PART II

WIND

SECTION B

This section will be used for the management method of calculating wind erosion. Contact the area or state agronomist for further assistance if you need to use this method of calculating wind erosion.

Estimating Wind Erosion Using the Management Period Method to Obtain a Weighted Estimate.

The following information is to be used for estimating wind erosion using the management period method. The WEQ factors are selected that represent conditions during each identified crop management period. Dates are established for the beginning of the crop production year and the end of each management period. The management period method is appropriate when:

* Wind erosion estimates are needed for specific periods.

* A system or practice is being designed to reduce crop damage during susceptible crop growth stages.

The crop production year(s) may be divided into as many management periods as appropriate. In North Dakota the following management periods will usually be adequate:

Post-harvest period (PH) - From harvest until primary tillage for the next crop or until planting the next crop with no tillage before planting.

Fallow period (F) - From primary tillage to secondary tillage for seedbed preparation. (In the case of summer fallow or other systems involving an extended sequence of tillage operations associated with significant changes in residue cover, the fallow period may need to be subdivided into more than one period.)

Seedbed period (SB) - From secondary tillage for seedbed preparation and planting until emergence of the new crop.

Establishment period (EST) - From crop emergence until cover provided by the new crop is sufficient to prevent wind erosion, approximately 25 percent canopy.

Growing/mature crop period (GM) - From time cover provided by the growing crop is sufficient to prevent wind erosion until crop harvest.

The Basic Steps for Using the Management Period Method are as Follows:

1. Establish the management periods with a beginning date for the crop or crop sequence and ending dates for each management period. Table 1, Page B - 9, Erosion Prediction, Part II, Section B, lists the days after planting to reach the end of management periods SB and EST.

2. Determine Soil erodibility "I" using Table 1, Page C-1, Erosion Prediction, Part II, Section C.

3. Determine the pattern ridge roughness "K" for each crop management period from Table 1, Page C-1, Erosion Prediction, Part II, Section C, when actual field conditions are unknown, or from Table 3, Pages C-6 to C-8, Erosion Prediction, Part II, Section C. The prevailing wind erosion direction may change with management period. Thus, a change in the angle of deviation may influence "K" along with changes in ridge height and spacing. See Figure 1, Page B-11, Erosion Prediction, Part II, Section B, to determine your Erosive Wind Energy (EWE) area. Use Figure 2, Pages B-12 to B-17, Erosion Prediction, Part II, Section B, to select an appropriate prevailing wind erosion direction for your location.

4. Select the appropriate climatic factor "C" from Figure 1, Page C-1, Erosion Prediction, Part II, Section C. Use the annual C factor for determining all management period erosion rates.

5. Determine the unsheltered distance "L" for each management period. This is a calculated "L" using prevailing wind erosion direction, preponderance, and field length to width ratios.

   a. Determine the appropriate prevailing wind erosion direction and preponderance from Figure(s) 2, Pages B-12 to B-17, Erosion Prediction, Part II, Section B, for each management period at your location.

   b. Measure the actual length and width of the area being evaluated and determine the ratio of field length to width.

   c. Determine the angle of deviation between the prevailing wind erosion direction and an imaginary line perpendicular to the long side of the field.

   d. Using information obtained in "a" through "c" determine the wind erosion direction factor from Table 1, Pages B-4, B-5, B-6, B-7, or B-8, Erosion Prediction, Part II, Section B.

   e. Multiply the field width from "b" by the wind erosion direction factor from "d."

   f. Calculate "L" using this method for each management period.

   g. Credit wind barriers present by subtracting 10H from the calculated L.

6. Estimate the kind, amount, and orientation of the residue and/or growing crop for each management period.

7. Convert the values recorded in step 6 to flat small grain equivalents (SGe) using Chart 1, Pages C-19 to C-52, Erosion Prediction, Part II, Section C. When both the previous crops' residue and a growing crop are present, use the following procedure to determine SGe.

   a. Estimate the air dry pounds of previous crop residue using Tables 4, Pages C-8 and C-9, Table 5, Page C-10, and Table 6, Page C-11 to C-14, Erosion Prediction, Part II, Section C.

   b. Estimate the air dry pounds of growing crop.

   c. Add the pounds of residue and pounds of growing crop for total biomass present and calculate the percent of each component.

   d. Use the total pounds from "c" and read the SGe from the appropriate (SGe) using Chart 1, Pages C-19 to C-52, Erosion Prediction, Part II, Section II, for each component.

   e. Multiply the pounds SGe from "d" by the appropriate percentage from "c."

   f. Add the results from "e" for the SGe for that management period.

8. Use the appropriate E TABLE for the selected "I", "K", "C", "L", and "V" to determine an annual soil erosion rate for each management period.

9. From Figure 2, Pages B-12 to B-17, Erosion Prediction, Part II, Section B, select the appropriate Erosive Wind Energy (EWE) Distribution Curve and determine the percent EWE for each crop management period date. Calculate the percent EWE that occurs during each management period.

10. For each management period multiply "E" by percent EWE. This is the estimated wind erosion (tons/acre) for each management period. The sum of these values for a single year is the annual wind erosion rate in tons/acre/year. The sum of these values for a crop sequence divided by the number of years in the sequence is the average annual wind erosion rate in tons/acre/year for the crop sequence.

11. Guidelines for Estimating Wind Erosion

    For most crops, the period from 25 percent canopy through harvest (crop management periods EST and GM) are protected from wind erosion by the growing crop. Enter estimated soil loss = 0 for these periods and eliminate all intermediate computations.

    For high and medium residue crops (such as small grains, corn for grain, etc., the standing stubble during crop management period PH usually provides complete protection from wind erosion. Handle this period in the same manner, unless there is fall tillage.

    For some low residue crops (such as soybeans, corn silage, sunflowers), crop management period PH may be subject to wind erosion. Using the worksheet, estimate potential soil loss for period PH when standing stubble does not provide complete protection.

