Natural Resources Conservation Service
Conservation Practice Standard

SEDIMENT BASIN
(No.)
CODE 350

DEFINITION

A basin constructed with an engineered outlet, formed by an embankment or excavation or a combination of the two.

PURPOSE

To capture and detain sediment laden runoff, or other debris for a sufficient length of time to allow it to settle out in the basin.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to urban land, construction sites, agricultural land, and other disturbed lands:

- Where physical conditions or land ownership preclude treatment of a sediment source by the installation of erosion-control measures.
- Where a sediment basin offers the most practical solution.
- Where failure of the basin will not result in loss of life, damage to homes, commercial or industrial buildings, main highways or railroads; or in the use of public utilities.
- The product of the storage times the effective height of the dam is less than 3,000. Storage is the volume, in acre-feet, in the reservoir below the elevation of the crest of the auxiliary spillway.
- The effective height of the dam is 35 feet or less. The effective height of the dam is the difference in elevation, in feet, between the auxiliary spillway crest and the lowest point in the cross section taken along the centerline of the dam.
- The Hazard Class of the dam is Low.

CRITERIA

Sediment basin design and construction must comply with all applicable federal, state and local laws and regulations.

Location. Sediment basins are the last line of defense for capturing sediment when erosion has already occurred. When possible construct basins prior to soil disturbance in the watershed. Choose the location of the sediment basin so that it intercepts as much of the runoff as possible from the disturbed area of the watershed. Choose a location that minimizes the number of entry points for runoff into the basin and interference with construction or farming activities. Do not locate sediment basins in perennial streams.

Basin Capacity. The sediment basin must have sediment storage capacity, detention storage and temporary flood storage capacities. For maximum sediment retention, design the basin so that the detention storage remains full of water between storm events. However, if site conditions, safety concerns, or local laws preclude a permanent pool of water, design all or a portion of the detention and sediment storages to be dewatered between storm events.

The capacity of the sediment basin shall equal the volume of sediment expected to be trapped at the site during the planned useful life of the basin or the improvements it is designed to protect. If it is determined that periodic removal of sediment will be practicable, the capacity may be proportionately reduced.

Average annual sediment volume shall be calculated in the following manner for drainage areas less than 50 acres. For drainage areas larger than 50 acres, consult with the area engineer.

Land Slope [2/]	Soil Loss Per Acre of Bare Ground [1/] in Tons
0 2%	5
2 – 5%	15
5 – 8%	30
8 – 12%	50
12 – 17%	100
17+%	300
Gully	300

1/ Soil loss from vegetated areas is considered negligible and not added for total sediment volume.

2/ Note: Submerged sediment weighs 75 lbs/ft^3 and aerated sediment weighs 90lbs/ft^3.

The design of dams, spillways, and drainage facilities shall be according to NRCS standards for Pond (378) and Grade Stabilization Structures

(410) or according to the requirements in TR-60, as appropriate for the class and kind of structure being considered.

Design the sediment storage for a minimum of 900 ft^3/acre of disturbed area. The sediment storage volume is calculated from the bottom of the basin. Design the detention storage for a minimum of 3600 ft^3/acre of drainage area. The detention volume is calculated from the top of the sediment storage to the crest of the principal spillway. Flood storage is based on the required design storm for the auxiliary spillways. Flood storage is calculated between the crest of the principal spillway and the crest of the auxiliary spillway. A minimum of 1 foot in elevation is required between the principal and auxiliary spillways.

See schematic on page 350-5 of this standard.

Temporary Basins. Temporary basins having drainage areas of 5 acres or less and a total embankment height of 5 feet or less may be designed with less conservative criteria if conditions warrant. The embankment shall have a minimum top width of 4 feet and side slope of 2:1 or flatter. An outlet shall be provided of earth, pipe, stone, or other devices adequate to keep the sediment in the trap and to handle the 10-year-frequency discharge without failure or significant erosion.

The design capacity of temporary basin must be at least 67 cubic yards per acre of drainage area, measured from the bottom of the basin to the crest of the principal spillway (riser pipe). The capacity of the basin may be estimated by 40% x Height x Surface Area. Sediment should be removed from the basin when the volume of the basin has been reduced to 27 cubic yards per acre of drainage area. In no case shall the sediment clean-out level be higher than one foot below the top of the riser. The elevation of the sediment clean-out level should be calculated and clearly marked on the riser.

