WATER EROSION EQUATION A -RKLSCP

A -predicted average annual soil loss (tons/acres year). Soil loss can be predicted on any field condition where soil erosion by water is probable.

R -rainfall-runoff erosivity factor. It is the average annual summation (EI) values in a normal year's rain. The erosion-index is a measure of the erosion force of specific rainfall. When other factors are constant, storm losses from rainfall are directly proportional to the product of the total kinetic energy of the storm (E) time its maximum 3D-minute intensity (I). Storms less than 0.5 inches are not included in the erosivity computations because these storms generally add little to the total R-value. R factors represent the average storm EI values over a 22-year record. R is an indication of the two most important characteristics of a storm determining its erosivity: amount of rainfall and peak intensity sustained over the extended period.

The erosivity of rainfall varies greatly by location. The R factor in Nebraska ranges from 35-175. Approximately 70 percent of the erosivity occurs in the months of May, June, July, and August in Nebraska.

K -soil-erodibility factor. It is a measure of erodibility for a standard condition. This standard condition is the unit plot, which is an erosion plot 72.6 feet long on a 9 percent slope, maintained in continuous fallow, tilled up and down hill periodically to control weeds and break crusts that form on the surface of the soil. The plots are plowed, disked, and cultivated the same for a row crop of corn or soybeans except that no crop is grown on the plot.

The soil erodibility factor K represents both susceptibility of soil to erosion and the rate of runoff, as measured under the standard unit plot condition. Fine textured soils high in clay have low K values, about .05 to .15, because they are resistant to detachment. Coarse textured soils, such as sandy soils, have low K values, about .05 to 0.2, because of low runoff even though these soils are easily detached. Medium textured soils, such as the silt loam soils, have moderate K values, about 0.25 to 0.4, because they are moderately susceptible to detachment and they produce moderate runoff. Soils having a high silt content are most erodible of all soils. They are easily detached; tend to crust and produce high rates of runoff. Values of K for these soils tend to be greater than 0.4.

On page 15a-15g there are K and Kf (adjusted K) factors listed for each soil series. The K for a soil series may vary by soil type. K factors are developed from a soil nomograph representing soil properties that influence erodibility by water: texture, organic matter, structure, and permeability. These are the major factors that affect the infiltration rate and the total water capacity of a soil. The soil nomograph rates each factor and is used along with Soils 5 data for each soil type to select a K factor and estimate how well a soil can resist the dispersion, splash, abrasion and transport forces of rainfall and runoff.

Organic matter reduces erodibility because it reduces the susceptibility of the soil to detachment, and it increases infiltration, which reduce runoff and thus erosion. Addition or accumulation of increased organic matter through management such as incorporation of manure is represented in the C factor rather than the K factor. Extrapolation of the K factor nomograph beyond an organic matter of 4 percent is not recommended or allowed in RUSLE. In RUSLE, factor K considers the whole soil and factor Kf considers only the fine-earth fraction of the material of <2.00mm equivalent diameter. FOR MOST SOILS Kf= K.

R (continued)

However, rock fragments are not taken into account in the nomograph or the RUSLE equation. If rock fragments are substantial, they have an armoring effect, and the K factor should be adjusted downward. Therefore, K will be less than Kf because armoring is comparable to mulching in the C factor, i.e. there is less splash erosion on gravelly soils. For example, from page 15. Water 16.4, is the Boyer soil series. A Boyer sandy loam soil type has a Kf of 0.24 and a K of 0.24. Kf equals K. A Boyer gravelly sandy loam has a Kf of 0.24 and a K of 0.17. Use the K of 0.17 to make the erosion prediction. K is less than Kf on this soil.

Soil structure affects both susceptibility to detachment and infiltration. Permeability of the soil profile affects K because it affects runoff.

Although a K factor was selected to represent a soil in its natural condition, past management or misuse of a soil by intensive cropping can increase a soil's erodibility. The K factor may need to be increased if the subsoil is exposed or where the organic matter has been depleted, the soil's structure destroyed or soil compaction has reduced permeability. A qualified soil scientist can assist in making this interpretation.

L -slope length factor. Represents the effect of slope length on erosion. It is the ratio of soil loss from the field slope length to that from a 72.6 foot length on the same soil type and gradient. Slope length is the distance from the origin of overflow flow along its flow path to the location of either concentrated flow or deposition. See figure 1. Fortunately, computed soil loss values are not especially sensitive to slope length and differences in slope length of + or -10 percent are not important on most slopes, especially flat landscapes.

Slope lengths are best determined by visiting the site, pacing out flow paths, and making measurements directly on the ground. Obtain L by measuring perpendicular to the contour form the point of origin of overland flow to where deposition begins to runoff enters a well defined channel. Contour maps having intervals greater then 2 feet should be used cautiously, if at all, to determine slope lengths. Slope length values are generally too long when contour maps are used to choose slope length. Slope lengths usually do not exceed 400 feet. Slope lengths longer than 1000 feet should not be used in RUSLE because the reliability of RUSLE at these long slope lengths is questionable, and flow becomes concentrated on most landscapes before such long slope lengths.

Determining where slope length end can be difficult in Nebraska's glacial topography. Generally it is necessary to measure several slopes in a field with variable soils. The main areas of deposition that end RUSLE slope length are at the base of concave slopes. If no signs of deposition are present, the user will have to visualize where deposition occurs. The slope-ending depositional area on a concave slope is usually below where the slope begins to flatten.