12. Use form ND-CPA-317 to estimate wind erosion using the management period method.

Soil And Crop Tolerances to Wind Erosion

Soil loss tolerances to protect the soil resource have been assigned to all soil series. These can be found on SCS soil interpretation records and other interpretive tables.

Wind erosion may also cause physical damage to growing crops. Crop tolerances to abrasion are usually less than soil loss tolerance. Estimated tolerances of several common crops to wind erosion during the seedling stage are shown in Table 2, Page B-10, Erosion Prediction, Part II, Section B. When crop damage is a major concern, the wind erosion control system should be designed to reduce wind erosion below the crop tolerance level during the seedling period of the affected crop. To estimate wind erosion during the seedling period, use the Crop Management period method.

Erosive Wind Energy (EWE) Distribution

Figure 1, Page B-11, Erosion Prediction, Part II, Section B, is a map showing the EWE areas for the state. Figure 2, Pages B-12 to B-17 are line graphs, and a table showing the percent of the erosive wind energy that occurs every two weeks. The line graphs show the erosive winds for the year on a cumulative basis.

TABLE 1

WIND EROSION DIRECTION FACTOR

ANGLE OF DEVIATION * = 0°							
	FIELD LENGTH/WIDTH RATIO						
Preponderance	1:1	2:1	4:1	8:1	10:1	12:1	16:1
1.0	1.03	1.46	1.70	1.85	1.88	1.90	1.95
1.2	1.03	1.30	1.45	1.53	1.56	1.58	1.62
1.4	1.03	1.20	1.28	1.32	1.35	1.37	1.40
1.6	1.03	1.14	1.18	1.20	1.22	1.23	1.25
1.8	1.03	1.10	1.11	1.12	1.13	1.14	1.15
2.0	1.02	1.07	1.07	1.07	1.08	1.08	1.08
2.2	1.02	1.05	1.05	1.05	1.05	1.05	1.05
2.4	1.02	1.04	1.04	1.04	1.04	1.04	1.04
2.6	1.01	1.03	1.03	1.03	1.03	1.03	1.03
2.8	1.01	1.02	1.02	1.02	1.02	1.02	1.02
3.0	1.01	1.02	1.02	1.02	1.02	1.02	1.02
3.2	1.01	1.01	1.01	1.01	1.01	1.01	1.01
3.4	1.01	1.01	1.01	1.01	1.01	1.01	1.01
3.6	1.00	1.01	1.01	1.01	1.01	1.01	1.01
3.8	1.00	1.01	1.01	1.01	1.01	1.01	1.01
4.0	1.00	1.01	1.01	1.01	1.01	1.01	1.01

* Angle of deviation is the difference between prevailing wind erosion direction and perpendicular to the long side of the field or strip (0° is perpendicular to the long side). Multiply the Wind Erosion Direction Factor times the width of the field for "L" distance.

TABLE 1 (Cont.)

WIND EROSION DIRECTION FACTOR

ANGLE Of DEVIATION * = 22.5°							
	FIELD LENGTH/WIDTH RATIO						
Preponderance	1:1	2:1	4:1	8:1	10:1	12:1	16:1
1.0	1.03	1.46	1.70	1.85	1.88	1.90	1.95
1.2	1.03	1.37	1.50	1.61	1.64	1.66	1.70
1.4	1.03	1.27	1.36	1.44	1.46	1.47	1.50
1.6	1.03	1.22	1.26	1.30	1.32	1.33	1.35
1.8	1.03	1.18	1.20	1.21	1.22	1.23	1.24
2.0	1.04	1.16	1.16	1.16	1.16	1.16	1.17
2.2	1.05	1.14	1.14	1.14	1.14	1.14	1.14
2.4	1.06	1.13	1.13	1.13	1.13	1.13	1.13
2.6	1.06	1.13	1.13	1.13	1.13	1.13	1.13
2.8	1.07	1.12	1.12	1.12	1.12	1.12	1.12
3.0	1.07	1.12	1.12	1.12	1.12	1.12	1.12
3.2	1.07	1.12	1.12	1.12	1.12	1.12	1.12
3.4	1.08	1.12	1.12	1.12	1.12	1.12	1.12
3.6	1.08	1.11	1.11	1.11	1.11	1.11	1.11
3.8	1.08	1.11	1.11	1.11	1.11	1.11	1.11
4.0	1.08	1.11	1.11	1.11	1.11	1.11	1.11

* Angle of deviation is the difference between prevailing wind erosion direction and perpendicular to the long side of the field or strip (0° is perpendicular to the long side). Multiply the Wind Erosion Direction Factor times the width of the field for "L" distance.

TABLE 1 (Cont.)

WIND EROSION DIRECTION FACTOR

ANGLE OF DEVIATION * = 45°							
	FIELD LENGTH/WIDTH RATIO						
Preponderance	1:1	2:1	4:1	8:1	10:1	12:1	16:1
1.0	1.03	1.46	1.70	1.85	1.88	1.90	1.95
1.2	1.03	1.44	1.63	1.72	1.75	1.77	1.81
1.4	1.03	1.42	1.57	1.62	1.65	1.67	1.70
1.6	1.03	1.42	1.52	1.55	1.57	1.58	1.61
1.8	1.03	1.42	1.49	1.51	1.52	1.53	1.55
2.0	1.03	1.42	1.48	1.49	1.49	1.49	1.50
2.2	1.02	1.42	1.48	1.48	1.48	1.48	1.48
2.4	1.02	1.42	1.48	1.48	1.48	1.48	1.48
2.6	1.01	1.42	1.48	1.48	1.48	1.48	1.48
2.8	1.01	1.42	1.48	1.48	1.48	1.48	1.48
3.0	1.01	1.42	1.48	1.48	1.48	1.48	1.48
3.2	1.01	1.42	1.48	1.48	1.48	1.48	1.48
3.4	1.01	1.42	1.48	1.48	1.48	1.48	1.48
3.6	1.01	1.42	1.48	1.48	1.48	1.48	1.48
3.8	1.01	1.42	1.48	1.48	1.48	1.48	1.48
4.0	1.01	1.42	1.48	1.48	1.48	1.48	1.48

* Angle of deviation is the difference between prevailing wind erosion direction and perpendicular to the long side of the field or strip (0° is perpendicular to the long side). Multiply the Wind Erosion Direction Factor times the width of the field for "L" distance.

