Determining Runoff Curve Numbers for Filtrexx® Slope Protection

Runoff curve numbers are often used in design applications to predict or estimate potential storm water runoff flow from a designated post construction area or watershed. A runoff curve number (CN) is the number assigned, between 1 and 100, to the runoff potential of a hydrologic soil-cover complex (Soil Conservation Service USDA, 1972). A hydrologic soil cover complex (and its assigned CN) is determined by the hydrologic soil group (A, B, C, or D), the land use (fallow, row crop, pasture, forest, etc), land treatment class (straight row, contour, terrace), the hydrologic condition of the soil (poor, fair, good), and the soil moisture content. The hydrologic condition of the soil is a subjective measure and the hydrologic soil group has been predetermined for every soil classification in the US (where A represents a low runoff potential soil and D represents a high runoff potential soil). For example, an impervious surface, like pavement, is 99, a wooded area with sandy soil is 46, and a surface that produces no runoff under any circumstance is 1. Today runoff curve numbers are usually estimated based on published book values and databases. Curve numbers for Filtrexx® Slope protection can be estimated with sufficient site and soil information based on these published book values. When determining runoff curve numbers, Filtrexx® Slope Protection can have a significant effect on storm water runoff potential and should be considered in the assignment of the correct CN. Additionally, if a low CN is the desired characteristic, particularly in Low Impact Development (LID) or Leadership in Energy and Environmental Design (LEED) projects, sensitive watershed environments, sediment and/or stormwater management pond catchment basins, or where storm water utilities are levied, inclusion of Filtrexx® Storm Water Blanket should be seriously considered.

Rationale

Filtrexx® Slope protection has been shown to significantly reduce storm water runoff, so much that they may be considered a runoff reduction tool as much as an erosion control tool. The humus fraction of compost (15-35% of the carbon originally used to make the compost or 60-80% of the stable organic matter content of the finished compost) is known to hold up to 5 times its weight in water (Brady and Weil, 1996).

Research at the University of Georgia (Faucette et al, 2005) and at Iowa State University (Persyn et al, 2004) have shown that Filtrexx® Slope protection used on hill slopes can significantly reduce runoff volumes during rain events.

Research at the University of Georgia showed that a 1.5 in thick Slope protection on a 10:1 slope, under a simulated rainfall of 3.1 in/hr for 60 min (50 yr return), could delay runoff commencement by up to one hour relative to bare soil conditions and by 45 minutes relative to a hydroseeded treated soil on a cecil sandy clay loam (hydrologic class B). Filtrexx® Slope protection reduced cumulative stormwater runoff over 1 year by 65% relative to a bare soil and 50% relative to a hydroseeded soil, and reduced stormwater volume during a single large storm event by as much as 96%. Similarly, Filtrexx® Slope protection reduced peak runoff rates by an average of 36% (and as much 67%) relative to bare soil and 27% relative to hydroseeded soil, over 1 yr duration. In a follow up study at the same site, under 2 simulated rainfall events of 4 in/hr for 60 min (100 yr return), Slope protection reduced total runoff by an average of 60% and retained an average of 80% of the total runoff applied.

Research from Iowa State University reported that a 2 in compost blanket on a 3:1 slope, under simulated rainfall of 4 in/hr for 60 min (100+ yr return), could delay runoff commencement by 50 min relative to a 6 in topsoil blanket or disk-tilled soil. Filtrexx® Slope protection reduced runoff rate by 79% relative a bare disked-tilled soil and 71% relative to a 6 in topsoil blanket (Persyn, 2004).

Research performed by the University of Texas-Austin, for the Federal Highway Administration and the US DOT, found that erosion control compost blankets 3 in thick on a clay soil and a 3:1 slope could reduce peak runoff rates 10 fold under a simulated rainfall of 3.45 in/hr for 3 hr duration (5 yr return) (Kirchhoff et al, 2003).

Research conducted at Texas A&M, for the TX Commission of Environmental Quality, using 2 inch compost blankets on a 3:1 slope of clayey soil, under a simulated rainfall of of 3.6 in/hr for 60 min (25 yr return), found that prior to vegetation establishment the compost blankets reduced runoff by 35% (and as much as 67%) relative to soils receiving commercial fertilizer, prior to vegetation establishment (Mukhtar et al, 2004).

In similar studies, Agassi et al (1998) found that compost mulches percolated twice as much water as a bare soil under rainfall simulation; Meyer et al (2001) found that incorporating compost at 40 Mg ha-1 to gravely clay loam and gravely sandy loam soils on 10 to 16% slopes can reduce runoff by 77% under a simulated rainfall of 4 in/hr for 30 minutes (100+ yr return), while the percent of runoff from rainfall was reduced from an average of 36% to 6%.

Runoff Curve Number for Slope Protection

Runoff curve numbers can be determined if rainfall and runoff volumes are known (Georgia Storm Water Management Manual, 2001). Using results from Faucette et al (2005) where three storms produced 10 inches of rainfall, and compost blankets (from yard debris) generated 2.6 in of runoff; and Pitts (1994) equation for determining runoff curve numbers when rainfall and runoff volumes known, where:

CN = 1000/[10 + 5(P) +10(Q) - 10(Q2 + 1.25QP)1/2]

CN = runoff curve number
P = rainfall volume (in.)
Q = runoff volume (in.)

CN = 43

NOTE: this CN is representative of the site and soil conditions at the research site. Runoff CNs assigned to soils that are predominantly sand, silt, not severely compacted, or belong to hydrologic soil group A will have a significantly lower CN. For accurate curve numbers that reflect your site and soil conditions, please consult the SCS National Engineering Handbook for Hydrology, a similar reference, or Dr. Britt Faucette at Filtrexx.

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