structure is to be permanent, then choose between the Class 2 and Class 3 basin and remember that the design criteria for both the sediment basin and the stormwater basin must be met.
 1. Class 1: This is a simple temporary basin, frequently used on construction sites. This basin consists of an excavated area or an earth embankment or dam less than 3 feet high constructed of the soil or stone which is available on the site. These basins can be quickly located and constructed with equipment available on most construction sites. Stabilization of the embankment with vegetation or paving is necessary. Maximum drainage is 20 acres.
 2. Class 2: This is a carefully constructed temporary or permanent sediment basin. It consists of an embankment of selected soil materials constructed under controlled procedures, with provisions for an emergency discharge for stormwater to prevent embankment failure. A class 2 basin is most applicable in situation where significant damage can result to downstream and off-site areas if the basin should fail. Maximum drainage is

3. Class 3: Class 3 basins have carefully engineered, sophisticated controls and are usually permanent. Both spillways and embankments are intended to serve as grade stabilization structures which will continue to function as stormwater control measures after construction activities are completed. A Class 3 basin should always be constructed if a basin is to be converted to a permanent stormwater detention site. **Class 3 basins must be restored to original design specifications prior to conversion to a stormwater control.** The maximum drainage is 100 acres.

- The basin should be stabilized before the upstream area is cleared
- Disposal sites for the sediment removed from the basin should be incorporated into the overall site plan.
- Sediment basins with dams over six feet in height or more and impounding five or more surface acres, are regulated under the Dam Safety Act. Other permits may also be needed.
- The effectiveness in reducing in-stream velocity and allowing suspended solids to settle out depends on the:
 - Surface area of the basin. In general the greater the area, the greater the detention time and the less the flow velocity
 - Size of the particles coming into the basin
 - Concentration of particles coming into the basin
 - Rate of flow into the basin
 - Volume. As sediment accumulates, the volume decreases (as does the effectiveness of the basin)
 - Travel distance
- **Temporary structures** should be designed with an expected life of no more than 3 years. Structures which will be in place longer than that should be designed as permanent structures (i.e. have emergency spillways).
- **Side Slopes:** For safety reasons, the side slopes of sediment basins should be no greater than 2:1 (horizontal to vertical). Use flatter slopes in urban or urbanizing areas for safety and liability.
- **Shape:** The basin shape should be greater than 4:1 (length to width), to improve trapping efficiency. Baffles can be used to modify the effective flow distance on shorter basins if the construction site is unable to accommodate a 4:1 basin.
- **Basin Capacity:** At a minimum, the sediment capacity of a sediment basin should be equal volume to contain 1 inch of runoff from the entire drainage area. This is roughly equivalent to 3,600 ft³/acre.
- **Dimensions:** The longer the basin, the more settling will occur. Therefore, at a minimum, the length of the basin should be no less than 4 times the width.

The length can effectively be "extended" for basins on sites that do not have the space to accommodate a 4:1 shape by adding a baffle in the basin perpendicular to the direction of the incoming sediment/water.

The basin depth should be a minimum of two feet deep and no shallower than the average distance from the inlet to the outlet (length) divided by 200

Basin dimensions can be determined using the following equations:

1. $Volume = Length \times Width \times Depth$
2. Basins with Volumes less than 80,000 ft³
 $Width = \sqrt{Volume / 8}$
 $Length = 4 \times Width$
 $Depth = 2 \text{ feet (a constant)}$
3. Basins with volumes more than 80,000 ft³
 $Width = \sqrt[3]{12.5 \times Volume}$
 $Length = 4 \times Width$
 $Depth = Length / 200$

- **Spillway System:** The spillway system should carry the peak runoff from the sediment basin design storm allowing for a 2 foot freeboard. The velocity of the flow discharged from the basin should not exceed that allowable for the receiving water body.
- **Principal Spillway (Mechanical Spillway):** Class 2 and 3 basins include the design of a principal spillway to allow a controlled discharge of water. The principle spillway normally consists of a vertical pipe (or riser) located at the deepest part of the basin, connected to a horizontal pipe which outlets through the dam or lower slope.
 - The top of the riser should be at least 3 feet below the top of the dam or crest of the emergency spillway.
 - The riser may be solid or perforated. Perforated risers are surrounded by wire mesh and a mound of well graded gravel. A trash rack over the top of the riser prevents debris from entering and clogging the spillway. **Geotextile fabric should not be wrapped around perforated risers because it can blind off quickly and effectively block the perforations.**
 - The horizontal pipe should be provided with anti-seep collars to prevent piping along the outside of the pipe.
 - The outlet of the principal spillway for Class 2 and Class 3 basins should be stabilized with riprap. Follow the specifications for Riprap – Stabilized Outlet. Class 1 basins will not have a spillway.
 - The size of the principal spillway should be large enough to pass 80% of the calculated peak discharge from the drainage area. For Class 1 basins, the peak discharge should be based on the storm frequency equivalent to the lifetime of the project in years, and the Class 2 and Class 3 basins should be designed on a 10-year and 25-year storm frequency, respectively. If the sediment basin will also be used as a stormwater basin then be sure to design the spillway using the appropriate stormwater basin procedure.
- **Emergency Spillway:** Class 2 and 3 basins require an emergency spillway to protect the embankment by providing an outlet from the basin for runoff

