ESTIMATING SOIL EROSION FROM WIND USING THE WIND EROSION EQUATION

I. The Wind Erosion Equation (WEQ):

The wind erosion equation is used to predict soil loss by wind forces from specific field areas. The equation is:

E = f (IKCLV) where:

E = the predicted average annual soil loss in tons per acre per year.

f = "a function of" symbol

I = the soil erodibility factor. It is expressed as the average annual soil loss per acre that would occur from an "isolated", "level", "smooth", "unsheltered", "wide", and "bare" field with a noncrusted surface where the climate factor is 100. "Wide" is the distance at which the flow of eroding soil reaches its maximum and does not increase with an increase in field size.

K = the ridge roughness factor. It is a measure of the effect of ridges made by tillage and planting implements. It is expressed as a decimal from 0.5 to 1.0. The standard height-spacing ratio is 1:4 (height for ridges: distance between ridges). Distance between ridges is measured parallel to the prevailing wind erosion direction. A smooth field has a K value of 1.0.

C = the climatic factor. This factor is based on the average wind velocity and the precipitation – evaporation index for the field location based on official weather records. The factor for any given area is expressed as a percentage of the C- factor for Garden City, Kansas, which has a value of 100.

L = the field length. It is the measured unsheltered distance along the prevailing wind erosion direction across the field or area to be evaluated. This factor relates the "isolated, unsheltered, and wide" field condition of I to the size and shape of the field for which the erosion estimate is being prepared.

V = the vegetative factor. It considers the kind, amount, and orientation of vegetation on the surface. This vegetative cover is expressed in pounds per acre of a flat small-grain residue equivalent.

NOTE: Soil erosion rates estimated with the Wind Erosion Equation (WEQ) will not be added to rates estimated with other Wind Erosion Prediction System (WEPS) or water erosion models (USLE, RUSLE, RUSLE2) for conservation planning and application purposes unless the unsheltered distance (L) of WEQ and the slope length (L) of USLE, RUSLE or RUSLE2 are from identical locations with identical L-values within the field. This condition would seldom, if ever, occur.

II. Glossary:

Angle of Deviation. The angle between the prevailing wind erosion direction and a line perpendicular to the row direction.

Barrier. A tree or tree and shrub windbreak or a grass strip, which is at least 3.5 feet tall and 3 feet wide, installed on the windward side of a field to reduce wind velocity.

Buffer Strip. Strips of grass or other low-growing erosion resistant perennial vegetation that is less than 3.5 feet tall planted between cultivated strips or fields and designed to trap saltation particles. Buffer strips must be a minimum of 12 feet wide.

Critical Wind Erosion Period. That period of the year when the erosive wind energy is at its maximum potential. (See Erosive Wind Energy Distribution Map and appropriate chart, Attachments B, Bl-Bll)

Crop Tolerance to Soil Blowing. The maximum rate of soil blowing that crop plants can tolerate during seedling stage without significant physical damage due to abrasion, burial, or dessication by moving soil particles. (See Table 4)

Crust. A surface layer on soils, ranging in thickness from a few millimeters to perhaps as much as an inch, that is much more compact than the material immediately beneath it, and therefore less erosive. Some crusts with a sand component actually increase erosion as the level, smooth surface is ideal for wind erosion.

Deposition. The soil material that settles out as wind flows across an area.

Detachment. The removal of transportable fragments of soil material from a soil mass by an eroding agent, usually falling raindrops, running water, or wind; through detachment, soil particles of aggregates are made ready for transport.

Dry Aggregate. A compound or secondary soil particle that is not destroyed by dry sieving.

Dune. A mound or ridge of sand formed by wind.

Erosion Pavement. A layer of course fragments, sand, or gravel, remaining on the surface of the ground after removal of fine particles by erosion.

Erosive Wind Energy Distribution. The expected distribution for specific period, of erosive wind at a particular geographical location. (See Attachments B, Bl-Bll)

E Tables. Computer-generated tables that give E values for most possible combinations of I, K, C, L, and V values.

E Value. The calculated soil loss estimated by the wind erosion equation given in tons/acre/year.

Isolated Field. Any field which is not receiving incoming saltation from adjacent fields. A field which is surrounded by stable areas.

Knoll Erodibility. The parameter of wind erosion that reflects the increase of potential erosion as the wind flow lines are compressed meeting the crest of certain slopes.

Leeward. The downwind side of a barrier, buffer strip, field, etc.

Prevailing Wind Erosion Direction. The direction from which most of the erosive winds commonly occur.

Random Roughness. An expression of soil roughness other than constructed ridges. Moldboard plowing creates random roughness. A field with random roughness is considered smooth for WEQ.

Saltation. Soil particle movement by wind where particles skip or bounce along the soil surface.

Small Grain Equivalent (SGe). The kind, amount and orientation of vegetation and/or residue as compared to any equivalent amount, in pounds per acre, flat small grain residue.

Soil Loss Tolerance (T). Erosion rate assigned to soil mapping units that represents the maximum rate of annual soil loss that can occur without reducing long-term productivity.

Stable Area. An area capable of stopping all saltating soil particles from entering the windward side of a downwind field or unprotected area.

Surface Armor. A layer of gravel, stone, or otherwise non-eroding soil material on the soil surface.

Surface Creep. Rolling and sliding of soil particles along the ground surface, primarily by the impact of particles in saltation rather than by direct force of the wind. Particles moving in the manner range up to about 6.02 mm (0.24 in).

Suspension. Floating movement of fine soil particles in wind, usually initiated by impact of particles in saltation. Particles are lifted into the air stream and carried over long distances. Particles moving in this manner are usually less than 0.1 mm (.004 in).

Threshold Velocity. The minimum velocity at which wind will begin moving particles of sand or other soil material. (12 mph @ 1 ft. or 18 mph @ 10 yards above the soil surface)

Transport. The movement of detached soil material across the land surface or through the air by wind.

Transport Capacity. The maximum amount of soil material which can be carried by wind under given conditions.

Unsheltered Distance (L). The distance across an erodible field, beginning at a stable area on the windward side and continuing downwind to a nonerodible or stable area, or to the downwind edge of the area being evaluated. If a barrier is present on the windward side, "L" can be determined by measuring the field along the prevailing wind direction and subtracting the distance sheltered by the barrier. Reduce L by 10 times the barrier height to allow for the sheltered distance.

Unsheltered Field. A field that is unprotected by windbreaks or barriers, or that portion of the field downwind from the area protected by a barrier.

Wide Field. A field with sufficient unsheltered distance to allow the soil moved by wind erosion to equal the transport capacity.

Windbreak. A living barrier of trees or combination of trees and shrubs located adjacent to a farmstead, field, feedlot or other area to protect soil resources; reduce wind erosion; conserve energy or moisture; control snow deposition; provide shelter for livestock or wildlife; reduce dust from annual feeding areas; or increase the natural beauty of an area; also called field windbreak, feedlot windbreak, or farmstead windbreak, depending upon the intended use.

Wind Erodibility Group. A grouping of soil mapping unites having approximately the same potential for erodibility by wind.

Wind Erosion. The detachment, transportation, and deposition of soil by wind.

Wind Erosion Equation (WEQ). An equation used for the design of wind erosion control systems. E = f (IKCLV) wherein E is the average annual soil loss, expressed in tons per acre per year; I is the soil erodibility; K is the soil ridge roughness; C is the climatic factor; L is the unsheltered distance across the field along the wind erosion direction; and V is the vegetative cover.

Windward. The upwind side of a barrier, buffer strip, field, etc.