TABLE 1 (Cont.)

WIND EROSION DIRECTION FACTOR

ANGLE OF DEVIATION * = 67.5°							
	FIELD LENGTH/WIDTH RATIO						
Preponderance	1:1	2:1	4:1	8:1	10:1	12:1	16:1
1.0	1.03	1.46	1.70	1.85	1.88	1.90	1.90
1.2	1.03	1.49	1.80	1.94	1.98	2.00	2.04
1.4	1.03	1.52	1.90	2.03	2.07	2.08	2.12
1.6	1.03	1.55	1.98	2.13	2.15	2.16	2.20
1.8	1.03	1.58	2.08	2.23	2.25	2.26	2.30
2.0	1.04	1.62	2.17	2.35	2.36	2.37	2.40
2.2	1.05	1.65	2.27	2.48	2.49	2.49	2.50
2.4	1.06	1.68	2.37	2.61	2.61	2.61	2.61
2.6	1.06	1.71	2.42	2.71	2.71	2.71	2.71
2.8	1.07	1.72	2.44	2.77	2.77	2.77	2.77
3.0	1.07	1.73	2,45	2.82	2.82	2.82	2.82
3.2	1.07	1.74	2.46	2.85	2.85	2.85	2.85
3.4	1.07	1.75	2.47	2.87	2.87	2.87	2.87
3.6	1.08	1.75	2.48	2.89	2.89	2.89	2.89
3.8	1.08	1.76	2.48	2.90	2.90	2.90	2.90
4.0	1.08	1.76	2.49	2.91	2.91	2.91	2.91

* Angle of deviation is the difference between prevailing wind erosion direction and perpendicular to the long side of the field or strip (0° is perpendicular to the long side). Multiply the Wind Erosion Direction Factor times the width of the field for "L" distance.

TABLE 1 (Cont.)

WIND EROSION DIRECTION FACTOR

ANGLE OF DEVIATION * = 90° FIELD LENGTH/WIDTH RATIO							
Preponderance	1:1	2:1	4:1	8:1	10:1	12:1	16:1
1.0	1.03	1.46	1.70	1.85	1.88	1.90	1.95
1.2	1.03	1.50	1.90	2.10	2.16	2.23	2.32
1.4	1.03	1.55	2.10	2.40	2.50	2.60	2.75
1.6	1.03	1.66	2.30	2.70	2.87	3.00	3.25
1.8	1.03	1.80	2.55	3.10	3.32	3.50	3.85
2.0	1.02	1.96	2.78	3.50	3.84	4.08	4.56
2.2	1.02	2.00	3.06	4.05	4.47	4.80	5.40
2.4	1.02	2.00	3.35	4.63	5.12	5.60	6.40
2.6	1.01	2.00	3.56	5.30	5.93	6.50	7.60
2.8	1.01	2.00	3.74	5.85	6.64	7.50	8.90
3.0	1.01	2.00	3.92	6.51	7.60	8.80	10.60
3.2	1.01	2.00	4.00	6.89	8.20	9.30	11.50
3.4	1.01	2.00	4.00	7.08	8.40	9.60	11.80
3.6	1.00	2.00	4.00	7.26	8.60	9.90	12.30
3.8	1.00	2.00	4.00	7.45	8.91	10.30	12.80
4.0	1.00	2.00	4.00	7.64	9.20	10.60	13.30

* Angle of deviation is the difference between prevailing wind erosion direction and perpendicular to the long side of the field or strip (0° is perpendicular to the long side). Multiply the Wind Erosion Direction Factor times the width of the field for "L" distance.

CIRCULAR FIELDS

Unsheltered distance "L" is equal to 1.83 times radius of field or 0.915 times diameter of field regardless of direction or preponderance.

TABLE 2 1/

CROP DEVELOPMENT INTERVALS

Crop	Days From Planting to % Canopy		
	25%	50%	75%
Alfalfa, spring planted	42	55	75
Alfalfa, late summer planted	45	60	305
Buckwheat	45	55	70
Corn	40	50	70
Flax	50	65	75
Millet	28	35	45
Mustard	40	50	60
Potatoes	35	45	65
Sorghum	40	50	70
Soybeans	40	50	70
Spring Grain	40	50	60
Sugar beets	40	50	65
Sunflowers	40	50	70
Winter Grain	35	50	245
Winter Cover Crop	20	35	210

1/ This table is used to determine the number of days from planting to reach a certain percent canopy for that crop. This information will be used in the management method of computing wind erosion.

TABLE 2 1/

Crop	Estimated Crop Tolerance 1/
Barley	2/
Buckwheat	2/
Corn	2.0
Irish Potatoes	1.0
Lima Beans	0.5
Oats	2/
Rye	2/
Snap Beans	0.5
Sorghum	2.0
Soybeans	1.0
Sugar beets	1.0
Sunflowers	2.0
Sweet Corn	2.0
Wheat	2/

1/ Crop tolerance values are expressed as Tons/Acre/Year.

2/ Will probably tolerate soil blowing equal to or greater than the tolerable soil loss.

3/ The figures in this table are only an indication of the amount of soil loss that the crop can withstand and not have any damage occurring to it.

