NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

ROOF RUNOFF STRUCTURE

(No.)

CODE 558

DEFINITION

Structures that collect, control, and transport precipitation from roofs.

PURPOSE

To improve water quality, reduce soil erosion, increase infiltration, protect structures, and/or increase water quantity.

CONDITIONS WHERE PRACTICE APPLIES

Where roof runoff from precipitation needs to be:

- diverted away from structures or contaminated areas;
- collected, controlled, and transported to a stable outlet; or
- collected and used for other purposes such as irrigation or animal watering facility.

CRITERIA

General Criteria Applicable to All Purposes

The minimum design capacity for roof runoff structures shall be a 10-year storm frequency, 5-minute rainfall precipitation event, except where excluding roof runoff from manure management facilities. In that case, a 25-year frequency, 5-minute precipitation event shall be used to design roof runoff structures (Refer to Agricultural Waste Management Field Handbook, NEH Part 651 Chapter 10 Appendix 10B). When gutters are used, the capacity of the downspout(s) must equal or exceed the gutter flow rate.

Outlets. Runoff may empty into surface or underground outlets, or onto the ground surface. Surface and underground outlets shall be sized to ensure adequate design capacity and shall provide for clean-out as appropriate. When runoff from roofs empties onto the ground surface, a stable outlet shall be provided. When runoff is conveyed through a gutter and downspout system, an elbow and energy dissipation device shall be placed at the end of the downspout to provide a stable outlet and direct water away from the building.

Surface or ground outlets such as rock pads, rock filled trenches with subsurface drains, concrete and other erosion-resistant pads, or preformed channels may be used, particularly where snow and ice are a significant load component on roofs.

Rock-filled trenches and pads shall consist of poorly graded rock (all rock fragments approximately the same size) and be free of appreciable amounts of sand and/or soil particles. Crushed limestone shall not be used for backfill material unless it has been washed. Subsurface drains or outlets shall meet the material requirements of the applicable NRCS conservation practice standard.

Underground conduits shall meet the requirements specified for Underground Outlet (620) or for Subsurface Drain (606).

Collection Trenches. Stone filled trenches with an underground outlet, under the roof dripline, may be used in lieu of roof gutter. Locate the trench so the trench centerline follows the roof dripline. The minimum width and depth for the collection trench is 24 inches. Line the trench with geotextile for soil separation to prevent soil movement into the stone and underground outlet.

The conduit for the underground outlet shall be perforated with and minimum diameter of 4 inches, and meet the requirements found in the underground outlets section of this standard. Size the conduit such that when combined with the temporary storage in the trench the trench will not overtop for the design storm of the system.

Backfill the trench MSHA #57 aggregate stone along the sides and extending 6 inches over the drain conduit. Backfill the remaining trench with clean coarse aggregate meeting gradations found in Maryland State Highway Administration, Standard Specifications for Construction and Materials, Section 901. When computing the volume of storage in the coarse aggregate use 25 percent voids.

Roof Gutter. Use K-style, half round, or box type roof gutter. When rafters are open ended, cut the rafters so that the edge is vertical and install a fascia board. Install the roof gutter so that it is free floating to allow for expansion and contraction. The minimum top width for roof gutters is 5-inches.

Down Spouts. Position downspout outlets as to avoid contamination with animal waste. Use preformed downspout outlets. Use the largest size of preformed outlet that will fit the roof gutter. Determine the down spout size and number of outlets by the method found in Design Guide MD #1, Roof Runoff Structure or by the following procedure. The ratio of roof drainage area to down spout cross-sectional area shall not exceed 100 square feet of roof area per one square inch of down spout area.

Supports. Gutter supports (hangers) shall have sufficient strength to withstand anticipated water, snow, and ice loads. Use a maximum spacing of 24 inches except when otherwise approved by the engineer. Mount roof gutters on fascia boards using hidden hangers, bolts and ferrules, gutter screws and ferrules, cradles, or by other approved methods. Spikes and ferrules are not acceptable.

