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A COMPARISON OF LYSIMETER - DERIVED POTENTIAL EVAPOTRANSPIRATION WITH COMPUTED VALUES

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A COMPARISON OF LYSIMETER- DERIVED POTENTIAL EVAPOTRANSPIRATION WITH COMPUTED VALUES

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INTRODUCTION

Many aspects of water resources planning in humid areas do not seem to be as critical as they are in more arid areas. Water supplies in humid areas are generally adequate and some excesses can be tolerated. Accurate estimates of water use in humid areas are necessary to estimate the occurrence of droughts and water shortages. The significance of water shortages relative to supplies is less in humid areas because of the infrequency of such shortages. Much of the current research on evapotranspiration (ET) is being done in subhumid and arid areas where water shortages are chronic.

Pressures on the currently adequate water resources of the more humid areas are increasing, however. The demands of an increasing population, rising use of water by both agriculture and industry, and failure to deal forcefully with our water pollution problems all tend to take us nearer the point where supplies will become marginal. Water supply development in headwater areas already costs hundreds of millions of dollars annually. Reliable basic data and improved technology will be necessary to solve the problems that future restrictions in water use will bring.

We also need more information on the ET process to handle today's problems. Techniques for accurately estimating ET would result in better predictions of water supplies to meet current needs and the downstream effects of land practices on water yield. Mathematical models of a humid area watershed may compute ET rates that are too low in one season of the year and too high in another. This discrepancy may not be too serious in the overall performance of the model because the soil moisture storage or some other parameter may have a compensating error. However, as the errors and biases in estimating precipitation, surface runoff, soil moisture storage, and deep percolation are reduced, the uncertainties in estimating ET must also be reduced. Valid prediction of short-term ET amounts is a prerequisite to a complete understanding of the entire hydrologic system.

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ET, which includes evaporation from bare soil and evaporation of intercepted water as well as transpiration, is generally considered to be a function of (1) the potential evapotranspiration (*PET*), the capacity of the atmosphere to evaporate and remove water; (2) the soil moisture supply, which affects the ability of the plants to transpire at their maximum rate; and (3) the type of plant cover that affects *ET* through such factors as depth of rooting, density, maturity, and canopy roughness.

This report deals with the first of the above functions, the estimation of *PET*. Determination of *PET* is usually the first step in the estimation of *ET*. Several methods have been proposed for estimating *PET* from climatic measurements—methods ranging from purely empirical relationships to others with a basis in the physics of the evaporation phenomena. Most of the estimating methods were developed in response to arid land needs, and application of these methods in humid areas is questionable. The purpose of this report is to compare data obtained through the various estimating methods with those from a lysimeter-derived "standard" *PET* curve as an aid to the selection of appropriate estimating methods for humid areas.

Another purpose of this report is to incorporate, in one place, the computational techniques required by the various estimating schemes. Some of the estimating methods are arithmetically complex and a "cookbook" approach to their solution should be helpful.

Finally, all the basic data used are tabulated in Appendix B. Thus, the reader who wants to test a method not included in this report has all the data available to do so.

DERIVATION OF "STANDARD" PET CURVE

Much of the research work in *ET* has utilized alfalfa as the experimental crop. Data are available from a deep-rooted grass-legume covered weighing lysimeter at the North Appalachian Experimental Watershed near Coshocton, Ohio, for the period 1948–65 less the years 1956, 1957, and 1964 when the cover was being renewed. These 15 years of data were shown to be representative of the long-term climate at Coshocton (*30*).[1]

Daily *ET* from the period of record from 1948 to 1965 were examined by Mustonen and McGuinness (*30*), and a listing of measured daily *ET* values was given in their report. These data form the basis for deriving a series of mean daily *ET* values which would have occurred had *PET* conditions existed. On the average, daily values of *ET* from the weighing lysimeter growing deep-rooted grass at

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[1] Italic numbers in parentheses refer to Literature Cited, p. 24.

Coshocton are less than daily values of PET because (1) the grass is cut for hay, which leaves less than a full green cover until some leaf regrowth has taken place; and (2) soil moisture is limiting during some periods in almost every year.

First, it was necessary to remove the effect of cutting hay from the data. Mustonen and McGuinness (30) found that after haycut, ET fell to about half of normal and then gradually increased until it again reached normal in about 30 days. To correct for this effect, at least 15 days of data were discarded after every haycut. The suceeding 15 days of data were scanned and subjectively eliminated if their ET values were still increasing with time. The values remaining after this step were considered representative of PET from a full cover condition, providing soil moisture supply was not limiting water use by plants.

Next, the values were corrected for the effect of limiting soil moisture. The equation developed by Mustonen and McGuinness (30) predicted daily ET during the growing season as

$$ET = 0.7 \ PET \ SM^{0.25}$$

where ET is daily evapotranspiration, PET is lake evaporation as computed by the U.S. Weather Bureau (USWB) formula (23), and SM is the soil moisture in the top 40 inches of the lysimeter soil profile. All units in the equation are water depths in inches. Daily values of both PET and SM as defined above were given by Mustonen and McGuinness (30).

For each growing season day when SM is below field capacity, ET can be computed from the above equation using, first, actual SM and then repeating the computation using field capacity SM. The difference between these two values is an estimate of the additional amount of ET that would have occurred had soil moisture not been limiting. These differences, therefore, were added to the measured ET values to produce data that should closely represent PET for deep-rooted vegetation at Coshocton.

Daily values derived as described above were then averaged for each day over the 15-year period of record. The resulting 366 averages are shown by the points plotted on figure 1. The curve drawn through the scatter of points is a five-term harmonic curve fitted to the daily averages. This smooth curve is taken to be as close a representation of the mean seasonal PET pattern as can be obtained from the Coshocton lysimeters. Mean daily values are tabulated in Appendix table 33.

The decision not to make comparisons based on individual years resulted from the inconsistency of the dates of haycuts. By averaging
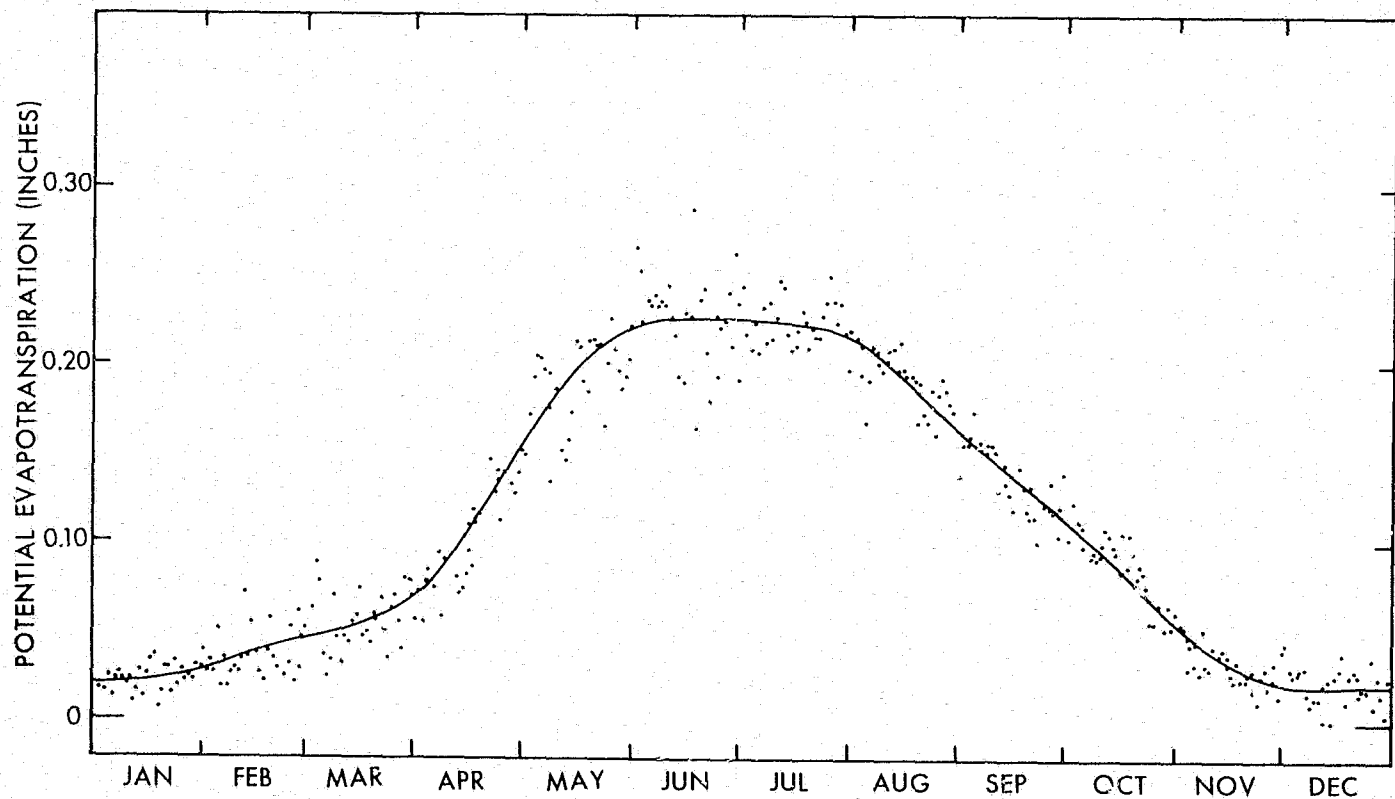
FIGURE 1.—Average daily potential evapotranspiration (*PET*) as estimated by a lysimeter growing deep-rooted grass-legume, 1948–65 less 1956, 1957, and 1964 when the cover was renewed. Observed *ET* values have been adjusted to remove the effect of haycut and of soil moisture below field capacity in the top 40 inches of soil.