FIGURE 1

NORTH DAKOTA EROSIVE WIND ENERGY (EWE) AREAS

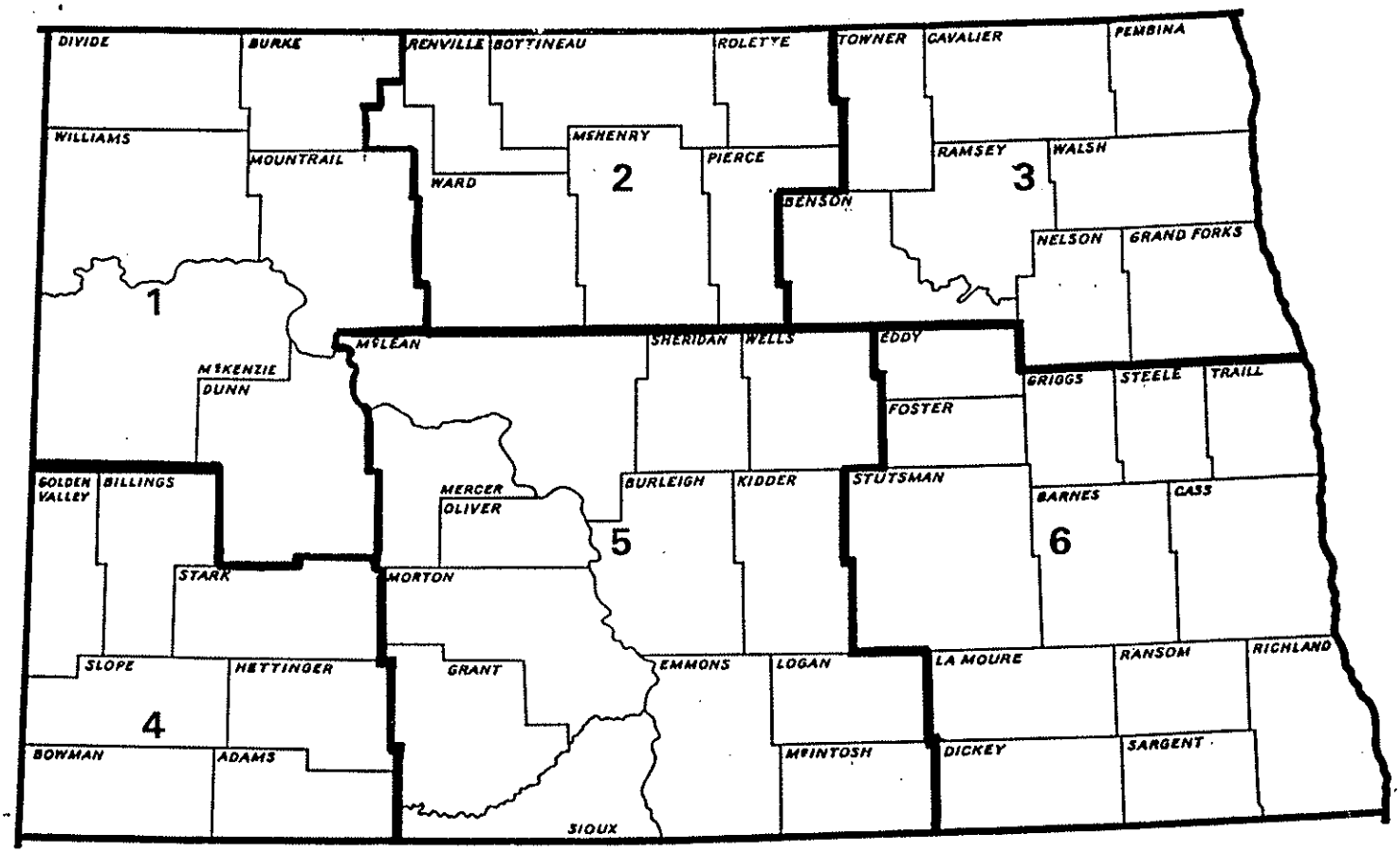
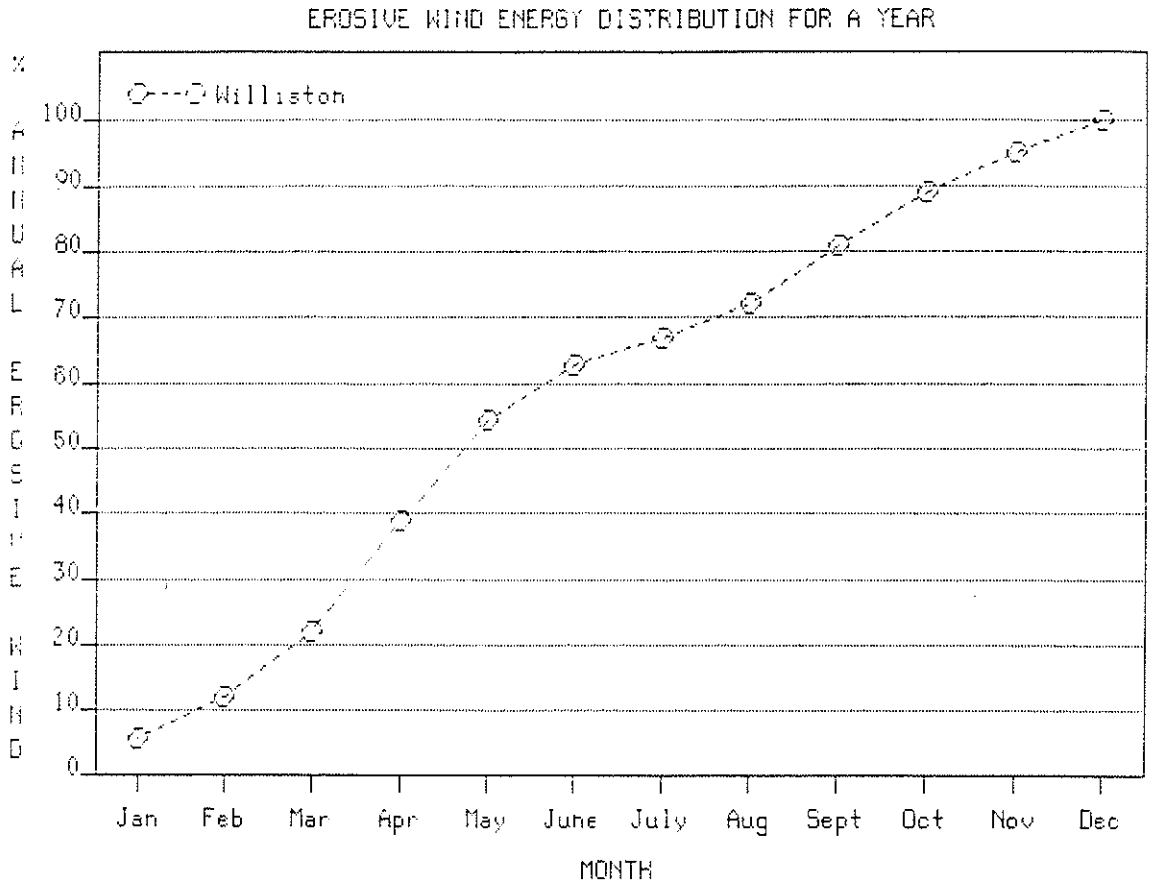