Principal and Auxiliary Spillway Design

The outlets for the basin may consist of a combination of principal and emergency spillways or a principal spillway alone. In either case, the outlet(s) must pass the peak runoff expected from the drainage area for a 10-year storm without damage to the embankment of the basin. Runoff computations shall be based upon the soil cover conditions which are expected to prevail during the life of the basin. The spillways will not necessarily result in any reduction in the peak rate or runoff. If a reduction in peak runoff is desired, the appropriate hydrographs should be generated to choose the basin and outlet sizes.

Design the principal spillway to carry long-duration, continuous, or frequent flows without discharge through the auxiliary spillway. The diameter of the principal spillway pipe must be 6 inches or greater.

The principal spillway can be designed to remove only water from the temporary flood storage or it can be designed to dewater all or part of the detention storage. Design the principal spillway to drawdown the temporary flood storage within 24 hours. Drawdown times for the detention storage can be longer to improve sediment trapping.

Design the auxiliary spillway to pass large storms without damage to the basin. Refer to NRCS Conservation Practice Standard 378, Ponds for the required design storm and design criteria for the auxiliary spillways.

The outlet of the principal spillway must be stable for anticipated design flow conditions.

Basin Shape. Design basins with a length to width ratio of 2 to 1 or greater. Baffles to divert the flow in the basin can be used to lengthen the flow path of incoming water to achieve the required length to width ratio.

Embankment and Side Slopes. If the sediment basin includes an embankment, it must be constructed of well compacted soil with stable side slopes. Refer to NRCS Conservation Practice Standard 378, Pond for design requirements for the embankment. Above the permanent water line, the side slopes of the pool area must be 3 horizontal to 1 vertical or flatter. Side slopes below the permanent water line can be as steep as 2 horizontal to 1 vertical.

Vegetation. Establish vegetation on the embankment and side slopes of the basin and pool area immediately after construction. Refer to NRCS Conservation Practice Standard 342, Critical Area Planting for criteria for the establishment of vegetation. If construction takes place during a time period that is not conducive to establishing vegetation, protect the embankment by mulching or other methods. Refer to NRCS Conservation Practice Standard 484, Mulching for mulching criteria.

If arid climatic conditions do not allow for the establishment of vegetation other means of reducing erosion may be used.

Safety. Sediment basins are often installed in developing areas and can be an attractive nuisance and safety hazard to the public. Design with the safety of the public in mind. Where appropriate, include safety features such as fencing to limit access to the pool area and embankment, signs to warn of danger and a safety ledge below the water level 6 feet wide and 4 horizontal to 1 vertical (4:1) or flatter around the edge of the permanent pool.

CONSIDERATIONS

A large sediment basin may have an effect on the peak discharge rate from a watershed. Planners should consider this, and take steps to mitigate any potential negative effects this may have on riparian habitat downstream from the structure.

In many cases the use of a sediment basin alone may not provide sufficient protection for offsite sedimentation problems. Sediment basins are at best only 70-80 percent effective in trapping sediment which flows into them. To work most effectively, the sediment basin should be the last practice in a series of erosion control and sediment capturing practices (i.e., temporary seeding, mulching, diversion dikes, etc.) installed in the disturbed area. This incremental approach will reduce the load on the basin and improve effectiveness of the overall effort to prevent offsite sedimentation problems.

To improve the effectiveness of the basin, it should be located so as to intercept the largest possible amount of runoff from the disturbed area. The best locations are generally low areas and natural drainageways below disturbed areas. Drainage into the basin can be improved by the use of diversion dikes and ditches. The basin must not be located in a live stream but should be located to trap sediment-laden runoff before it enters the stream. The basin should not be located where its failure would result in the loss of life or interruption of the use or service of public utilities or roads.

The efficiency of sediment removal in a basin is affected by the detention time of runoff, the type of dewatering device, the presence of a permanent pool in the basin, a decrease in turbulence in the basin and soil particle size. The uses of the following techniques are particularly effective if there is a need to remove clay and other fine grained particles.

- Detention time can be increased by increasing the storage volume in the basin. Increased storage along with a properly designed dewatering device can significantly improve the efficiency of sediment capture.
- Dewatering should be done in a manner which removes the cleaner water above the sediment storage, without removing the sediment laden water found deeper in the basin. One dewatering device that has been very successful is a skimming device that floats on the surface of the water and rises and falls with the water level in the basin. Use of this type of dewatering device should improve the quality of the water leaving the basin. Details for this type of dewatering device can be found in the North Carolina Erosion and Sediment Control Planning and Design Manual.
- Maintaining a permanent pool also improves sediment trapping by reducing the re-suspension of sediment in the basin. This can be accomplished by only dewatering the temporary flood storage or only a portion of the detention storage. Removal of sediment from the basin before it reaches the sediment storage elevation will maintain the pool volume and improve trapping efficiency.
- Turbulence in the basin can be reduced by constructing porous baffles that extend across the entire basin. The baffles slow down flows and force water to spread across the entire width of the basin. A thorough discussion and design criteria for porous baffles can be found in the North Carolina Erosion and Sediment Control Planning and Design Manual.
- For very fine grained sediments, flocculants can be added to the runoff before it enters the basin. One commonly used flocculant is anionic polyacrylamide (PAM). Do not use cationic polyacrylamide because it can be toxic to aquatic life.