over 15 years, the effects of variable dates of haycut should be minimized thus allowing an average seasonal pattern of PET to be shown.

In evaluating the Coshocton lysimeters, Mustonen and McGuinness (30) concluded that the lysimeter ET values obtained were too high as compared with ET values from surrounding grassed fields but that there was no seasonal bias in the differences. Thus, although the curve of figure 1 has the correct shape, it may be too high by a fixed amount per day throughout the year. The "standard" PET curve of figure 1 will be referred to in quotation marks throughout this report as a reminder of this possible difference.

COMPUTED PET CURVES

Numerous formulas and methods for computing PET have been proposed over the years. All of these methods use climatic information in their development. Most of the empirical methods require the input of only one or two commonly available parameters, such as mean daily air temperature or air temperature plus radiation. The success of these empirical methods depends on the correlation of PET with the input parameters. There is always the danger that empirical methods may not operate too satisfactorily outside the climatic regime in which the original correlations were developed.

The combination method of estimating PET is based on the physics of the evaporation process. This method involves the simultaneous solution of the aerodynamic equation and the energy balance equation. Input requirements are more stringent than in most empirical methods, requiring air temperature, humidity, wind, and solar (or net) radiation parameters.

The climatic data required by the various methods were averaged in much the same manner as the data for the "standard" PET curve. Thus, air temperature data from the Coshocton station were averaged over the same period as for the PET data, a harmonic curve was fitted to the data, and the 366 daily values of the fitted curve were used as the air temperature input for the various PET methods. Smoothed input values of mean daily dewpoint temperature, wind in miles per day, solar radiation in langleys per day, and computed pan evaporation in inches per day were all determined this way.

Almost all the normal day-to-day variability has been removed from the climatic input data and from the "standard" PET curve. The final data sets are the result of first averaging 15 years of data and then fitting a smooth curve through the resulting data points. The input data for the various PET formulas and the "standard" PET data are taken from these smooth curves. These smoothed input data were then used to compute PET curves by methods advocated

by various workers over the years. These methods have been classified by their climatic input requirements and are described briefly below. A detailed description of the computational methods is given in Appendix A.

The methods of computing *PET* described below and in Appendix A are by no means exhaustive. Many of the more widely used methods are included. The basic data used in this study, however, are tabulated in Appendix B so that the reader can apply other techniques should he so desire.

Air temperature only.—Two well-known systems for computing *PET* from air temperature data only are the Thornthwaite (*50*) and the Blaney-Criddle (*3*) methods. Both methods have been widely used and are well known. Daily values of crop growth stage for the Blaney-Criddle method were obtained from a Soil Conservation Service publication (*44*). The Hamon (*14*) and Papadakis (*33*) methods also require an input of air temperature although they also utilize a humidity function. In both cases, the humidity term can be obtained from tabled values using air temperature as the argument. Again, the methods were modified from a monthly basis when necessary.

Air temperature plus solar radiation.—The methods falling in this category include those of Grassi (*13*), Stephens and Stewart (*46*), Turc (*52*), Jensen and Haise (*21*), and Makkink (*27*).

All pertinent climatic inputs.—The method used in this class is that developed by Christiansen (*5*). Although empirical, Christiansen's method provides for the inclusion of as many climatic parameters as are available.

Combination methods.—The remaining methods, all based on the combination method, include Penman (*36*), van Bavel (*53*), and the pan and lake evaporation methods of Kohler, Nordenson, and Fox (*23*).

For each of the above methods, values of *PET* were computed for each day of the year. In addition, the input values were averaged for each month and monthly *PET* was also calculated by the various methods.

The data were also analyzed for an April-October growing season period as well as for the whole year. For some purposes, such as irrigation scheduling, only the growing season data are pertinent. Because many hydrologic analyses require data for the entire year, the methods are also compared on this basis.

RESULTS

Mean daily *PET* values derived from each of the methods listed in the preceding section were compared with mean daily values from the lysimeter *PET* curve (the "standard" curve). Tabulations of the smoothed climatic data used as input to the computations and the computed *PET* values for each method are given in Appendix B. Computational details for each method are given in Appendix A.

Graphs of the comparisons of computed *PET* curves with the "standard" lysimeter *PET* curve are given in figures 2 to 5. The solid line curve on figure 2 is the "standard" lysimeter curve, whereas the broken lines are mean daily *PET* values as computed by the Thornthwaite, Blaney-Criddle, Hamon, and Papadakis methods. These methods use air temperature only as input. The other figures in this set are for the other three groups of methods previously listed. In every case, the solid curve represents the "standard" lysimeter data.

In addition to daily values as given in figures 2 to 5, mean monthly values of *PET* were also computed by the various methods. Results of these calculations are given in table 1 along with the lysimeter-derived values for comparison. The monthly values of table 1 were computed by using average monthly values of climatic factors as input to the various formulas. They are not the sums of the daily values in figures 2 to 5.

The statistical method used to compare the "standard" curve and the computed curves was the root mean square (R.M.S.) computed as

$$R.M.S. = (D^2/N)^{0.5}$$

where D is the sum of the daily differences between values from the "standard" and computed curves and N is the number of observations. This statistic gives equal weight to absolute differences between the "standard" and computed curves.