FIGURE 2

EWE - AREA 1



PREVAILING WIND DIRECTION, PREPONDERANCE OF WIND EROSION FORCES IN THE PREVAILING WIND DIRECTION, AND BI-MONTHLY EWE FIGURES

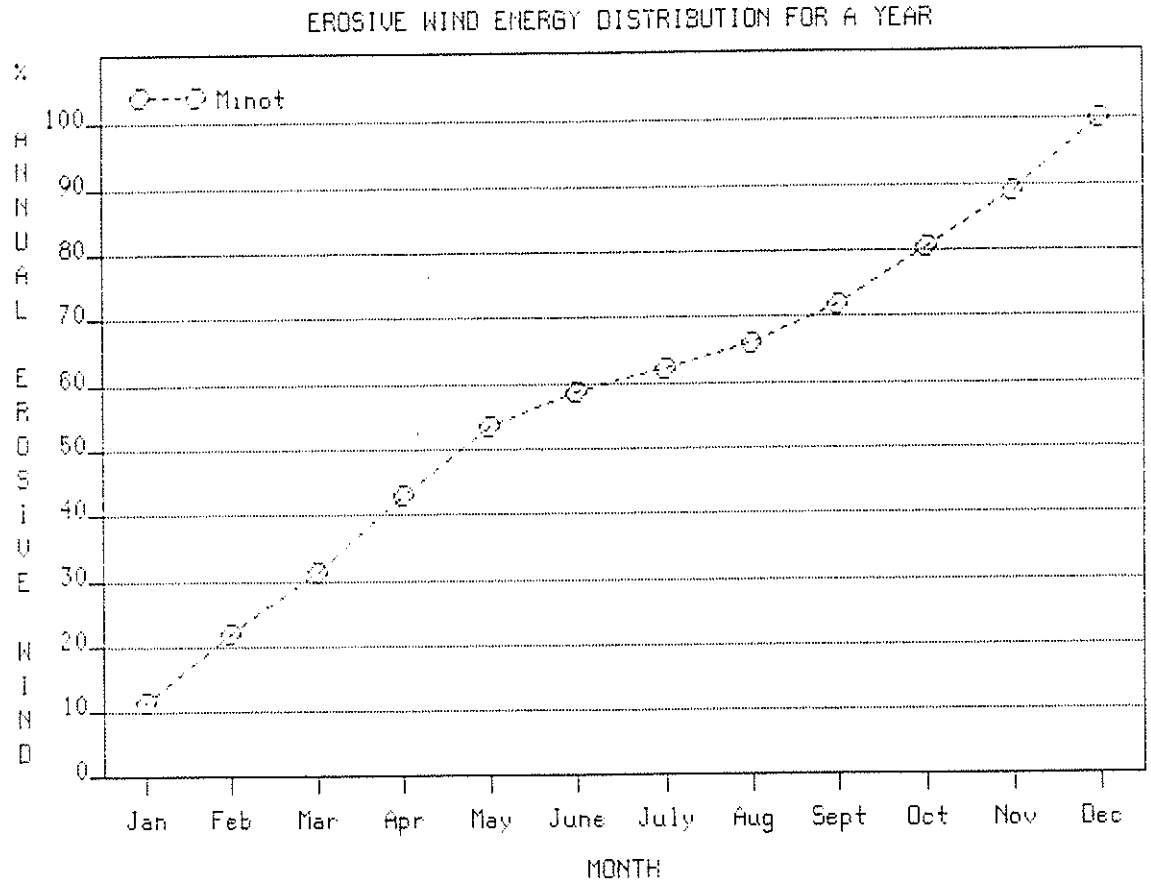
Location and Item	Month Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
EWE Area 1												
Monthly	5.8	6.2	9.9	17.0	15.4	8.5	4.1	5.2	8.9	8.2	5.9	4.9
Day 1 - 15	2.9	3.1	5.0	8.5	7.7	4.3	2.1	2.6	4.5	4.1	3.0	2.5
Day 16 - 30	2.9	3.1	4.9	8.5	7.7	4.2	2.0	2.6	4.4	4.1	2.9	2.4
Direction 1/	315	315	315	315	315	293	315	337	293	315	315	315
Preponderance	1.7	1.8	1.7	1.5	1.5	1.3	1.5	1.4	1.7	1.8	2.2	1.6

Instructions: Select the wind direction and preponderance for the crop stage period desired.

1/ Wind direction is in degrees with 0° North, 90° East, 180° South, 270° West.