Since the sediment basin must be designed to handle all of the contributing drainage whether it is from disturbed areas or not, diverting runoff from undisturbed areas away from the basin will improve the function of the basin. The design storm for diversion measures should be equal to the design storm for the auxiliary spillway of the basin.

The use of forebays that are separate from the main basin, and easily accessible for cleanout will reduce turbulence and will allow larger particles to settle out of the runoff before it enters the main basin.

Because the sediment storage capacity of a basin is finite, choose a location that will allow access for sediment removal when the storage capacity is full.
Visual aesthetics may be a concern, especially in urban or suburban areas. To address these concerns, design the basin to blend with the surrounding topography, or use plantings to screen the view from surrounding homes or buildings.

In some situations, after they have served the sediment capture function, sediment basins may remain in place to function as stormwater detention or wildlife ponds. This will require appropriate planning during the design phase to ensure that the basin can function for a different use. In addition, significant modifications to outlet structures may need to be made as well as removal of accumulated sediment to convert it to a new use.

If the basin will be used by wildlife, the use of native species is recommended to provide food and habitat diversity. Also, consider wildlife use of the basin when scheduling maintenance activities that may disrupt wildlife life cycles or negatively impact pollinators.

PLANS AND SPECIFICATIONS

Plans for installing sediment basins shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. . Include as a minimum, the following in the plans and specifications:

1. A plan view of the layout of the sediment basin.
2. Typical cross sections of the basin.
3. Details of the outlet system
4. Seeding requirements if needed.
5. Construction specifications that describe in writing site specific installation requirements of the sediment basin.

Specifications for construction and installation of a sediment basin shall use or be in conformance with the requirements of the attached "Construction Specification." Any variation from these specifications shall be approved by an engineer.

OPERATION AND MAINTENANCE

Prepare an operation and maintenance plan for the operator. Vegetation damaged by livestock, machinery, herbicides, or erosion must be repaired promptly.

The minimum requirements to be addressed in the operation and maintenance plan are:

1. Periodic inspections and maintenance of the embankment, principal and auxiliary spillways and dewatering device especially following significant runoff events.
2. Prompt repair or replacement of damaged components.
3. Prompt removal of sediment when it reaches pre-determined storage elevations. The basin should be checked after each runoff-producing rainfall for sediment clean-out.
4. Periodic mowing of vegetation to control of trees, brush and invasive species.
5. Periodic inspection of safety components and immediate repair if necessary.

REFERENCES

California Stormwater Quality Association. 2003. California Stormwater BMP Handbook, Construction. Menlo Park, CA.

Center for Watershed Protection. 2000. Improving the Trapping Efficiency of Sediment Basins, Article 58, The Practice of Watershed Protection: Techniques for Protecting and Restoring Urban Watersheds. Ellicott City, MD.

Department of Conservation and Recreation, Commonwealth of Virginia. 1992. Virginia Erosion and Sediment Control Handbook, 3rd Edition, Richmond, VA

Jarrett, A. R. August 1998. Controlling the Dewatering of Sedimentation Basins, Agricultural and Biological Engineering, Pennsylvania State University, University Park, PA.

North Carolina Department of Environmental and Natural Resources, Division of Land Resources. 2006. North Carolina Erosion and Sediment Control Planning and Design Manual. Raleigh, NC.