As discussed earlier, the "standard" lysimeter *PET* curve values may be too high, but the shape of the curve is probably correct. Thus, the fact that the "standard" curve is higher on the chart than the Thornthwaite curve (fig. 2) may be partly due to this cause. To compare the shapes of the two curves, the "standard" curve was shifted by multiplying each daily value by a constant to make the area under the "standard" *PET* curve equal to the area under the Thornthwaite curve. This procedure makes the mean daily *PET* equal for the two curves under comparison.
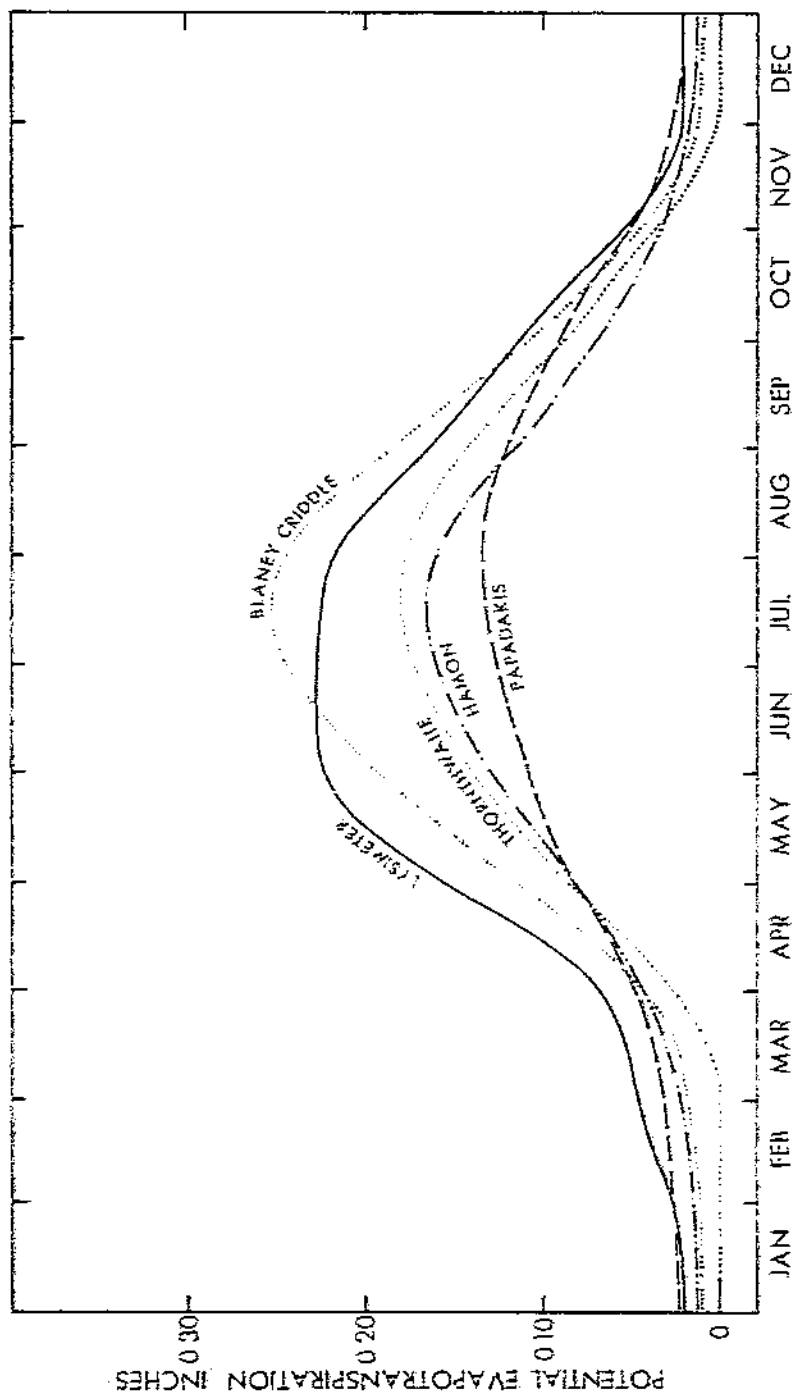
FIGURE 2.—Average daily potential evapotranspiration (PWP) as estimated by a lysimeter growing deep-rooted grass-legume and as computed by the Thornthwaite, Blaney-Criddle, Hamon, and Papadakis methods.
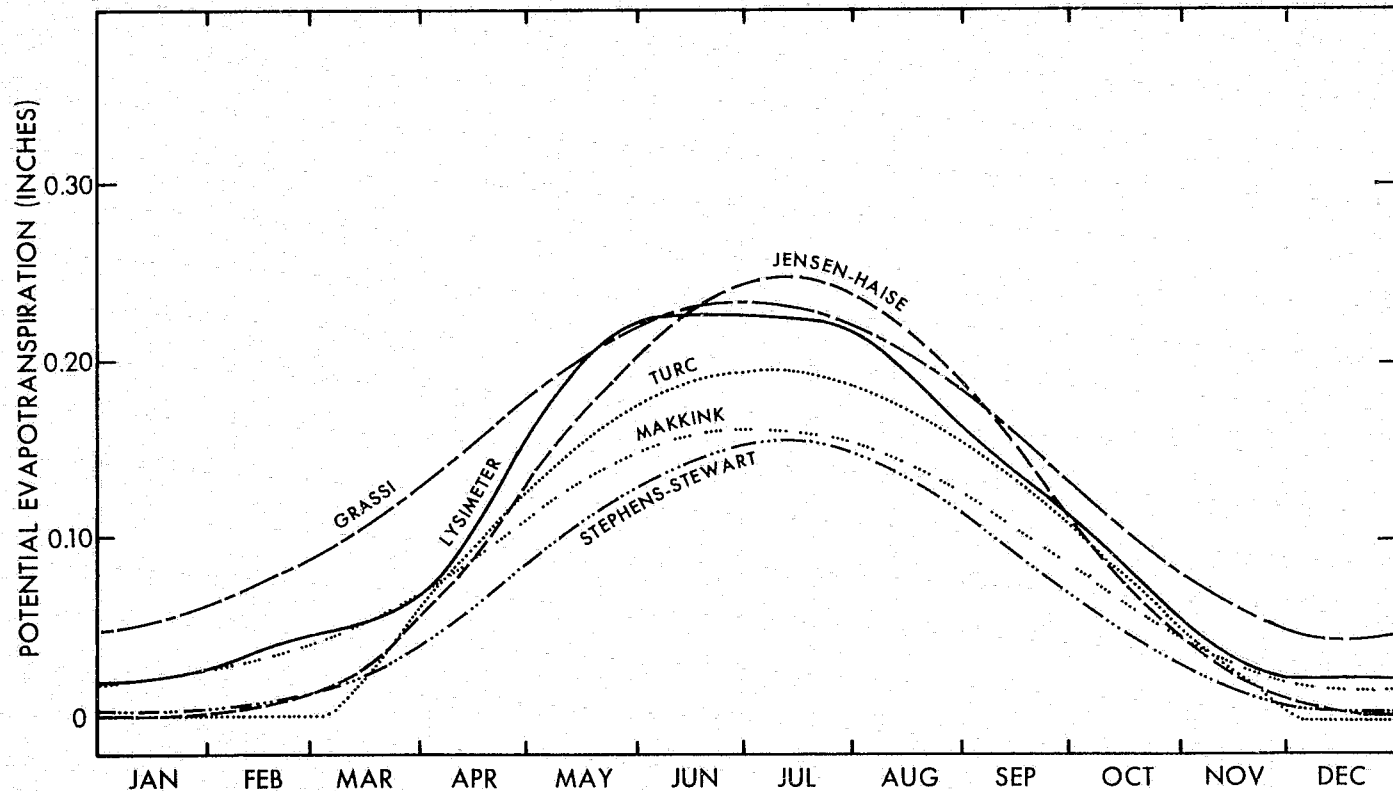
FIGURE 3.—Average daily potential evapotranspiration (*PET*) as estimated by a lysimeter growing deep-rooted grass-legume and as computed by the Grassi, Stephens-Stewart, Turc, Jensen-Haise, and Makkink methods.
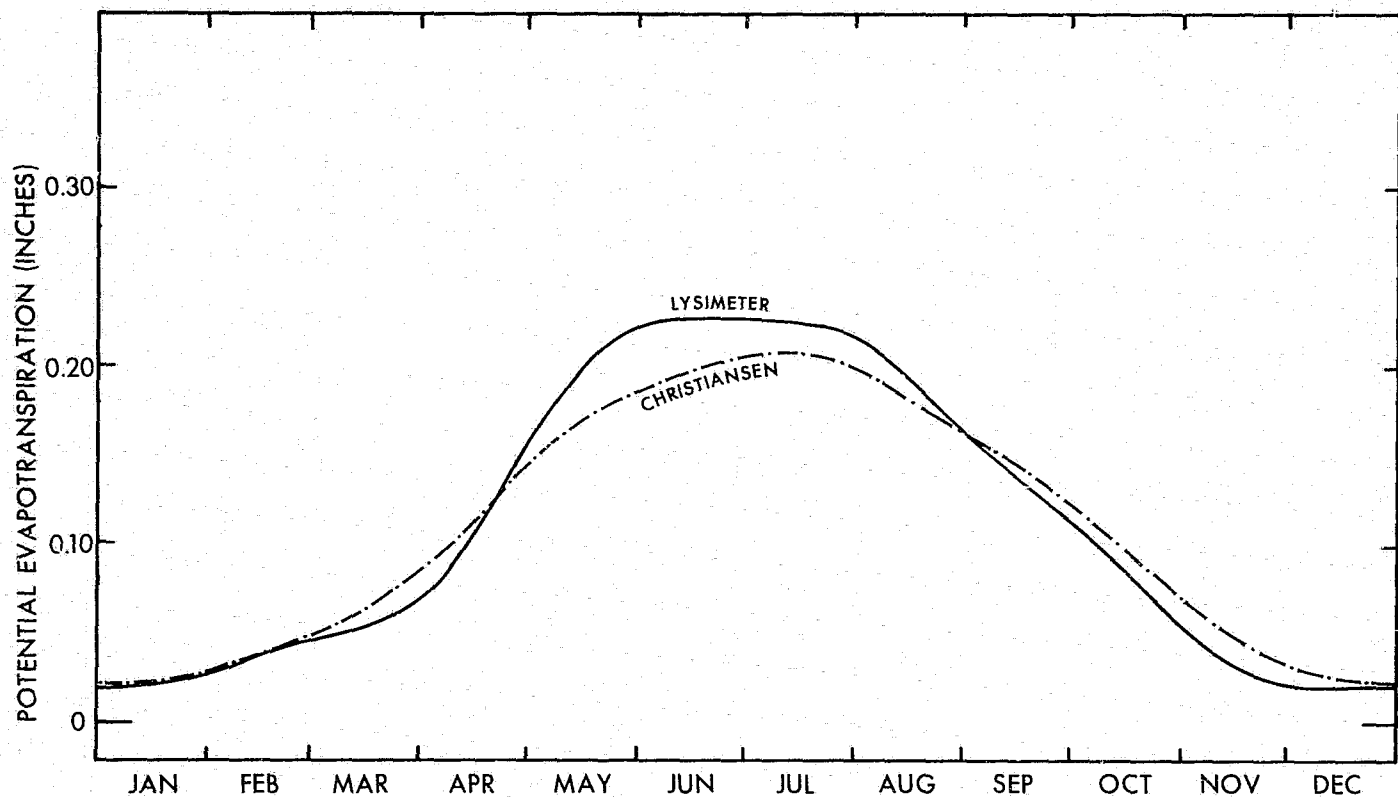
FIGURE 4.—Average daily potential evapotranspiration (*PET*) as estimated by a lysimeter growing deep-rooted grass-legume and as computed by the Christiansen method.
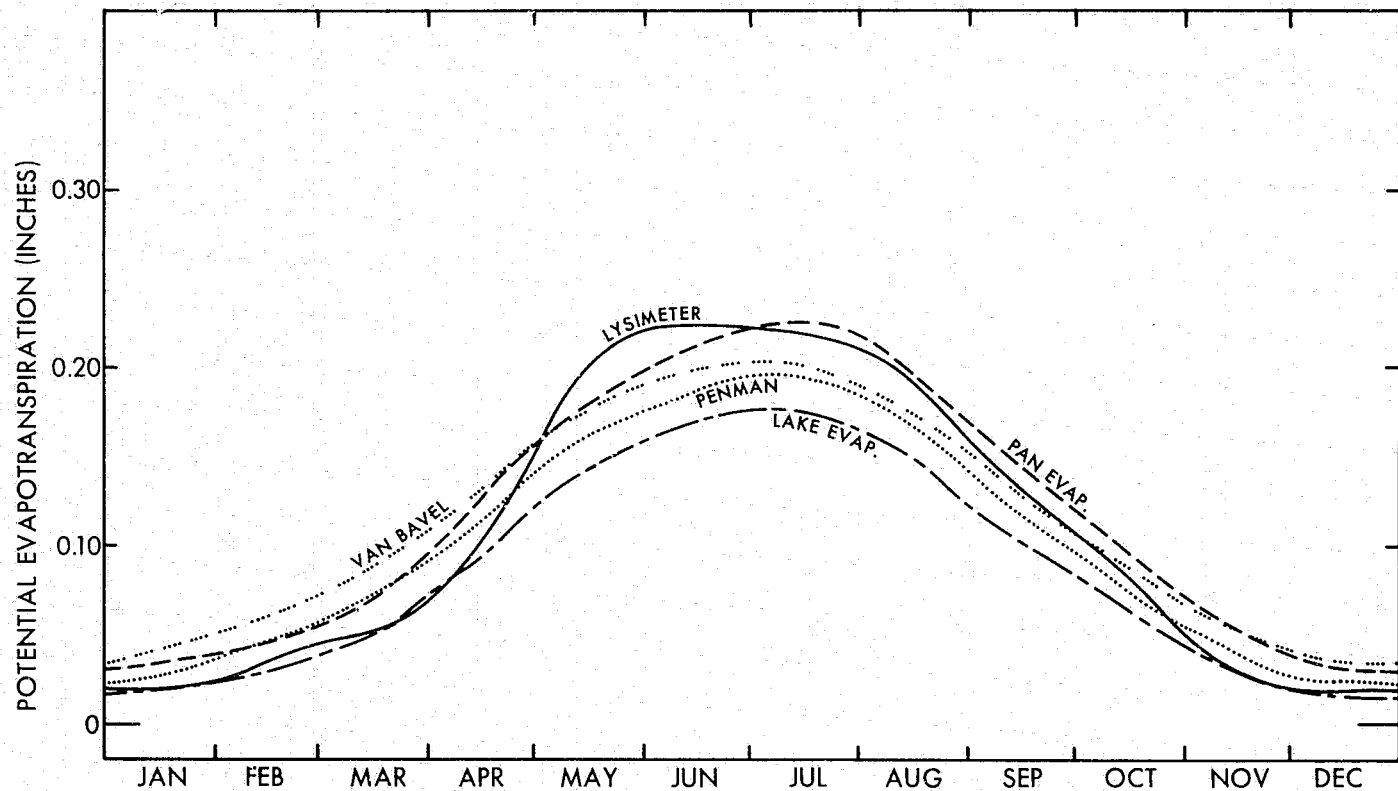
FIGURE 5.—Average daily potential evapotranspiration (*PET*) as estimated by a lysimeter growing deep-rooted grass-legume and as computed by the Penman, van Bavel, and U.S. Weather Bureau methods.