Replace fascia boards that are in poor condition. Rafters with unsound ends shall be repaired or replaced. Existing fascia boards with a nominal thickness less than 2 inches that meet the criteria found in Design Guide MD #1, Roof Runoff Structure need not be replaced.

Securely fasten down spouts at the top and bottom with intermediate supports (fasteners) at maximum 10 intervals. Install fasteners in accordance with manufacturer recommendations.

Protection. Protect the roof gutter and downspouts from damage by livestock and equipment. Where animals or equipment may come in contact with down spouts, steel pipe, schedule 40 pvc pipe, or similar materials shall be used. Roof gutters may be installed below the projection of the roofline to further reduce gutter damage from snow and ice.

Roof Gutter and Downspout Materials. Roof runoff structures shall be made of durable materials with a minimum design life of ten years. Roof gutters and downspouts may be made of aluminum, galvanized steel, wood or plastic. Aluminum gutters and downspouts shall have a nominal thickness of at least 0.027 inch and 0.020 inch respectively. Galvanized steel gutters and downspouts shall be at least 28 gage. Wood shall be clear and free of knots. A water-repellent preservative shall be applied to the flow area of wood other than redwood, cedar, or cypress. Plastics shall contain ultraviolet stabilizers. Dissimilar metals shall not be in contact with each other.

Wood and plastic roof gutters shall be approved by a staff engineer on a case by case basis.

Lumber. All lumber used for fascia board and rafter end repair or replacement shall have a minimum nominal thickness of 2 inches. Nominal size as applied to timber or lumber, is the size by which it is known and sold in the market, and often differs from actual size. Pressure treated lumber shall not be used for fascia boards. Cover fascia boards with aluminum or vinyl flashing or paint prior to installation of roof gutter.

Concrete. Use type I cement, 28-day compressive strength of 4000 psi, 5% to 7.5% air entrainment with a slump of 1.5 inches to 3 inches.

Rock. Gravel (aggregates) and rock riprap must meet the requirements of Maryland Department of Transportation, State Highway Administration, *Standard Specifications for Construction and Materials,* Sections 901.01 and 901.02 respectively or appropriate AASHTO Standards. Recycled concrete may be substituted if appropriately sized.

Geotextile. Geotextile may be woven or nonwoven and must meet the requirements of Maryland Department of Transportation, State Highway Administration, *Standard Specifications for Construction and Materials,* Section 921.09, Class SE.

Additional Criteria to Increase Infiltration

Runoff shall be routed onto pervious landscaped areas (e.g., lawns, mass planting areas, infiltration trenches, and natural areas) to increase infiltration of runoff. These areas shall be capable of infiltrating the runoff in such a way that replenishes soil moisture without adversely affecting the desired plant species.

Additional Criteria to Protect Structures

Runoff shall be directed away from structure foundations to avoid wetness and hydraulic loading on the foundation.

On expansive soils or bedrock, downspout extensions shall be used to discharge runoff a minimum of five (5) feet from the structure.

The discharge area for runoff must slope away from the protected structure.

Additional Criteria to Increase Water Quantity

Storage structures for non-potable purposes such as irrigation water shall be designed in accordance with NRCS conservation practice standards, as appropriate.

Potable water storage structures shall be constructed of materials and in a manner that will not increase the contamination of the stored water. Roof runoff collected and stored for potable uses must be treated prior to consumption and shall be tested periodically to assure that adequate quality is maintained for human consumption.

CONSIDERATIONS

Avoid discharging outlets near wells and sinkholes.

Some designs may provide secondary benefits, e.g. rock pads may also reduce rodent problems around livestock and poultry barns.

PLANS AND SPECIFICATIONS

The plans and specifications shall show the location, spacing, size, and grade of all gutters and downspouts and type and quality of material to be used. Plans and specifications for other practices essential to the proper functioning of the roof runoff structure, such as underground outlet, shall be included.

OPERATION AND MAINTENANCE

An operation and maintenance plan shall be developed that is consistent with the purposes of the practice, its intended life, safety requirements, and the criteria for the design. The plan shall contain, but not be limited to, the following provisions:

- Keep roof runoff structures clean and free of obstructions that reduce flow.
- Make regular inspections and perform repair maintenance as needed to ensure proper functioning of the roof runoff structures.