Tennessee Erosion and Sediment Control Handbook . 2002. Tennessee Department of Environment and Conservation. Nashville, TN

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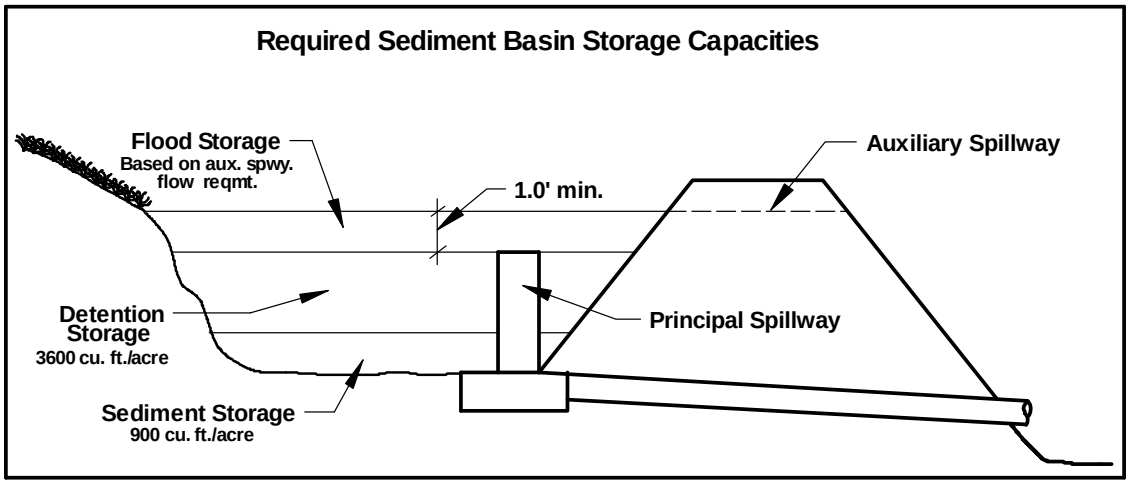

Natural Resources Conservation Service
Construction Specification

SEDIMENT BASIN

1. SCOPE

Work shall consist of constructing the sediment basin and include all clearing, excavation, fill placement, installation for pipe spillway, drains, and other features to lines, grades, and elevations as specified on the drawings and staked in the field. The location of the embankment shall be as shown on furnished drawings or as staked in the field.

2. SITE PREPARATION

The pool area shall be cleared to the extent desired and as shown on the plans. Trees shall be cut as flush with the ground as practical and burned and buried at designated locations.

Clearing of the staked foundation, spillway, and borrow area(s) shall include removal of logs, stumps, roots, sod, and other trash that would prevent a good bond between the foundation and fill material.

3. EXCAVATION

Topsoil from foundation, emergency spillway, and borrow area(s) shall be stockpiled for spreading on the completed dam and spillway as needed to help establish vegetation.

Existing stream channels crossing the foundation area shall be deepened and widened as necessary to remove all stones, gravel, sand, sediment, stumps, roots, organic matter and other objectionable material and to accommodate compaction equipment. Side slopes of the channels and other foundation surfaces shall be left no steeper than 1:1. The foundation area shall be thoroughly scarifier before placement of the fill material. Moisture shall be added and soil compacted as necessary so that the first layer of fill material will be bonded to the foundation.

The cutoff trench shall be excavated to the depths, bottom width and side slopes shown on the plans. Material removed from the cutoff trench which is free of boulders, roots, organic matter and other objectionable material may be placed in the downstream one-third of the fill. All excess water shall be removed from the trench and the foundation area when fill material is being placed.

Excavated sediment basins shall be constructed to conform to the shapes, lines and grades shown on the drawings or as staked in the field. The material excavated from the pool area shall be placed so that its weight will not endanger the stability of the pool side slopes and so that it will not be washed back into the pool by rainfall.

4. FILL PLACEMENT

The material placed in the fill shall be free of all sod, roots, frozen soil, stones over 6 inches in diameter, and other objectionable material.

Placing and spreading of the fill material shall begin at the lowest point of the foundation and be brought up in approximately horizontal layers not exceeding 8 inches thick. These layers shall be reasonably uniform in thickness and shall extend over the entire area of the fill. The earth hauling or compacting equipment shall be operated over each layer so that reasonable compaction of the fill material will be obtained. A minimum of 5 percent shall be added to fill heights constructed with compaction equipment or having each layer covered by the wheel track of construction equipment during the fill placement process. Without compaction or wheel track coverage, 10 percent added fill height shall be required.

The distribution and gradation of materials throughout the fill shall be such that there will be no lenses, pockets, streaks, or layers of material differing substantially in texture or gradation from the surrounding material. Where it is necessary to use material of varying texture and gradation, the more impervious material shall be placed in the upstream and center portions of the fill. Construction of the fill shall be undertaken only at such times when the moisture content of the fill material will permit a satisfactory degree of compaction and bonding or when moisture can be satisfactorily added and incorporated in dry soil material as it is being placed. The embankment, emergency spillway, and borrow areas shall be finished to a smoothness so the surface can be readily traveled upon by farm type equipment.