TABLE 1.—*Monthly values of PET for various methods computed using average monthly values as input*

Method	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
AIR TEMPERATURE													
Thornthwaite	0.00	0.00	0.31	1.70	3.50	4.89	5.56	4.99	3.46	1.93	0.47	0.00	26.61
Blaney-Criddle	.34	.45	.86	2.35	4.84	6.66	7.74	6.72	4.36	2.34	.79	.37	37.79
Hamon	.43	.54	.97	1.85	3.30	4.40	5.08	4.30	2.73	1.56	.75	.46	26.37
Papadakis	.09	.78	1.18	1.91	2.94	3.43	4.07	3.90	3.16	2.23	1.12	.71	26.21
AIR TEMPERATURE PLUS SOLAR RADIATION													
Grassi	1.68	2.21	3.34	4.60	6.22	6.86	7.00	6.29	4.78	3.32	1.90	1.42	49.71
Stephens-Stewart	.12	.23	.75	1.86	3.37	4.26	4.73	4.14	2.80	1.53	.53	.16	24.48
Turc	.00	.00	.88	2.93	4.78	5.57	5.91	5.27	3.91	2.45	.85	.00	32.55
Jensen-Haise	.03	.18	.98	2.81	5.50	6.81	7.62	6.65	4.45	2.35	.73	.14	38.05
Makkink	.67	.97	1.71	2.78	4.12	4.72	4.96	4.37	3.20	2.03	.96	.57	31.06
AVAILABLE CLIMATIC INFORMATION													
Christiansen	.79	1.14	2.05	3.48	5.21	5.84	6.32	5.71	4.39	3.05	1.52	.80	40.30
COMBINATION METHODS													
Penman	.90	1.14	2.30	3.45	4.91	5.58	6.00	5.21	3.68	2.38	1.20	.87	37.62
Van Bavel	1.26	1.78	2.87	4.02	5.37	5.87	6.24	5.42	3.93	2.80	1.61	1.28	42.45
Lake evaporation	.05	.90	1.07	2.84	4.36	5.00	5.39	4.59	3.15	1.99	.98	.57	32.15
Pan evaporation	1.09	1.35	2.31	3.74	5.54	6.34	6.97	6.05	4.29	3.01	1.65	1.01	43.35
LYSIMETER DERIVED													
Lysimeter	.07	1.06	1.66	3.13	6.03	6.70	6.83	5.89	4.03	2.55	.98	.61	40.14

R.M.S. values were computed for the comparisons of "standard" versus PET values (figs. 2 to 5), as well as for the "shifted standard" versus PET values. In the first case, the magnitude of the PET values is taken into account, and the R.M.S. statistics are a measure of the goodness-of-fit between the "standard" and computed curves (figs. 2 to 5). The comparison of "shifted standard" with PET is essentially a comparison of the shapes of the "standard" with computed PET curves where the magnitude has been normalized.

