SECTION I – EROSION PREDICTION

Wind Erosion Equation (WEQ)

This section describes use of the Wind Erosion Equation (WEQ) for estimating wind erosion in Utah. The wind erosion equation is an empirical formula used to estimate the average annual tons of soil loss per acre as represented by the value "E" in the equation E = *f*[(IKC)LV]. "E" represents the amount of soil that will erode due to the wind passing over an area or site that is characterized by the unsheltered distance (L), soil erodibility (I), climate (C), and vegetative (V) conditions. Erosion rates are a function "*f*"of the I, K, C, L, and V factors. The soil loss in tons/acre/year is obtained from "E" tables developed for each of the various I, K, C, L, and V combinations. The "E" tables can be used in reverse when the soil loss tolerance or crop tolerance is known. The desired loss as given by the soil loss tolerance or crop tolerance is selected on the appropriate C, I, and K table and various combinations L and V are then determined. The form "Estimating Wind Erosion by the Management Period Method" UT-3/98, excel wind erosion worksheet, or other appropriate hand or computer generated forms may be used to document wind erosion calculations. The Utah Wind Erosion Guide has all of the necessary information to make WEQ calculations by hand or in a computer spreadsheet.

WEQ is to be used as a tool to develop conservation management systems that will limit soil loss to the soil tolerance level, and to compare various cropping and management systems against each other to determine the relative effectiveness of each. The effectiveness of a particular land treatment alternative can be evaluated by comparing the predicted soil loss for the treatment with the soil loss tolerance "T" for the specific soil. Soil loss tolerance denotes the maximum allowable soil erosion that will still allow sustainable and economic crop productivity. Generally, several crop and tillage alternatives are developed for a particular field or farm. This allows the farm operator to select a cropping and management system that will meet the desired soil loss requirements, meet their management goals, and be economically feasible.

Wind erosion estimates can be made using either the annual or management period method. The management period method is the preferred method that is to be used in Utah. The annual method may be used when the predicted erosion rates are known to be below the soil loss tolerance and for NRI inventories. The management period method should be used for the development of highly erodible (HEL) plans and for all HEL compliance determinations. It should also be used when developing conservation plans for wind erosion control where vegetables or other low wind tolerant plants are grown in the rotation. It is also used to make erosion estimates during specific time periods, to design a system of practices during susceptible crop growth stages and when factors such as I, K, L, and/or V change significantly throughout the year.

When estimating wind erosion using the annual method, WEQ factors are selected that represent the conditions during the critical erosion period. This is the period when the greatest amount of erosion is likely to take place. In Utah, this is generally in the spring months when wind

velocities are high and soil preparation activities are underway. To estimate wind erosion using the management period method, WEQ factors are selected that represent the conditions during identified crop management periods. The percent wind energy by month should be taken from the Utah Wind Erosion Guide. Crusting factor adjustments as well as the allowed irrigation adjustments are to be used only when using the management period method. The crusting factor is to be used only during the time period that the crust is present. The irrigation adjustment is to be used only on soils that are fully irrigated. The erosive wind energy (EWE) irrigation adjustment is made only during the time period that the soils are being irrigated.

The crop production year(s) may be divided into as many management periods as appropriate. Management periods should generally not be shorter than 15 days. The following general management periods should usually be adequate for making the calculation:

Post-harvest (PH)	Following harvest until primary tillage for the next crop, or until winter, or until planting the next spring if no tillage occurs prior to planting and crop residues are sufficient to prevent wind erosion.
Winter (W)	Generally during the winter months when snow covers the ground. This period may also begin in the fall when the soil freezes and continue in the spring until the soil thaws and is dry or until tillage or planting occurs.
Fallow (F)	From primary tillage to secondary tillage for seedbed prep. (In dryland systems, this time period should be broken into additional periods that correspond with significant changes in I, K, L, and/or V).
Seedbed (SB)	From secondary tillage for seedbed preparation and planting until emergence of the new crop.
Establishment (EST)	From crop emergence until the growing cover is sufficient to prevent wind erosion (approx. 25% canopy cover).
Crop growth (CG)	From the time the cover is sufficient to prevent wind erosion until the crop is harvested.