As a rule of thumb, if no signs of deposition are present on a concave slope, assume that deposition begins at the location where the steepness is 1/2 of the average steepness of the concave area.

Another difficulty is determining if a channel is a concentrated flow channel that ends a RUSLE slope length. Channels that collect the flow from numerous rills are generally considered to be slope ending concentrated flow channels.

S -slope steepness. Represents the effect of slope steepness on erosion. Soil loss increases more rapidly with slope steepness than it does with slope length. It is the ratio of soil loss from the field gradient to that from a 9 percent slope under otherwise identical conditions. The relation of soil loss to gradient is influenced by density of vegetative cover and soil particle size.

LS factors -The slope length factor L computes the effect of slope length on erosion and the slope steepness factor S computes the effect of slope steepness on erosion. Values of both Land S equal 1 for the unit plot conditions of 72.6-ft. length and 9 percent steepness. Values of Land S are relative and represent how erodible the particular slope length and steepness is relative to the 72.6-ft. long, 9 percent steep unit plot. Thus some values of Land S are c less than 1 and some values are greater than 1. Stripcropping or contouring does on affect the LS value.

In Nebraska three of the four RUSLE LS tables are used to compute LS values. Page 16 is chosen for most cultivated cropland in row crops and small grains. Table 1a is used for pastureland and situations where the soil is consolidated and resistant to rill erosion. Table 1c is for the case where most of the erosion is caused by rill erosion, which is often the case for construction sites immediately after disturbance.

C -cover-management factor. The C factor is used to reflect the effect of cropping and management practices on erosion rates. It is the factor used most often to compare the relative impacts of management options on conservation plans. The C factor indicates how the conservation plan will affect the average annual soil loss and how that soil-loss potential will be distributed in time " during construction activities, crop rotations, or other management schemes.

The C factor is based on the concept of deviation from a standard, in this case an area under clean-tilled continuous-fallow conditions. The Soil Loss Ration (SLR) is then an estimate of the ratio of soil loss under actual conditions to losses experienced under the reference conditions.

"C" represents the effects of plants, soil cover, soil biomass, and soil disturbing activities on erosion. RUSLE uses a subfactor method to compute soil loss ratios, which are the ratios at any given time in a cover management sequence to soil loss from the unit plot. Soil loss ratios vary with time as canopy, ground cover, roughness, soil biomass, and consolidation changes. A "C" factor value is an average soil loss ratio weighted according to the distribution of R during the year. The subfactors used to compute soil loss ratio values are canopy, surface cover, surface roughness, prior land use, and antecedent soil moisture.

Surface cover is material in contact with the soil surface that intercepts raindrops and slows surface runoff. The total percent of the surface covered is the characteristic used by RUSLE to compute how surface cover affects erosion. Surface cover includes all cover that is present, including rock fragments, live vegetation, cryptograms, and plant residue. The only minimum size requirement for material to be counted as surface residue is that it either be of sufficient size or attached to the surface such that is not removed by runoff.

RUSLE accounts for surface roughness in the C value calculation. Surface roughness ponds water in depressions and reduces erosivity of raindrop impact and water flow. If the deposition is sufficiently deep, much deposition occurs in them. Over time, roughness disappears as the depressions fill with sediment and the soil subsides after the tillage operations that formed the depressions.

Roughness is reduced in RUSLE as a function of cumulative rainfall after the last tillage operation. Roughness also indicates the degree of clodiness and the likelihood that the surface will seal, producing increased runoff and soil erodibility. Accounting for roughness, such as with the plow plant tillage system, is one reason some C values are lower with RUSLE.

If a C factor of 0.15 represents the specified cropping management system, it signifies that the erosion will be reduced to 15 percent of the amount that would have occurred under continuous fallow conditions. The C factor in Nebraska ranges from .005 for continuous grass/hay to 0.50 for continuous row crops with low residue returned to the soil. C factors are also available for pastureland, wildlife land, idle land, and woodland uses.

There are seven regions representing Nebraska's RUSLE C & K factor zones: 57.2, 83.1, 87 A/B, 87 C/D, 88B 88E, 99. Each zone is represented by the following cities for historical weather data as follows: Torrington, WY; Yuma, CO; Valentine, NE; Norfolk, NE; Norton, KS; Shenendoah, IA; and Hastings, NE.

P -support practice factor. The RUSLE P factor reflects the impact of support practices on the average annual erosion rate. It is the ratio of soil loss with contouring and/or stripcropping to that with straight row farming up-and-down slope.

As with the other factors, the P factor differentiates between cropland and rangeland or permanent pasture. Both options allow for terracing or contouring, but the cropland option contains a stripcropping routine whereas the rangeland/permanent-pasture option contains an "other mechanical disturbance" routine. For the purpose of this factor, the rangeland/permanent-pasture option is based on the support operation being performed infrequently, whereas in the cropland option the support operations are part of the annual management practice.

T -soil loss tolerance expressed in tons per acre per year.

The "t" value is important in the use of the soil loss equation itself. Soil loss tolerance is the maximum amount of soil loss in tons per acre per year, that can be tolerated and still permit a high level of crop productivity to be sustained economically and indefinitely.

Soil loss tolerance values of 1 through 5 are used. These values represent the tolerable tons of soil loss per acre per year where food, feed, and fiber plants are to be grown. T values are not applicable to construction sites or other non-farm uses of the erosion equation.