Results of the R.M.S. comparisons are given in table 2 for daily values and in table 3 for monthly values. Both tables give annual totals of the PET values.

DISCUSSION

Many previous studies have compared the reliability of computed PET with values measured from open pan evaporation or lysimeters. Almost all of these studies, however, usually lasted less than a year. One exception is a study by Smith (43), where a 26-year evaporation record from a standard British sunken pan was used. Data from a 15-year period of record were used in the current study.

The time periods for which PET estimates have been made vary widely. Van Bavel (53) gave a formula for obtaining instantaneous PET rates and calculated PET for periods as short as 1 hour. On the other hand, Smith (43) calculated PET for seasons and entire years in his study. In practical engineering applications, the period of interest usually ranges from 1 day to 1 month. These two durations were used in the current study.

The lysimeter "standard" curve shown on figure 1 and tabulated in Appendix table 33 is partly computed and partly measured. Mustonen and McGuinness (30) found that the lysimeter overestimated annual field ET. They drew no conclusions on the ability of the lysimeter to assess PET.

The inference that the lysimeter overestimates PET might not be true if standardized surfaces were used in the computations. Some methods were derived for grass surfaces, usually clipped. Others were derived for aerodynamically rougher crops, like alfalfa, in which case PET would be higher.

A recent Technical Note of the World Meteorological Organization (11) listed the following requirements for reliability of evapotranspirometer measurements, which are applicable to the Coshocton lysimeters:

1. Disturbances due to the existence of the evapotranspirometer must be minimal.

TABLE 2.—*Yearly and April-October growing season PET as computed from daily values with root mean squares (R.M.S.) for unadjusted and adjusted lysimeter values*

Method	Annual total	Unad-justed R.M.S.	Ad-justed R.M.S.	Seasonal total	Unad-justed R.M.S.	Ad-justed R.M.S.
AIR TEMPERATURE						
Thornthwaite	26.63	0.04	0.02	25.79	0.05	0.02
Blaney-Criddle	38.11	.02	.02	35.22	.02	.02
Hamon	26.52	.05	.01	23.34	.06	.01
Papadakis	26.30	.06	.02	21.79	.07	.02
AIR TEMPERATURE PLUS SOLAR RADIATION						
Grassi	49.73	.03	.03	39.17	.02	.02
Stephens-Stewart	24.58	.05	.01	22.76	.06	.01
Turc	32.55	.03	.01	30.82	.03	.01
Jensen-Haise	38.24	.02	.02	36.10	.02	.02
Makkink	33.11	.04	.01	26.21	.05	.01
AVAILABLE CLIMATIC INFORMATION						
Christiansen	40.42	.02	.02	34.08	.02	.02
COMBINATION METHODS						
Penman	37.74	.02	.01	31.24	.03	.02
Van Bavel	42.23	.02	.02	33.66	.02	.03
Lake evaporation	32.18	.03	.01	27.44	.04	01
Pan evaporation	43.35	.02	.02	36.02	.01	.01

TABLE 3.—*Yearly and April-October growing season PET as computed from monthly values with root mean squares (R.M.S.) for unadjusted and adjusted lysimeter values*

Method	Annual total	Unad-justed R.M.S.	Ad-justed R.M.S.	Seasonal total	Unad-justed R.M.S.	Ad-justed R.M.S.
AIR TEMPERATURE						
Thornthwaite	26.61	1.28	0.64	25.83	1.49	0.57
Blaney-Criddle	37.79	.64	.68	35.01	.73	.73
Hamon	26.37	1.40	.95	23.22	1.80	.38
Papadakis	26.21	1.69	.51	21.73	2.20	.55
AIR TEMPERATURE PLUS SOLAR RADIATION						
Grassi	40.71	.93	.97	39.16	.72	.60
Stephens-Stewart	24.48	1.50	.32	22.69	1.88	.29
Turc	32.55	.75	.47	30.82	.77	.29
Jensen-Haise	38.05	.58	.64	35.99	.54	.52
Makkink	31.06	1.10	.30	26.18	1.44	.26
AVAILABLE CLIMATIC INFORMATION						
Christiansen	40.30	.48	.48	34.00	.56	.49
COMBINATION METHODS						
Penman	37.62	.61	.45	31.21	.75	.34
Van Bavel	42.45	.69	.79	33.65	.90	.50
Lake evaporation	32.15	.93	.23	27.38	1.22	.21
Pan evaporation	43.85	.44	.51	35.94	.39	.40

2. Evapotranspirometer area must be sufficiently large to give a representative vegetative cover and to minimize disturbances due to walls.

3. Evapotranspirometer depth must permit free growth of plant roots.

4. The width of the annulus formed by the containing and retaining walls plus the gap separating them should be as small as possible.

5. Restricted drainage at the bottom resulting from surface tension at the soil-air interface must be prevented.

6. The temperature below the soil container should be regulated when necessary, to minimize disturbances due to thermal isolation from the soil beneath.

7. Vertical seepage at the walls can be reduced by using shallow corrugated walls and inward projecting flange rings to break the direct flow.

8. The evapotranspirometer should be located at a sufficient distance from the upwind edge of the surrounding area.

9. The surface should be covered with vegetation typical of the surrounding area and the state of plant growth inside and outside the evapotranspirometer must also be similar.

10. It is important that the local soil should be representative of the area under study and that the evapotranspirometer soil correspond closely to that under natural undisturbed conditions.

11. The soil surface inside and outside the evapotranspirometer must be at the same level.

12. Agricultural operations should be carried out at the same time and at the same intensity as in the surrounding field.

13. To avoid wind loading effect, evapotranspirometers should not be weighed in windy conditions.

14. To avoid errors due to rainfall catch, the plants in the evapotranspirometers should be kept vertical, and broken leaves should not extend outside the tank.

With the exception of requirement 4, adequate provisions have been made in installing and operating the Coshocton lysimeters to satisfy the other 13 requirements. The perimeter of the lysimeter was about 16 inches wide during much of the period of record when data for this report were being assembled. This wide border area is one of the reasons for putting the "standard" curve in quotation marks as a reminder that the values may be too high. The lysimeter perimeter has been about 3 inches wide since 1964. Detailed descriptions of the Coshocton lysimeters have been published by Harrold and Dreibelbis (*17, 18*).

The "standard" curve of figure 1 is not a maximum possible *PET* curve. To derive such a maximum curve, it would be necessary to plot the maximum *PET* found for each date in any of the 15 years of record and then fit an envelope curve over the scatter of points. The "standard" curve of figure 1 is an average of *PET* conditions at Coshocton.

Parmele (*34*) recently made an intensive study of *ET* at the Coshocton lysimeter. Under high soil moisture (*PET*) conditions, he found that the Bowen ratio method of estimating *ET* gave almost the same values as those measured with the lysimeter. This lends some confidence to the use of lysimeter values, at least as measured under *PET* conditions.

The shape of the lysimeter "standard" *PET* curve (fig. 1) is a little startling at first glance. The broad crest of the curve covering June and July seems anomolous because one would expect a more peaked curve. *PET* is primarily regulated by solar radiation, which means that a peak should occur in late June (App. table 8). The crop during these months, however, is either (1) an old, mature meadow, which is almost ready for cutting; or (2) the freshly regrown meadow at least 2 weeks after the first cutting has been made. Thus, plant physiology probably affects the *ET* values during this period. More variation occurs in the data at this time of year than at any other (fig. 1).

When soil moisture was below field capacity, a correction was added to *ET* to arrive at a *PET* value. The method of computation should not have introduced any bias into the "standard" curve. It can be shown algebraically that only the effect of limiting soil moisture was allowed for and that the effect of *PET* in the correcting equations cancels out. Daily values of average soil moisture are given in Appendix table 7.

The climatic and other input data used in the calculation of the theoretical *PET* curves were not all collected onsite. Of the input factors tabulated in Appendix B, only air temperature, humidity, soil moisture, and lysimeter *PET* were derived from onsite measurements.

The most important missing onsite data is undoubtedly radiation. The values of solar radiation in Appendix table 8 are a mixture of actual measurements at Wooster and values computed from sunshine measurements at Columbus by standard methods (*16*). Both locations are close enough to Coshocton to be representative of Coshocton solar radiation conditions. The fact that 15 years of data were averaged for each day and the daily averages were then fitted with a smooth curve to get the values of Appendix table 8 also helps to achieve a realistic pattern of solar radiation values.