- The emergency spillway should be sized to pass the difference in discharge between the design storm frequency and the capacity of the principle spillway.
- If the basin will be used as a stormwater basin, the emergency spillway should be designed to pass the 100-year storm.
- Emergency spillways can be as simple as a slope drain constructed of a half section of corrugated metal pipe, or a riprap channel constructed down the dam slope.
- The crest of the spillway should be three feet above the crest of the mechanical riser and a minimum of two feet above the expected water level for the design storm.
- The cross-section should be trapezoidal, with side slopes 3:1 or flatter.
- The outlet of the emergency spillway for Class 2 and Class 3 basins should be stabilized with riprap. Follow the specifications in the Riprap – stabilized outlet BMP. The emergency spillway for a Class 1 basin can consist of a simple berm alongside the outlet to channel water to a stabilized area.
- **Riser and Barrel:** To facilitate installation and reduce the potential for failure from blockage, the minimum barrel size for corrugated metal pipe should be 8 inches, and 6 inches for smooth wall pipe. The cross-sectional area of the riser at least 1.5 times that of the barrel to improve the efficiency of the principal spillway system.
- **Embankments:** The embankments should always be constructed with the most stable fill material available. For permanent embankments, selected material may have to be hauled in. Where possible, use soils other than sand. Sandy soils tend to shift.

Construction Guidelines

1. **Never build a sediment basin in a perennial stream or in wetlands. In-stream sediment basins are allowed only upon permit by the DNRE.**
2. Construct the sediment basins before any other land clearing or grading is done. Construct according to the design and by following the guidelines below.
3. The natural ground under any proposed embankment or dam should be cleared and stripped of trees, other vegetation and roots. The remainder of the basin area should be cleared of trees and larger vegetation to allow easy periodic removal of sediment. Natural grasses and groundcover, however, should be retained to provide stabilization.
4. Disc or scarify the area where embankment fill will be placed to allow a good bond between the fill and the existing soil. The placement of fill should be in controlled, uniform layers, and should be compacted.
5. Stabilize all exposed areas of the embankment by seeding and mulching or sodding. Stabilization of the embankment is particularly important with Class 1 basins since the embankment functions as the spillway.
6. Immediately after the sediment basin is constructed, the top banks of the basin and all surrounding areas should be stabilized with vegetation.
7. After the entire construction project is completed, temporary sediment basins should be dewatered, then filled in to conform with the contours of the area.

8. For sediment basins that will be converted to permanent stormwater controls, the sediment accumulated in the basin during construction, but should be removed to accommodate the conversion.

Monitoring

- Check the basin depth to ensure the capacity of the basin is adequate for stormwater and sediment deposition
- Check the basin for piping, seepage, and other mechanical damage
- Check for the presence of soil caking around the perforated riser pipe, which would prevent proper drainage from the basin.
- Check the outfall to ensure drainage is not causing erosive velocities, and to ensure the outlet is not clogged.

