Sediment Trap

Plan Symbol

Description

A sediment trap is formed by excavating a pond or by placing an earthen embankment across a low area or drainage swale. An outlet or spillway is constructed using stones or aggregate to slow the release of runoff. The trap retains the runoff long enough to allow most of the silt to settle out. Design sediment traps to have an 80 percent design removal efficiency goal of the total suspended solids (TSS) in the inflow.

When and Where to Use It

A sediment trap may be formed completely by excavation or by construction of a compacted embankment. The outlet should be a rock fill weir/spillway section, with the area below the weir acting as a filter for sediment and the upper area as the overflow spillway depth. Temporary sediment traps should not be placed in Waters of the State or USGS blue-line streams (unless approved by SCDHEC, State, or Federal authorities).

Sediment Trap Design Criteria

To complete the design of the temporary sediment trap:

- Determine the required sediment storage volume.
- Determine the bottom and top surface area of the sediment storage volume using 3H:1V side slope from the bottom of the trap.
- Determine the total trap dimensions by adding the depth required for the 10-year, 24-hour design storm above the surface of the sediment storage volume, while not exceeding 2H:1V side slopes. Side slopes of 3H:1V are recommended, with a maximum of 2H:1V.
- Design temporary sediment traps with a minimum storage capacity of 1800 cubic feet of storage for each acre draining to them, regardless of the calculated trapping efficiency.

Design Aids

The Design Aids located in this section may be used to properly size sediment traps. Sedimot III, SEDCAD4, and other computer models that utilize eroded particle size distributions and calculates a corresponding trapping efficiency may also be utilized.

General Design Requirements

a. Maximum Drainage Area - 5 acres
b. Maximum Design Life - 18 months
c. 80 percent design removal efficiency goal for TSS
d. Basin Shape - The flow length is 2 times the flow width.
e. Embankment Requirements:
   1. Maximum dam height: 5-feet.
   2. Maximum stone height: 3.5-feet.
   3. Minimum rock bottom width: 3-feet.
   4. Discharge and treatment capacity for the 10-year 24-hour storm event.

Installation

Install a non-woven geotextile filter fabric before installing the stone for the outlet structure. Allow the stone to extend downstream past the toe of the embankment. Mark the sediment cleanout level of trap with a stake in the field. Seed and mulch all disturbed areas.

Inspection and Maintenance

The key to a functional sediment trap is continual monitoring, regular maintenance and regular sediment removal.

- Remove sediment when it reaches 50 percent of storage volume or top of cleanout stake.
- Inspect every 7 calendar days and within 24-hours after each rainfall event that produces ½-inches or more of precipitation.
- Remove all temporary sediment traps within 30 days after final site stabilization is achieved or after it is no longer needed.
- Remove trapped sediment from the site, or stabilized on site.
- Permanently stabilized disturbed areas resulting from the removal of sediment traps.

Sediment Trap Design Aids

The sediment trap design aid is a single line grouping all soil textures together. For the sediment trap, the ratio is:

$$\text{Sediment Trap Ratio} = \frac{q_{po}}{A\,V_{15}}$$

Where

q_{po} = Peak outflow for the 10-year 24-hour storm event (cfs)
A = Surface area at the elevation equal to the bottom of the rock fill outlet (acres)
V_{15} = Characteristic settling velocity (fps), of the characteristic D_{15} eroded particle (mm).

Read D_{15} is read Figure ST-1, or determine from a site specific soil eroded particle size distribution analysis. Never use the primary particle size distribution.

Read V_{15} from Figure SV1.

Constraints for the use of Sediment Trap Design Aids are:

- Watershed area less than or equal to 5 acres
- Overland slope less than or equal to 20 percent
- Rock fill diameter greater than 0.2-feet and less than 0.6-feet
- Rock fill height less than 5-feet
- Top width of rock fill between 2- and 4-feet
- Maximum Side slopes 1:1 to 1.5:1.

Sediment Trap Ratios above the design curves are not recommended for any application of the design aids. If the sediment trap ratio intersects the curve at a point having a trapping efficiency less than the desired value, the design is inadequate and must be revised.

A sediment trap ratio equal to 9.0 E4 has an 80 percent trapping efficiency

Route storm flows through sediment traps to calculate the required depth and storage volume of the trap.

Calculate a sediment storage volume and provide this volume below the bottom of the rock fill outlet structure.

Sediment trap Design Example

Given: A sediment trap designed for a 10-year, 24-hour storm is to be constructed on a development site as a temporary sediment control measure for a 3-acre drainage area that is totally disturbed.

The outlet is to be a rock fill constructed of rock with a mean diameter of 0.5-feet.

The soil is a Cecil sandy loam, the slope of the watershed is 5 percent, and the time of concentration is 6 minutes.

Find: If the desired trapping efficiency is 80 percent, what is the required peak discharge for trap areas of 0.10, 0.25, and 0.50 acres.

Solution:

1. Determine the Sediment Trap Ratio. From the Sediment Trap Design Aid (Figure ST1), the ratio for a design trapping efficiency of 80 percent is 9.0E4 ft^2/acre.

2. Determine the ratio of qpo/A required from the Sediment Trap Ratio,

$$\textit{Sediment Trap Ratio} = 9.0x10^4 = qpo/A * V_{15}$$

3. The D_{15} for a Cecil soil is 0.0066 mm, and the corresponding V_{15} for a Cecil sandy loam soil is 1.2E-4 ft/sec. Hence,

$$9.0x10^4\ V_{15} = qpo/A = (9.0x10^4)(1.2x10^{-4}) = 11\ cfs\ /acre\ of\ pond.$$

4. Determine qpo/A values. The following results are tabulated for the acreage shown:

Sediment Trap Bottom Area (acres)	qpo Through Rock Fill (cfs)
0.10	1.1
0.25	2.8
0.50	5.5

Each of these combinations will give the desired resulting 80 percent trapping efficiency.

The rock fill outlet structure must be designed to convey a peak flow of that shown in column two of the table above. See Section 6.4 for design details. If the check rock fill overtops, the trapping efficiency is assumed to be zero.

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Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Outlet spillway is clogged with the debris.	Remove debris by lightly raking debris from upstream side of spillway. If debris is excessive, remove smaller filter stone on upstream side of spillway and replace with new clean stone.
Spillway erodes due to high velocity flows.	Stabilize outlet with larger riprap on downstream side of spillway.
Side Slope eroding.	Stabilize slopes with vegetation, ECB, TRM, riprap or equivalent method.
Excessive accumulated sediment buildup.	Remove sediment to maintain sediment storage capacity.
Drainage area is too large.	Limit the contributing drainage area by installing diversion ditches and adding additional BMPs to accommodate the diverted flow.