Smoothing the climatic data has resulted in input variates that are averages rather than maximums. For instance, the air temperature value of 71.0° F. used for July 1 (App. table 4) is the average value expected, whereas a maximum average daily temperature for that date might be in the 80's. Therefore, the computed PET curves must also represent average rather than maximum PET conditions. The derivation process for the "standard" lysimeter curve is such that it too represents average rather than maximum conditions.

Inspection of tables 2 and 3 shows that no one group of methods is particularly outstanding. The Blaney-Criddle, Jensen-Haise, Christiansen, Penman, van Bavel, and pan evaporation methods all gave annual totals within 10 percent of the 40.14 inches indicated by the "standard" curve. In each of these six cases, the R.M.S. values for both the unadjusted and adjusted curves are low, indicating a close fit between the shapes of the "standard" and theoretical curves. These same PET curves were also within about 10 percent of the 35.16 inches indicated by the "standard" curve for the April-October growing season, and, again, the low R.M.S. values indicated a close fit of the curve shapes.

Several methods were considered for judging goodness-of-fit of the computed to the "standard" curve. If the curves were recast into the equivalent cumulative form, the Kolmogorov-Smirnov test (42) would be appropriate. This test, however, is concerned with the point of greatest divergence between the two distributions and falls short of being a comprehensive overall comparison.

The chi-squared test was not suitable because it deals with the expected number of responses falling in each category. Chi-squared also tends to weight a divergence inversely according to the size of the expected number. Correlation coefficients were rejected because of the high degree of correlation built in by the seasonality of the data (41). The R.M.S. technique is free from these objections. It is not much different from the T-statistic used by Dawdy and O'Donnell (8).

The Thornthwaite curve of figure 2 is consistently below the lysimeter "standard" values. Annual totals were 26.63 and 40.14 inches, respectively. This is in contrast to Smith's (43) findings that Thornthwaite values consistently exceeded pan evaporation on an annual basis in the temperate maritime climate of northern England. In the same general geographical area, Makkink (27) reported that Thornthwaite values of PET were very similar to measured lysimeter values in the Netherlands.

The Thornthwaite curve on figure 2 shows zero values of PET from December 6 to March 3, when mean daily air temperatures are

less than 32° F. The fit to the "standard" curve is better during the fall months than during the spring. The Thornthwaite method is widely used because of its simplicity and because it is part of a system for computing the water balance (49).

Pelton, King, and Tanner (35) found that PET estimates by the Thornthwaite method are not reliable when based on short-term mean temperatures. They reasoned that the failure of the Thornthwaite method over short time periods is due to the fact that short-term mean temperature is not a suitable index of incoming radiation. Stern and Fitzpatrick (47) also reported that empirical relationships based on temperature had no practical value as short-term predictors in the dry monsoonal climate of northwestern Australia.

Smith (43) compared PET values calculated by the Thornthwaite and Penman methods with a 26-year record of measured pan evaporation. Thornthwaite estimates were greater than pan evaporation, especially in summer; whereas Penman estimates were lower than pan values, especially in the fall. In the current study, the computed pan evaporation curve (fig. 5) was higher than the Thornthwaite curve in every season, especially in the first half of the year.

The Blaney-Criddle curve on figure 2 resembles the lysimeter "standard" curve much more than the other curves requiring only temperature as input. The annual total of 38.11 inches compares favorably with the 40.14 inch total from the lysimeter. The greatest discrepancy between the curves amounts to about 15 percent at the summer peak. The Blaney-Criddle technique is widely used in irrigation agriculture but also seems to be well adapted to the humid Eastern environment.

The curve computed by Hamon's (14) method is based on possible hours of sunshine and the saturated water vapor density at the daily mean temperature. The curve is consistently low in all seasons, especially the growing season. A more recent version of the formula (15) was also tried, but the results were slightly more at variance with the "standard" curve than the curve on figure 2 and are not presented here. Jones (22) found that the Penman method gave larger values than the Thornthwaite and Hamon methods in spring and early summer. He chose the Hamon method for his study of the variability of ET in Illinois because of its greater simplicity and ease of calculation.

The Papadakis curve shown on figure 2 is derived from the saturated vapor pressure at the daily maximum and mean daily dewpoint temperatures. The annual total is 26.30 inches compared with 40.14 inches for the "standard" curve. The Papadakis curve matches the "standard" curve during winter but is much flatter during the rest of the year.

All the computed PET curves peak during middle to late July in harmony with the distribution of air temperature (App. table 4). In contrast, the PET curves of figure 3 all peak earlier in the season, more in accord with the distribution of solar radiation.

Figure 3 shows the lysimeter "standard" curve compared to five methods of computed PET, which require a knowledge of solar radiation. The Grassi (13) formula requires inputs of solar radiation, air temperature, and coefficients for type of crop and density of cover. The annual total of 49.73 inches is somewhat above the 40.14 inches for the "standard" curve. The fit to the "standard" curve is good around the peak, but the Grassi curve overestimates at other times. Grassi (13) has also devised a method that utilizes measurements of cloud cover when solar radiation measurements are not available.

The Stephens and Stewart (46) curve shown on figure 3 also utilizes measurements of solar radiation and air temperature to compute PET. The yearly total, 24.58 inches, is lower than the 40.14 inches from the lysimeter. The curve is consistently low, and it seems likely that this method might have performed better had new coefficients been developed that would better reflect the Ohio climate.

Turc (52) also developed a formula for computing PET using solar radiation and air temperature as inputs. His curve. shown on figure 3, totals 30.88 inches for the year. This method also gives zero estimates of PET for the December 6 to March 2 period, when air temperatures are below freezing.

The Jensen and Haise (21) formula gives values of PET that were designed for irrigated fields in the arid and semiarid west. The curve shown on figure 3 totals 38.24 inches. very close to the 40.14 inches of the lysimeter. The shape of the Jensen and Haise curve closely resembles that of the lysimeter curve, being somewhat high in the summer and lower at other times.

The final method using solar radiation and air temperature as inputs is the Makkink (39) formula (fig. 3). The annual total is 33.11 inches. The curve matches the "standard" curve during the winter but is lower at other times.

The method developed by Christiansen (5) and his associates (fig. 4) has the advantage of permitting the user to utilize all the climatological information available at a site. The equation is so structured that the prediction is applicable to the mean values of any factors omitted from the prediction equation as well as the actual values of the factors included. The total for the year for the Christiansen curve is 40.42 inches, quite close to the 40.14 inches of the "standard" curve, and the fit is good throughout the year.

Figure 5 shows the comparison of various combination methods of computing *PET* as compared with the "standard" lysimeter curve. The inputs to the Penman equation (*36, 37*) were air temperature, dewpoint temperature, windspeed, solar radiation, and albedo. The total for the year, 37.74 inches, is close to the 40.14 inches from the lysimeter. The Penman curve underestimates during the growing season but fits the "standard" curve closely throughout the rest of the year.

The van Bavel (*53*) method of computing *PET* has the same climatic inputs as the Penman method. The yearly total, 42.23 inches, is close to the 40.14 inches of the "standard" curve. The van Bavel curve has the same general shape as the Penman curve and is displaced about 0.012 inch per day higher.

The lake and pan evaporation curves were computed by the USWB method (*23*). Input values to the formulas are the same as in the Penman method except for albedo. The annual total of 32.18 for lake evaporation is below the 43.35 inches of pan evaporation. The latter figure compares favorably with the 40.14 inches from the lysimeter.

There was some question about the form of the wind function most suitable for the Penman and van Bavel methods. Penman's (*38*) original aerodynamic term, as described in Appendix A, was used. Tanner and Pelton (*48*) found that a wind function derived over a vegetated surface was more appropriate than the Penman term. They concluded that the revised term was necessary even in the summer when the relative error in *PET* due to using an inappropriate wind function was at a minimum.

Tanner and Pelton (*48*) also suggested that a daytime-nighttime weighting of the data might be of value. They found that the use of 24-hour averages of temperature, saturation deficit, and windspeed gave a reasonable value for the aerodynamic term only because of two compensating errors. The basic data available for the Coshocton study were such that these refinements were not possible.