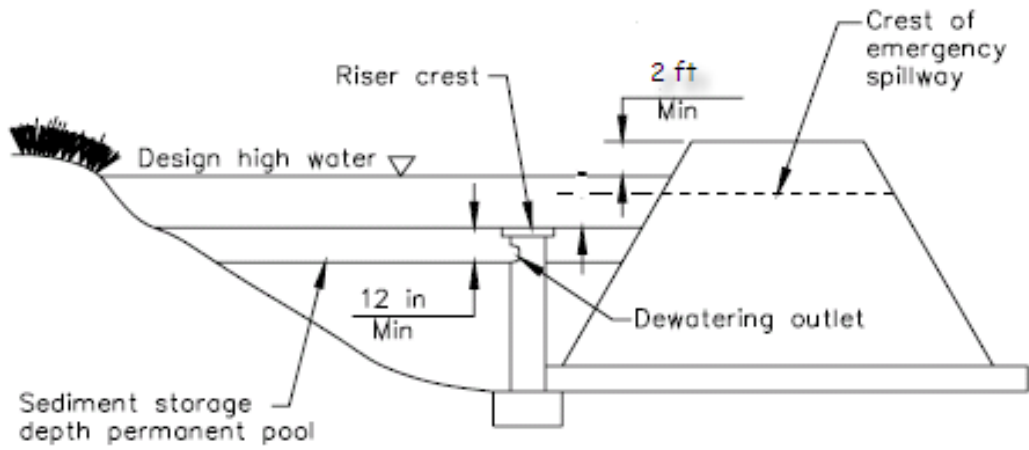
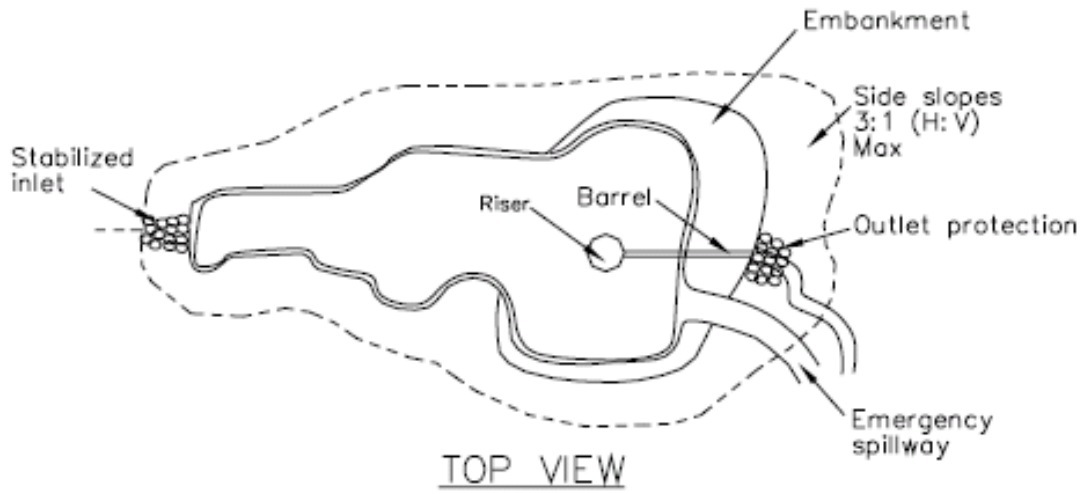
Maintenance

- Remove sediment when it has accumulated to no more than 50% of the design depth.
- Any problems discovered during the maintenance monitoring should be addressed immediately.
- Sediment removed during cleaning should be placed at an upland area and stabilized so that it does not re-enter the drainage course.

References

California Stormwater Quality Association, 2003. *Construction BMP Handbook*.
Sediment Basin.
Dyersburg, Tennessee. *Erosion Control Handbook*. Sediment Basin.

Exhibit 1. Sediment Basin – Standard Riser



NOTE:
This outlet provides no drainage for permanent pool.