FIGURE 2

EWE - AREA 2



PREVAILING WIND DIRECTION, PREPONDERANCE OF WIND EROSION FORCES IN THE PREVAILING WIND DIRECTION, AND BI-MONTHLY EWE FIGURES

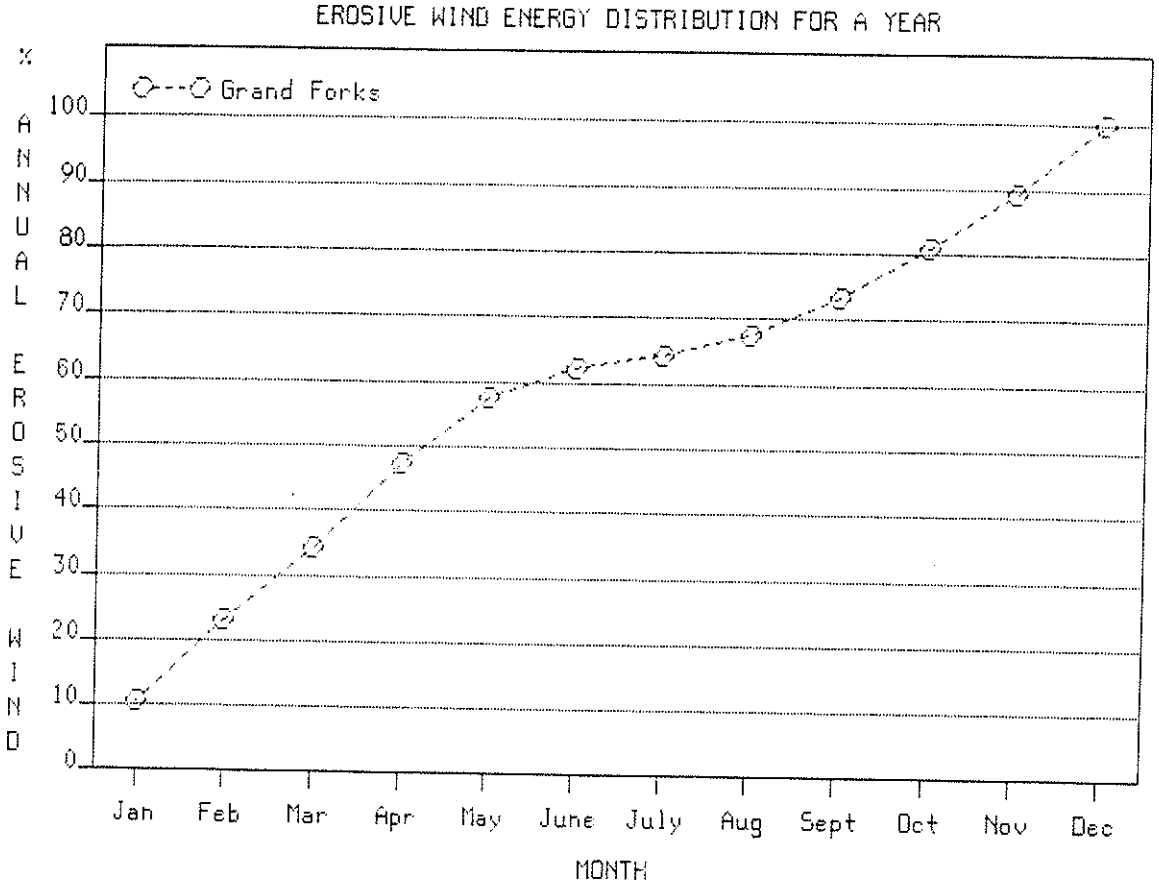
Location and Item	Month Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
EWE Area 2												
Monthly	11.6	10.4	9.4	11.6	10.5	5.2	3.6	3.7	6.0	8.5	8.7	10.8
Day 1 - 15	5.8	5.2	4.7	5.8	5.3	2.6	1.8	1.9	3.0	4.3	4.4	5.4
Day 16 - 30	5.8	5.2	4.7	5.8	5.2	2.6	1.8	1.8	3.0	4.2	4.3	5.4
Direction 1/	315	315	315	315	315	293	315	337	293	315	315	315
Preponderance	1.7	1.8	1.7	1.5	1.5	1.3	1.5	1.4	1.7	1.8	2.2	1.6

Instructions: Select the wind direction and preponderance for the crop stage period desired.

1/ Wind direction is in degrees with 0° North, 90° East, 180° South, 270° West.

FIGURE 2

EWE - AREA 3



PREVAILING WIND DIRECTION, PREPONDERANCE OF WIND EROSION FORCES IN THE PREVAILING WIND DIRECTION, AND BI-MONTHLY EWE FIGURES

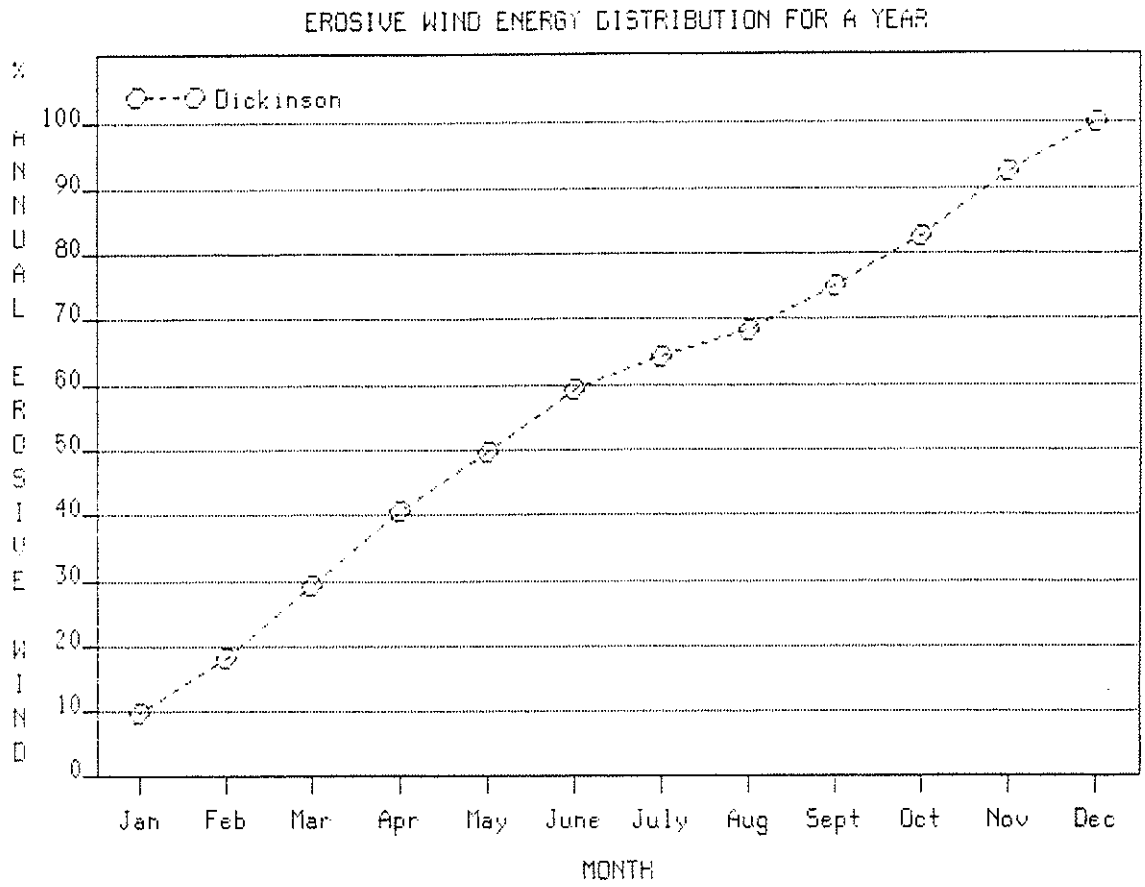
Location and Item	Month Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
EWE Area 3												
Monthly	10.6	12.6	11.2	12.9	10.4	4.6	2.1	3.0	5.8	7.8	8.3	10.7
Day 1 - 15	5.3	6.3	5.6	6.5	5.2	2.3	1.1	1.5	2.9	3.9	4.2	5.4
Day 16 - 30	5.3	6.3	5.6	6.4	5.2	2.3	1.0	1.5	2.9	3.9	4.1	5.3
Direction 1/	338	337	338	337	337	270	337	158	315	337	337	337
Preponderance	3.2	2.5	2.1	2.0	1.5	1.2	1.4	1.7	1.3	1.8	2.5	2.5