TABLE 1 - RAINFALL INTENSITIES [1]		
County	**10-year (ft./sec.)**	**25-year (ft./sec.)**
Allegany	0.00015	0.00017
Anne Arundel	0.00015	0.00019
Baltimore	0.00015	0.00018
Calvert	0.00015	0.00019
Caroline	0.00016	0.00019
Carroll	0.00015	0.00018
Cecil	0.00015	0.00018
Charles	0.00015	0.00019
Dorchester	0.00016	0.00019
Frederick	0.00015	0.00018
Garrett	0.00015	0.00017
Harford	0.00015	0.00018
Howard	0.00015	0.00018
Kent	0.00015	0.00019
Montgomery	0.00015	0.00018
Prince George's	0.00015	0.00019
Queen Anne's	0.00015	0.00019
Somerset	0.00016	0.00020
St. Mary's	0.00015	0.00019
Talbot	0.00016	0.00019
Washington	0.00015	0.00018
Wicomico	0.00016	0.00020
Worcester	0.00016	0.00020

[1] Converted values for the 10-year and 25-year frequency five-minute rainfalls. The values shown above are given in ft/sec.

NRCS, MD

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SUPPORTING DATA AND DOCUMENTATION

Field Data and Survey Notes

The following is a list of the minimum data needed:

1. System plan sketch;
2. Dimensions of buildings, and proposed locations of downspout and underground outlets.

Design Data

For guidance on the preparation of engineering plans see chapter 5 of the EFH, Part 650 and National Engineering Handbook Part 641 or Maryland Amendment Number 1. The following is a list of the minimum required design data:

1. Plan view showing roofs that need roof runoff control and where the systems may safely outlet and construction specifications;
2. The peak runoff from each roof for the design storm selected, roof gutter and outlet design as found in worksheet 1 of Design Guide MD #1;
3. Underground outlet systems shall be sized as found in worksheet 2 of design guide MD #1;
4. Job class on plans;
5. Quantities estimate;
6. Planting plan. This must meet the criteria, specifications, and documentation requirements of the Maryland conservation practice standard, Critical Area Planting, code 342;
7. Drawings to include the following as a minimum: Plan view; roof gutter location, gage, type, size, slope, direction, and mounting instructions, underground outlet type, size direction and installation instructions, and construction specifications;
8. Written Operation and Maintenance plan.

Construction Check Data/As-built

Record on survey notepaper, SCS-ENG-28 or other as appropriate. Plot survey data in red. The following is a list of minimum data needed for As-builts:

1. Documentation of site visits on CPA-6. Include the date, who performed the inspection, specifics as to what was inspected, all alternatives discussed, and decisions made and by whom;
2. Actual location, length, size, and dimensions of the installed roof gutter and downspouts;
3. Verification of the method of mounting;
4. When applicable verify the underground outlet size, type, location, outlet type, rodent guard type, vertical distance between invert of outlet pipe and normal water in outlet stream or ditch bottom, and vertical distance between invert of outlet pipe and top of bank;
5. Final quantities, documentation for quantity changes, and materials certification;
6. Sign and date plans to include statement that practice meets or exceeds NRCS practice standard.

REFERENCES

American Society for Testing and Materials, ASTM Standards, Philadelphia, Pennsylvania.

Maryland Department of Transportation, State Highway Administration, Standard Specifications for Construction and Materials, Baltimore, Maryland, January 2001.

USDA, Natural Resources Conservation Service, Maryland Field Office Technical Guide, Section IV, Standards and Specifications.

USDA, Natural Resources Conservation Service, MD #1, Roof Runoff Structure, MD #1, Maryland Design Guide Field Handbook.

USDA, Natural Resources Conservation Service, National Engineering Handbook, Part 650, Engineering Field Handbook.

USDA, Natural Resources Conservation Service, National Handbook of Conservation Practices.

USDA-NRCS. 1999. National Engineering Handbook, Part 651, Agricultural Waste Management Field Handbook

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