Aslyng (*1*), in Denmark, found that the Penman method overestimated *PET* for the year and the first part of the summer, but was in good agreement with measured values the last half of the year. In the current study, the Penman method underestimated for late spring and summer but was in good agreement for the year.

Papadakis (*33*) concluded that the Penman formula should be reduced to saturation deficit and multiplied by a constant, thus implying that the radiation and wind terms should be ignored. He criticizes the Penman method as underestimating *ET* in the dry climate, overestimating that of spring, underestimating that of autumn, and overestimating that of windy days.

Omar (*31*) compared *PET* estimates by the Penman, Papadakis, Thornthwaite, and Hamon methods with values derived from measurements in a large field in a warm, arid climate near Cairo in the United Arab Republic. The Penman and Papadakis methods provided a close fit to the values; however, the Papadakis method provided somewhat closer monthly estimates. The Thornthwaite and Hamon methods gave estimates of about two-thirds the measured value.

Fitzpatrick and Stern (*10*) found that the use of inappropriate constants in the Penman formula is probably a greater source of error when determining *PET* than instrument deficiencies.

Cruff and Thompson (*7*) investigated the Thornthwaite, USWB, Lowry-Johnson (*26*), Hamon, Blaney-Criddle, and Lane (*25*) methods of computing *PET* in arid and subhumid conditions. Only the USWB method gave estimates of *PET* that agreed closely with pan evaporation at all sites. For practical use, however, the Blaney-Criddle method was recommended.

Rijtema (*39*) compared values of *PET* from the formulas of Penman, Makkink, Turc, and Haude (*19*) with measured values from a pan and from lysimeters in grass. He concluded that it is possible to calculate *PET* with the formulas of Penman, Makkink, and Turc with the same degree of accuracy as is obtained with lysimeters or evaporation pans.

Stanhill (*45*) compared eight methods of computing *PET* with lysimeter data under arid conditions in Israel. He found that the Penman formula gave the best results for monthly and weekly periods. The next best were the formulas of Thornthwaite, Blaney-Criddle, and Makkink—in that order.

Jensen (*20*) reviewed empirical methods for estimating *PET* and concluded that "those using radiation as the primary variable provide adequate and reliable estimates of evapotranspiration for most engineering purposes when limited meteorological data are available."

Stephens and Stewart (*46*) compared correlation coefficients for measured versus computed monthly pan evaporation for 16 station years in Florida. The highest correlation was for the USWB pan evaporation method followed by the methods of Stephens and Stewart, Blaney-Criddle, Penman, Hamon, and Thornthwaite. For a 30-month comparison with the *PET* from St. Augustine grass in southern Florida, the methods from high to low correlation were Stephens-Stewart, Penman, USWB pan evaporation, Blaney-Criddle, Hamon, and Thornthwaite. They suggested the Blaney-Criddle method as suitable where data are limited.

Rijtema (40) pointed out that many calculation methods lead to an underestimate of PET. He stated that this is apparently not too serious in present day irrigation practice because soil fertility is not near optimum and the calculated values of PET are corrected with a factor for irrigation efficiency.

It seems likely that computational methods for estimating PET will be used in agriculture and other endeavors for some time to come. The current trend toward use of the more complex combination methods and away from the simpler empirical methods will probably continue. However, the more demanding input requirements of the combination methods insures that the empirical methods will continue in use into the foreseeable future.

SUMMARY AND CONCLUSIONS

A "standard" PET curve was derived from measured lysimeter values. Corrections were made for the effects of haycut and less than optimum soil moisture conditions. Thus, the "standard" PET curve represents the ET that could be obtained with nonlimiting soil and vegetative conditions.

Fourteen methods of computing PET daily values were segregated into groups depending upon the climatic inputs required. In the temperature-only-group, the Blaney-Criddle method gave the closest fit to the "standard" curve. The methods of Thornthwaite, Hamon, and Papadakis gave less satisfactory results.

The method of Jensen-Haise was best in the group using temperature plus solar radiation as input. The methods of Grassi, Stephens-Stewart, Turc, and Makkink were also included in this group. The Christiansen method was the only entry in the group using all available climatic information and provided a good fit to the "standard" curve.

Under combination methods, the USWB pan evaporation, the Penman and the van Bavel formulas gave good fits to the "standard" curve. The USWB lake evaporation method was less satisfactory.

Daily and monthly comparisons were made for the entire year and for the April-October growing season. The goodness-of-fit of the computed to the "standard" curve was evaluated by the R.M.S. procedure.

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APPENDIX A—COMPUTATIONAL METHODS

This Appendix gives computational details for each method of computing *PET* discussed in the main body of the report. The formula as given in the original reference is given first. Any changes needed to convert units and to obtain a daily estimate are then made. Finally, a numerical example is given using July 1 data.

The formulas are expressed in FORTRAN computer language for simplicity of presentation. The operators $+$, $-$, $/$, and $=$. have their usual arithmetic significance. The symbol for multiplication is $*$ and for exponentiation is $**$. Unless directed otherwise by parentheses, exponentiation is performed first, then multiplication and division, and finally addition and subtraction. When multiple parentheses occur, the order of calculation is from innermost to outermost parentheses.

The order of presentation of the formulas in this Appendix follows that of the main section of the report.

Thornthwaite Method

Instructions and tables for calculating *PET* by this method have been published by Thornthwaite and Mather (*50*). Basically, mean monthly air temperatures are used to compute a heat index, *I*. Daily unadjusted *PET* is obtained from tables that use daily air temperature and *I* as the arguments. The final adjusted *PET* values are obtained after a correction for day length.

When followed explicitly, the published instructions (*50*) produced a computed curve resembling a series of steps up and down the graph. The tabled values of unadjusted *PET* were given to two decimal places and lacked sensitivity when used with the smoothed air temperature input from Appendix table 4.

To correct this condition, values of temperature and *PET* were read from the *I* columns straddling the computed *I*. These points were plotted on a large scale graph, and a smooth curve was drawn to represent the relationship for the computed *I* value. A tabulation was then made of values from this curve with unadjusted *PET* read off in three decimals. This tabulation was used in place of the original tabled values in the computations, and the resulting curve was smooth throughout the year (fig. 2). Computed daily values are given in Appendix table 19.

Palmer and Havens (*32*) stated that the Thornthwaite method can be represented by the formula

$$PET = 1.6 \ (10 \ TC/I)^a.$$

where *PET* is monthly potential evapotranspiration in centimeters,

TC is monthly mean temperature in degrees Centigrade, I is the heat index (48.02 for Coshocton) and is the sum of 12 monthly index values of i (a function of monthly normal temperatures), and a is an empirically derived exponent, which is a function of I:

$$a = 0.49 + 0.01791\,I - 0.0000771\,I^2 + 0.000000675\,I^3.$$

These formulas may be used for computerizing the calculation if desired, although a day length correction would also be needed. The program developed by Black (2) is one example.

The Thornthwaite method is designed for computations of PET for 1 day or for a full month and should therefore be applicable for the durations computed in this report.

Blaney-Criddle Method

The procedure used in computing the Blaney-Criddle PET curve was given in a U.S. Soil Conservation Service (SCS) publication (44). The general formula is

$$PET = (0.0173\,TA - 0.314) * KC * TA * (DL/4465.6).$$

where TA is mean daily air temperature (App. table 4), KC is a crop growth stage coefficient for alfalfa (App. table 16), and DL is a day length in hours (App. table 14). The constant, 4465.6, is the sum of the day lengths of Appendix table 14 for the year. When TA is less than 35.0° F., the first term in parentheses is given a constant value of 0.3.

The Blaney-Criddle method was originally devised for estimating seasonal consumptive use. The modifications as described in the SCS report (44) are designed to extend the method to give reasonably accurate estimates of consumptive use for short periods of from 5 to 30 days. The authors used the term $DL/4465.6$ to enable estimates to be made on a daily basis. For July 1, the Blaney-Criddle PET is computed as

$$PET = (0.0173 * 71.0 - 0.314) * 1.12 * 71.0 * (15.0/4465.6) = 0.244.$$

A tabulation of computed daily values is given in Appendix table 20.

Hamon Method

Hamon (14) derived an equation for computing PET based on possible hours of sunshine and the saturated water vapor density at the daily mean temperature. His formula is

$$PET = C\,D^2\,PT/100.$$

where C is a constant, 0.55; D is the possible hours of sunshine in

units of 12 hours (the data of App. table 14 divided by 12); and PT is the saturated water vapor density (absolute humidity) at the daily mean temperature, divided by 100.