Instructions: Select the wind direction and preponderance for the crop stage period desired.

1/ Wind direction is in degrees with 0° North, 90° East, 180° South, 270° West.

FIGURE 2

EWE - AREA 4



PREVAILING WIND DIRECTION, PREPONDERANCE OF WIND EROSION FORCES IN THE PREVAILING WIND DIRECTION, AND BI-MONTHLY EWE FIGURES

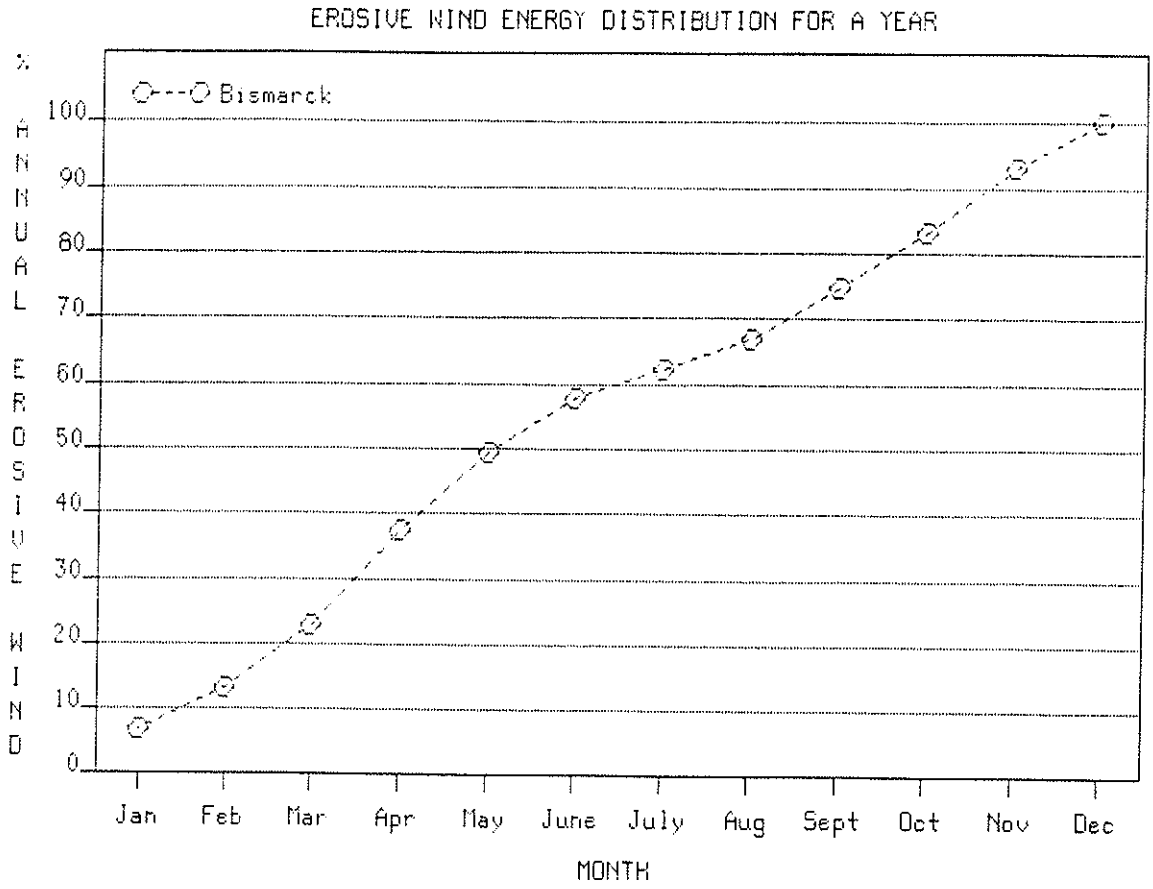
Location and Item	Month Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
EWE Area 4												
Monthly	9.7	8.6	11.1	11.4	9.0	9.5	5.1	4.1	6.7	7.4	9.9	7.5
Day 1 - 15	4.9	4.3	5.6	5.7	4.5	4.8	2.6	2.1	3.9	3.7	5.0	3.8
Day 16 - 30	4.8	4.3	5.5	5.7	4.5	4.7	2.5	2.0	3.8	3.7	4.9	3.7
Direction 1/	315	293	325	315	315	293	315	315	315	315	315	315
Preponderance	1.7	2.0	1.3	1.7	1.8	1.7	1.5	1.4	2.1	2.0	2.4	2.4

Instructions: Select the wind direction and preponderance for the crop stage period desired.