Instructions for Using the WEQ Worksheet

The basic steps for using the management period and filling out the Wind Erosion Worksheet are as follows:

Step 1: Determine the soil erodibility "I" from the appropriate wind erodibility group and soil erodibility index table, from the soils Form 5, or from other appropriate soils data.

Wind Erosion Equation (WEQ)

Step 2: Select the appropriate "C" factor from the national, state, or locally developed "C" factor map.

Step 3: Enter the crop, crop growth stage, or management period description and the beginning and ending date for each period.

Step 4: Adjust the "I" value for knolls, crusts, or for irrigated soils as appropriate during each management period. Refer to the appropriate tables for making the adjustments.

Step 5: Determine the surface roughness "K" as it would occur during each management period. Three factors must be considered: (1) Ridge height, (2) Distance between ridges, (3) Adjustments that must be made to ridge spacing due to the prevailing wind direction. Use the table titled "Wind Erosion Ridge - Roughness - "K" from Various Furrow Spacings and Ridge Heights" or the formula described in the "K" section materials to determine the "K" factor. Account for the prevailing wind erosion direction by (PWED) measuring the ridge distance along the PWED or by calculating the distance using the appropriate "K" factor with the angle of deviation adjustment tables for 0, 22.5, 45, 67.5, or 90 degrees.

Step 6: Further adjustments may be made to the "K" value by entering the "Krr" value for random roughness. Use the appropriate table or pictures to determine the "Krr" value. The "K" value is then multiplied by the "Krr" value to obtain the final "K" value. Do not use a value less than 0.5 at the present time. The "Krr" value is to be used only when using the management period method of determining wind erosion.

Step 7: Determine the unsheltered distance "L" for each management period. This may be determined by using an aerial map and measuring the distance across the unsheltered area along the prevailing wind direction or by using the prevailing wind erosion direction, preponderance, and field length to width ratios. If using the latter method, first determine the appropriate wind station and obtain the preponderance and the prevailing wind erosion direction during each management period. Then calculate the field length to width ratio and the angle of deviation. After finding the appropriate value from the angle of deviation tables, multiply the field length by the table value. This is the value that is entered in the "L" column.

Step 8: List the predicted kind, amount, and orientation of the surface and/or growing vegetation for each management period. Convert the recorded information in flat small grain equivalents (SGe) using the appropriate chart(s). Use the procedures as described in the manual for calculating a weighted SGe when there are a combination of standing and flat residues or a combination of flat and growing vegetation.

Wind Erosion Equation (WEQ)

Example: Winter wheat, 2,500 lbs. residue after harvest, 60% standing, 40% flat.

2,500 lbs standing = 8,600 lbs SGe x 0.60 = 5,160 lbs
2,500 lbs flat = 3,300 lbs SGe x 0.40 = 1,320 lbs
Weighted Average SGe = 6,480 lbs

Step 9: Determine the amount of erosion for each management period by using the appropriate "E" table for the selected "I", "K", "C", "L", and "V" values. Enter the amount of erosion in the column titled E T/AC.

Step 10: Enter the % erosive wind energy (EWE) from the appropriate table for the given management period. The % EWE is obtained from the appropriate city station table titled "Direction, Preponderance, and Cumulative Erosive Wind Energy" and by then calculating the % EWE during each management period. Note: The total % EWE should be equal to the number of crop years in the rotation (exa: total EWE should add up to 200% for a 2 year rotation).

Step 11: Adjust the EWE for management periods when irrigation takes place. Use the table titled "Wind Erodibility Groups and Soil Erodibility Index" to obtain the EWE texture wetness factor. Use the procedures described in the section titled ""C" Value - Climatic Factor" of the manual to determine the EWE adjustment for irrigation.

Step 12: The period erosion is now calculated by multiplying the amount of erosion (E T/AC) by the %EWE or Adjusted %EWE during periods when irrigation takes place. The amount of erosion during each period is then added to obtain the total erosion. Total erosion is then divided by the number of years in the rotation to obtain the average annual erosion in tons/acre/year. If crop loss during germination is due to soil blowing, compare the soil loss in the management period where germination occurs to the acceptable crop tolerance loss listed in the "Estimated Crop Tolerances to Soil Loss (Blowing)" table.

The NRCS State or Area Agronomist should be contacted for help in running the excel spreadsheet, making calculations for crops or other situations that are not available in the materials, or for help selecting the values that should be used for a given situation.