

**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.

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.

In regions where snow and ice will accumulate on roofs, guards and sufficient supports to withstand the anticipated design load shall be included.

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 minimum nominal thickness of 0.027 inches and 0.020 inches, respectively. Galvanized steel gutters and downspouts shall be a minimum 28 gauge. Wood shall be clear and free of knots. Wood may be redwood, cedar, cypress, or other species that has the desired longevity. Plastics shall contain ultraviolet stabilizers. Dissimilar metals shall not be in contact with each other.

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.

Concrete appurtenances used shall meet the requirements of NRCS Conservation Practice 561, Heavy Use Protection.

Roof runoff structures shall be protected from damage by livestock and equipment.

The following runoff rates may be used for design:

- 1) For 10-yr. frequency: 0.6 in / 5 min. or 0.17 cfs per 1000 sf of roof
- 2) For 25-yr. frequency: 0.72 in / 5 min. or 0.20 cfs per 1000 sf of roof

The flow rates for downspouts shall be calculated by using the orifice discharge equation with a coefficient of discharge (c) not greater than 0.65. Downspout (orifice) size may determine the design capacity of a gutter and downspout system. The capacity of the system is the lesser of the gutter and the downspout flow rates.

Agricultural Engineering Technical Note N1: Roof Runoff Management – Gutter Selection Size. (Refer to FOTG Section I NC Engineer Technical References) may be used to match roof area to roof gutter size and to select the size and spacing of downspouts.

In addition, strainers shall be used at the head of downspouts when underground outlets are used.

Gutter supports shall have a maximum spacing of 48 inches for galvanized steel and 32 inches for aluminum and plastic. Gutters that are not mounted on fascia boards shall have lateral supports spaced not more than 10 feet apart.

Downspouts shall be securely fastened at the top and bottom with intermediate supports no more than 10 feet apart. Lateral downspouts shall have supports that are a maximum of 5 feet apart.

Gutters will normally be installed below a line formed by projecting the roof line down and out away from the building.

Gravel drip lines shall function as either a water collection/conveyance device or as a raindrop impact barrier. The minimum depth of washed gravel shall be four (4) inches and the minimum width shall be two (2) feet, centered directly beneath the drip line of the roof.

#### **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.

**REFERENCES**

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

USDA-NRCS. 1986. NENTC, TN, Agricultural Engineering Technical Note N1: Roof Runoff Management – Gutter Selection Size. (Located in FOTG Section I NC Engineer Technical References)