Final construction shall be considered satisfactory when:

Excavation elevations are within ± 0.2 foot of design grade or modified grade. Excavation slopes may be flatter than designed but not steeper.

Fill elevations are not less than design height plus settlement. Fill above the required settlement elevation will require extra fill material to maintain side slopes within design limits.

Fill slopes may be flatter than designed but may not be steeper and shall be uniform throughout their length. Allowance for anticipated settlement may be considered when calculating side slopes for construction check.

Selected backfill material shall be placed around structures, pipe conduits, and drainfill or antiseep collars at about the same rate on all sides to prevent damage from unequal loading. Fill adjacent (within 1 foot) to these components shall be compacted to a density equivalent to that of the surrounding fill by hand tamping or by using manually directed power tampers or plate vibrators. Care shall be taken during backfill around pipe conduit to prevent uplift of pipe. Preparation of a shaped bed with 1 inch of moist, loose soil supporting about one-third of pipe circumference will help ensure the pipe to soil contact.

Drainfill material placed next to the pipe conduit or other structural features shall be kept free of contaminating fill materials by either placing in a cleanly excavated trench or by keeping the drainfill at least 1 foot above the adjacent earthfill.

5. CONSTRUCTION MATERIALS

Pipe conduit shall conform to appropriate ASTM and federal specifications. Antiseep collars shall be of materials compatible with that of the pipe and shall be installed so that they are watertight. The pipe shall be installed according to the manufacturer's instructions and be firmly and uniformly bedded throughout its length to the specified line and grade shown on the drawings.

Used welded steel pipe shall be of good quality, free of pits, dents, or other items that might reduce the durability, capacity, or planned life of the structural measure.

Spillway conduit installations shall be considered satisfactory when the conduit is within ± 0.2 foot of design grade, has a positive slope toward the outlet, has the required appurtenances (bands, antiseep collars, risers, cathodic protection, etc.) attached, has all surface coating damage repaired, and has adequate backfill and compaction applied.

Concrete used for antiseep collars, riser base, riser crest perimeter protection, or pipe inlet protection shall consist of a mix containing a minimum of six bags per cubic yard and a maximum net water content of 7 gallons per bag of cement. A minimum 24 hours curing time shall be allowed before fill material is placed against the concrete. Concrete shall be placed and finished in an acceptable manner. Reinforcing steel shall be placed as indicated on the plans and shall be held securely in place during concrete placement. Subgrades and forms shall be installed to line and grade, and the forms shall be mortar-tight and unyielding as the concrete is placed.

Filter and drainage diaphragm materials shall have a gradation equal to the fine concrete aggregate gradation listed in the Mississippi State Highway Department, "Standard Specifications for Road and Bridge Construction." The drain shall have a minimum 2-foot thickness of uncontaminated filter material.

6. PROTECTION

A protective cover of vegetation shall be established over all the exposed surfaces of the embankment, spillway, excavation disposal, and borrow area(s). Temporary vegetation may be used until permanent vegetation can be established. The embankment and spillway shall be fenced to protect vegetation from livestock as needed.

Surface drainage shall be provided around excavation disposal areas and other areas for non-erosive entry of runoff into the sediment basin or for non-erosive disposal of runoff away from the embankment.

7. MEASUREMENT

Excavation volumes from core trench, foundation stripping, stream channel clean-out, etc., shall be calculated from design sections, surveyed cross sections, or other acceptable methods. Fill material in the embankment shall be calculated to the neat lines of the design section and added to the excavation volume for total borrow volume needed. No additional volume will be added for settlement. Calculations will be to the nearest 1.0 cubic yard.

Measurement of conduit and conduit riser shall be the purchased length. Each antiseep collar, connecting band, riser fabrication, and anti-

vortex baffle shall be individually itemized and accounted for.

Concrete for the riser base, antiseep collar(s), and riser crest protection shall be measured to the neat lines of the design dimensions. Reinforcement steel, wire mesh, and any forming required will be included in payment for the concrete. Concrete shall be calculated to the nearest 0.1 cubic yard.

Measurement for vegetative plantings area shall cover all disturbed areas (embankment, emergency spillway, borrow area, etc.). Areas shall be measured to the nearest 0.1 acre.

8. VEGETATION DETAILS

Seeding Date: _____ , _____ , _____

Seed Type: _____, _____, _____

Seed Rate: _____, _____, _____

Soil Preparation: _____

_____

Fertilizer: _____ Rate _____ #/acre

Lime: _____ Rate _____ #/acre

Mulch: _____ Rate _____ #/acre

Other: _____ _____

9. CONSTRUCTION DETAILS

_____

_____

_____

_____