1/ Wind direction is in degrees with 0° North, 90° East, 180° South, 270° West.

FIGURE 2

EWE - AREA 5



PREVAILING WIND DIRECTION, PREPONDERANCE OF WIND EROSION FORCES IN THE PREVAILING WIND DIRECTION, AND BI-MONTHLY EWE FIGURES

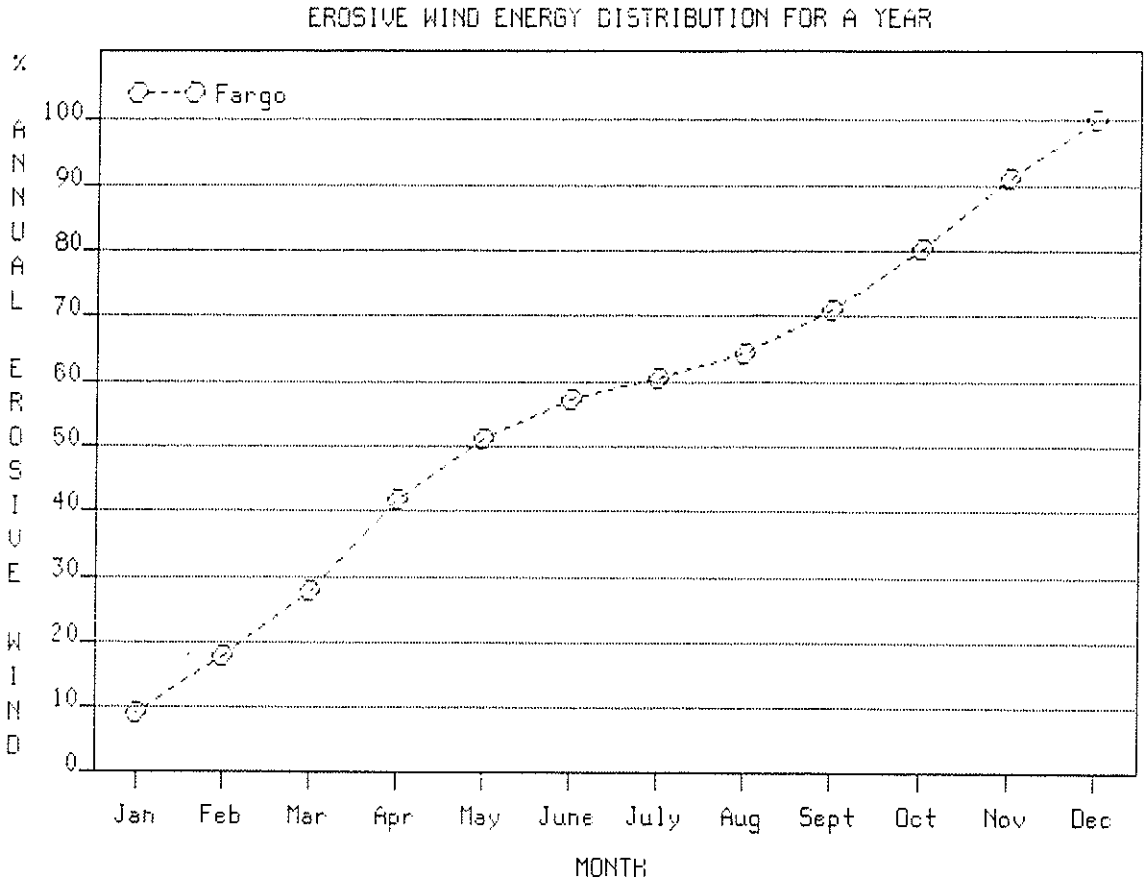
Location and Item	Month Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
EWE Area 5												
Monthly	6.9	6.9	6.4	9.7	14.6	11.8	8.5	4.4	4.7	7.8	8.5	9.8
Day 1 - 15	3.5	3.5	3.2	4.9	7.3	5.9	4.3	2.2	2.4	3.9	4.3	4.9
Day 16 - 30	3.4	3.4	3.2	4.8	7.3	5.9	4.2	2.2	2.3	3.9	4.2	4.9
Direction 1/	315	293	325	315	315	293	315	315	315	315	315	315
Preponderance	1.7	2.0	1.3	1.7	1.8	1.7	1.5	1.4	2.1	2.0	2.4	2.4

Instructions: Select the wind direction and preponderance for the crop stage period desired.

1/ Wind direction is in degrees with 0° North, 90° East, 180° South, 270° West.

FIGURE 2

EWE - AREA 6



PREVAILING WIND DIRECTION, PREPONDERANCE OF WIND EROSION FORCES IN THE PREVAILING WIND DIRECTION, AND BI-MONTHLY EWE FIGURES

Location and Item	Month Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
EWE Area 6												
Monthly	9.2	8.6	9.9	14.1	9.4	6.2	3.2	3.8	6.6	9.2	11.0	8.8
Day 1 - 15	4.6	4.3	5.0	7.1	4.7	3.1	1.6	1.9	3.3	4.6	5.5	4.4
Day 16 - 30	4.6	4.3	4.9	7.0	4.7	3.1	1.6	1.9	3.3	4.6	5.5	4.4
Direction 1/	337	337	337	315	337	315	157	158	315	315	337	337
Preponderance	2.5	2.0	1.9	1.7	1.5	1.2	1.7	1.6	1.6	1.9	2.4	2.2

Instructions: Select the wind direction and preponderance for the crop stage period desired.

1/ Wind direction is in degrees with 0° North, 90° East, 180° South, 270° West.