APPENDIX F

Universal Soil Loss Equation and Wind Erosion Equation Summary

Universal Soil Loss Equation and Wind Erosion Equation Summary

from 7 Code of Federal Regulations 610.12 – 610.14

The Natural Resources Conservation Service (NRCS) of the United States Department of Agriculture (the Department), utilizes the universal soil loss equation (USLE), the revised universal soil loss equation (RUSLE) and the wind erosion equation (WEQ) to predict soil erosion due to water and wind. Section 301(c) of the Federal Agriculture Improvement and Reform Act of 1996 (FAIRA), which was enacted April 4, 1996, requires the Secretary of Agriculture to publish in the Federal Register by June 3, 1996, the USLE and WEQ used by the Department as of the date of publication. NRCS is publishing the equations and the rules under which the USLE, RUSLE, and WEQ factors are used for administering programs.

The Department was first statutorily required to use the factors from the USLE and WEQ to make highly erodible land (HEL) determinations under the Food Security Act (FSA) of 1985, Pub. L. 99-198. Since the passage of the FSA in 1985, USLE and WEQ have been used to compile the highly erodible soils list and to make highly erodible field determinations.

Universal Soil Loss Equation (USLE)

The equation for predicting soil loss due to erosion for both the USLE and RUSLE is

$$A=R \times K \times LS \times C \times P$$

The factors in the equation have the following definitions:

1) ***A*** is the estimation of average annual soil loss in tons per acre caused by sheet and rill erosion.
2) ***R*** is the rainfall erosivity factor.
3) ***K*** is the soil erodibility factor.
4) ***LS*** is the slope length and steepness factor.
5) ***C*** is the cover and management factor.
6) ***P*** is the support practice factor.

Since the publication of the USLE in 1985, additional research on erosion processes has resulted in refined technology for determining the factor values in the USLE. RUSLE represents a revision of the USLE technology in how the factor values in the equation are determined. RUSLE is explained in the U.S. Department of Agriculture Handbook 703, "Predicting Soil Erosion by Water: A Guide to Conservation Planning with the Revised Universal Soil Loss Equation (RUSLE)." A paper published by K.G. Renard, et al., in the May-June, 1994 Journal of Soil and Water Conservation, volume 49(3), pages 213-220, entitled, "RUSLE revisited: Status, questions, answers, and the future", describes the revision. Primary differences between the USLE and RUSLE include the following:

R Factor: RUSLE includes more R values for the Western United States than the USLE. For the eastern United States, R values are generally the same as those used in the USLE but includes some revisions.

K Factor: Values used in RUSLE are similar to the USLE values but are adjusted to account for changes, such as freezing and thawing, and soil moisture. These adjustments are calculated at one-half month intervals for use in RUSLE and are applicable in the northern and southern plains, midwest, southern, and eastern United States.

LS Factor: USLE uses one LS table; RUSLE uses four LS tables, as determined by the relationship of rill to interrill erosion. Although both the USLE and RUSLE can account for the effects of complex slopes, RUSLE simplifies this LS determination through the use of computer technology.

C Factor: USLE provides estimates of soil changes for 4-5 crop stage periods throughout the year. RUSLE provides estimates of cover and soil changes on one-half month intervals, especially in relation to canopy, surface residue, residue just under the surface, and the effects of climate on residue decomposition, roughness, roots, and soil consolidation.

P Factor: USLE uses P factors for contouring, contour stripcropping, and terracing from table values established for field slope ranges; and for terraces, the P factor is also based on channel gradients. RUSLE uses P factors for farming across the slope and includes new process-based routines to determine the effect of stripcropping and buffer strips. Values for farming across the slope are based on slope length and steepness, row grade, ridge height, storm severity, soil infiltration, and the cover and roughness conditions. The stripcropping P factor is based on the amount and location of soil deposition.

Wind Erosion Equation

The equation for predicting soil loss due to wind erosion is

$$E = f(IKCLV).$$

The factors in the equation have the following definitions:

1. ***E*** is the estimation of average annual soil loss in tons per acre.
2. ***f*** indicates the equation includes functional relationships that are not straight-line mathematical calculations.
3. **I** is the soil erodibility index.
4. ***K*** is the ridge roughness factor.
5. ***C*** is the climatic factor. All climatic factor values are expressed as a percentage of the value established at Garden City, Kansas. Garden City, Kansas was the location of early research in the WEQ and established the standard for climatic factors against which the other locations are measured.
6. ***L*** is the unsheltered distance across an erodible field, measured along the prevailing wind erosion direction.
7. ***V*** is the vegetative cover factor.