Exhibit 2. Sediment Basin – Perforated Riser

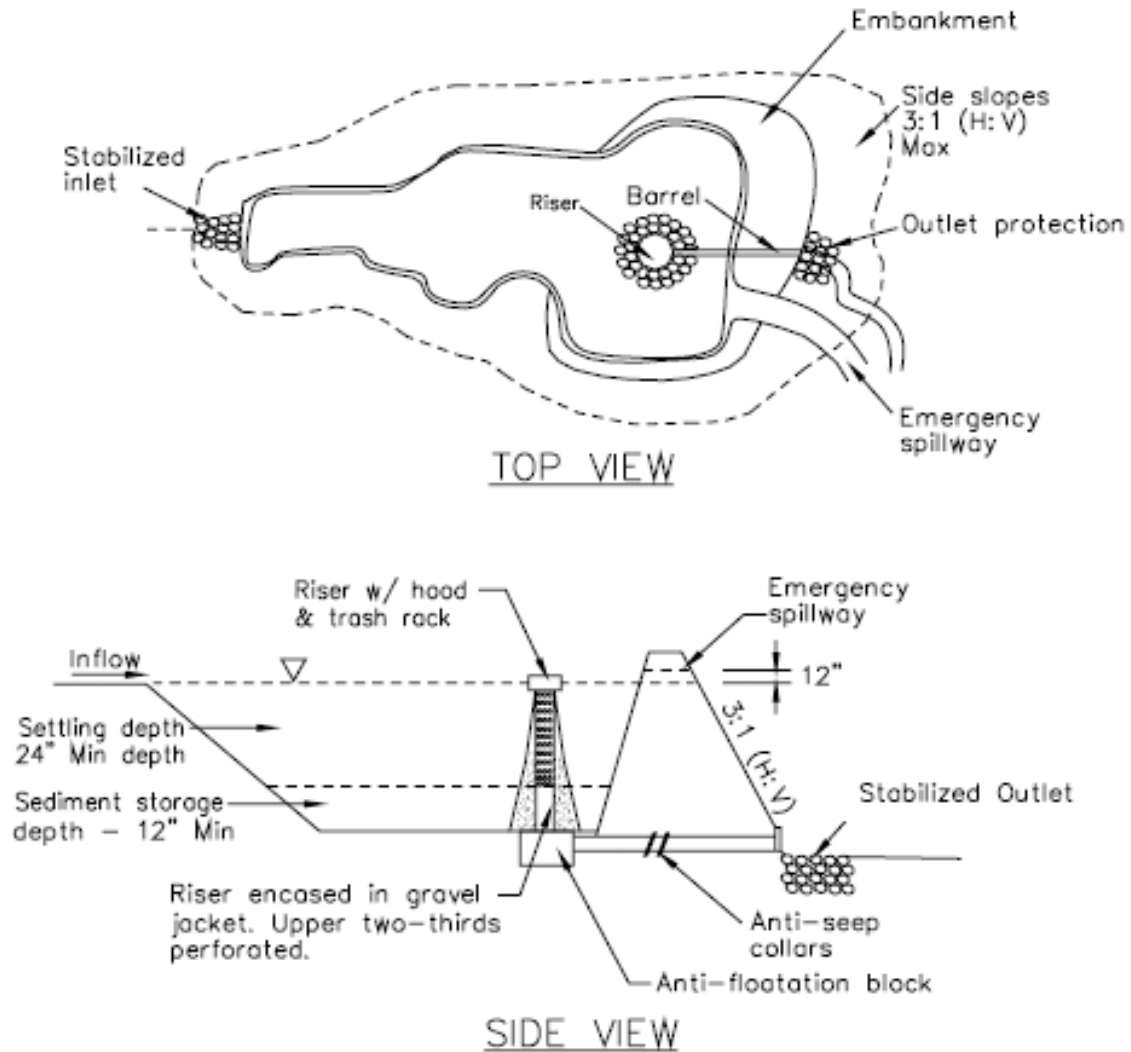


Exhibit 3. Sediment Basin – Outlet Riser

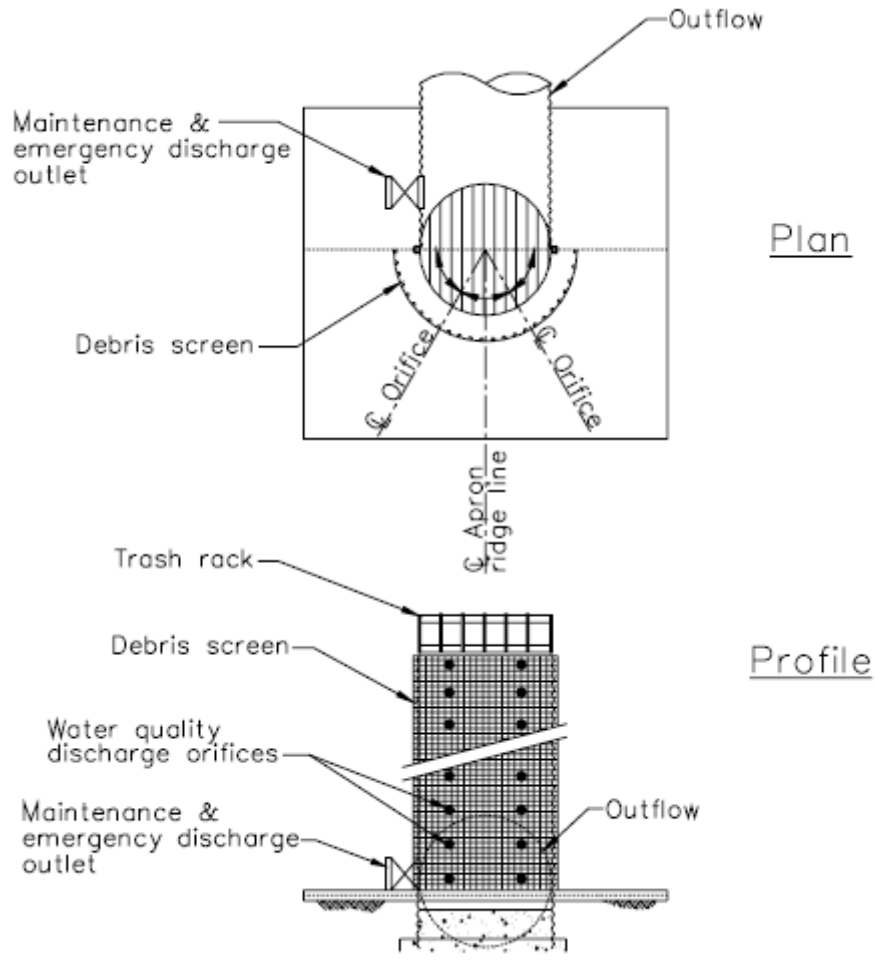


Exhibit 4. Sediment Basin – Baffle Placement