The computing formula is

$$PET = 0.0055 * (DL/12)**2 * (AH * 2.2881).$$

DL is the day length value from Appendix table 14. The AH term is obtained by linear interpolation in the 100-percent column of Marvin's table XII (29) using air temperature from Appendix table 4 as the argument. The constant, 2.2881, converts units. For July 1, TA is 71.0 so AH is 8.240 and

$$PET = 0.0055 * (15.0/12)**2 * (8.240 * 2.2881) = 0.162.$$

Computed daily values are given in Appendix table 21.

In calculating monthly PET by the Hamon method, Jones (22) made a 4-percent correction to adjust to the summation of daily average temperatures. This adjustment was not used here to maintain consistency with the calculations made by other formulas.

Papadakis Method

Papadakis (33) suggested that PET may be computed from the simple formula

$$PET = 0.5625 (e_{ma} - e_{mi-2}).$$

where PET is monthly potential evapotranspiration in centimeters: e_{ma} is the saturation vapor pressure in millibars, corresponding to the average daily maximum temperature; and e_{mi-2} is the saturated vapor pressure in millibars corresponding to the average daily minimum temperature minus $2°$ C. Papadakis reasoned that $2°$ is the usual difference between minimum and dewpoint temperatures.

Because dewpoint temperatures are available in this study (App. table 5), the equation was modified to read

$$PET = 0.5625 (e_{ma} - e_{td}),$$

where e_{td} is the saturated vapor pressure in millibars corresponding to the dewpoint temperature.

The computing formula is

$$PET = 0.2459 (e_{ma} - e_{td}),$$

where the temperature of ma is found by adding the value of Appendix table 15 to that of Appendix table 4, and the temperature of td is given in Appendix table 5. The constant, 0.2459, is found from

$$0.5625 (0.3937) (33.864) / 30.5 = 0.2459.$$

where 0.5625 is the Papadakis constant, 0.3937 converts centimeters to inches, 33.864 converts inches of mercury to millibars, and 30.5 is the average number of days in the month.

Using July 1 data, the temperature of ma is $71.0 + 10.2 = 81.2$ from which $e_{ma} = 1.063$ from Marvin's (29) tables. The temperature of td is 62.2 so $e_{td} = 0.559$. Then for July 1,

$$PET = 0.2459 \ (1.063 - 0.559),$$

and $PET = 0.124$ for the day. Computed daily values are given in Appendix table 22.

Grassi Method

Grassi (13) developed a formula for computing PET when measurements of incident radiation were available. The formula is

$$PET = KC_{Rs} \ C_T C_{Crc} F.$$

In this formula, K is a constant, 0.537. C_{Rs} is the coefficient for radiation and is computed as $0.000675 \ RI$, where RI is radiation from Appendix table 8 and the constant converts from langleys to inches of evaporation equivalent. In this formula, C_T takes the linear form, $0.620 + 0.00559 \ TA$, where TA is air temperature from Appendix table 4. The C_{Crc} coefficient representing plant cover was set at 1.0 for the meadow and F equaled 1.09 for alfalfa. The computing formula for this method is

$$PET = 0.537 * 0.000675 * RI * (0.620 + 0.00559 * TA) * 1.09.$$

Using July 1 data,

$$PET = 0.537 * 0.000675 * 581 * (0.620 + 0.00559 * 71.0) * 1.09 = 0.233.$$

Daily computed values are given in Appendix table 23.

Grassi (13) mentioned that there was less statistical error in both this method and his method using extraterrestrial radiation than in his method using pan evaporation. He also was cautious about not using any of the methods for periods of less than a week or two.

Stephens and Stewart Method

Stephens and Stewart (46) examined several computational methods with Florida data. For PET from grass, they found their fractional evaporation equivalent method ranked highest. They pointed out that the equation was developed for Florida conditions.

For PET from grass, the Stephens and Stewart formula is

$$PET = (0.0082 \ TA - 0.19) \ (RI / 1,500),$$

where TA and RI are air temperature and solar radiation (App. tables 4 and 8), respectively. The constants 0.0082 and 0.19 were developed by regression analysis, and the 1,500 value converts langleys to inches of evaporation. The computing formula is

$$PET = (0.0082 * TA - 0.19) * (RI/1,500).$$

For July 1, when $TA = 71.0$ and $RI = 581$, PET is computed as 0.152. Daily computed values are listed in Appendix table 24.

The Stephens and Stewart method was devised for monthly estimates.

Turc Method

Turc (52) derived a formula for PET as

$$PET = 0.40\ TC(RI + 50)/(TC + 15).$$

where TC is air temperature in degrees Centigrade, RI is solar radiation in langleys, and PET is in millimeters per month. The computing formula is

$$PET = ((0.40 * (5 * (TA - 32))/9) * (RI + 50)/$$
$$((5 * (TA - 32)/9) + 15) / (25.4 * 30.5),$$

where TA is air temperature in degrees Fahrenheit (App. table 4), RI is solar radiation (App. table 8), and the last two constants convert to inches per day from millimeters per month. Using July 1 data,

$$PET = ((0.40 * (5 * (71.0 - 32.0))/9) * (581 + 50) /$$
$$((5 * (71.0 - 32.0) / 9) + 15) / (25.4 * 30.5)$$
$$= 0.193.$$

Daily computed values are given in Appendix table 25.

The Turc formula was designed to give monthly PET and was modified as above for daily estimates. Note that the formula used in this report is not that originally developed by Turc (51) but a later development.

Jensen-Haise Method

Jensen and Haise (21) developed a formula for computing PET based on mean air temperature and solar radiation. Their formula is

$$PET = (0.014\ TA - 0.37)\ RI,$$

where TA is air temperature and RI is solar radiation (App. tables 4 and 8). The computing formula is

$$PET = (0.014 * TA - 0.37) * RI * 0.000673.$$

where 0.000673 converts from langleys to inches of evaporation equivalent. Using July 1 data, with TA = 71.0 and RI = 581, PET is computed as 0.244. Daily computed values are given in Appendix table 26.

PET in the Jensen-Haise method refers to the ET that can occur in irrigated fields located in arid and semiarid areas. The estimating equation is based on data for periods greater than 5 days.

Makkink Method

Makkink (39) developed a formula based on radiation and temperature as

$$PET = 0.61 \; RI \; (\Delta \; \Delta - \gamma) - 0.12,$$

where PET is monthly potential evapotranspiration in millimeters. RI is solar radiation in millimeters per day evaporation equivalent, Δ is the slope of the saturated vapor pressure-temperature curve at the mean air temperature, and γ is the psychrometric constant, 0.27 for degrees Fahrenheit and millimeters of mercury. The fraction was divided through by γ so tabled values of $\Delta \; \gamma$ could be used. A short table of $\Delta \; \gamma$ (dimensionless) versus temperature in degrees Centigrade was given by van Bavel (53), and a more extensive table obtained from him is given in Appendix table 18. The values below 0° C. in the table were computed at Coshocton.

The computing formula is

$$PET = (0.61 * 0.0171 * RI * (DOG/DOG + 1) - 0.12) * 0.03937,$$

where RI is solar radiation in langleys (App. table 8), 0.0171 converts langleys to millimeters of evaporation equivalent, DOG is $\Delta \; \gamma$ and is interpolated from Appendix table 18 using air temperature from Appendix table 4 (converted to degrees Centigrade) as the argument, and 0.03937 converts from millimeters to inches.

Using July 1 data, TA from Appendix table 4 is 71.0 so the temperature is 21.67° C. Interpolating in Appendix table 18, DOG is 2.342. Then

$$PET = ((0.61 * 0.0171 * 581. * (2.342/3.342)) - 0.12) * 0.03937 = 0.162.$$

The Makkink formula was designed to predict monthly PET but is used here for daily PET values. Daily computed values are given in Appendix table 27.

Christiansen Method

Christiansen (5) and his students at Utah State University have been developing a method of computing pan evaporation from climatic data. The formula is

$$PET = 0.473 \ R_T \ C_T \ C_W \ C_H \ C_S \ C_E \ C_M.$$

In this formula, 0.473 is a dimensionless constant. R_T is solar radiation at the top of the atmosphere in inches of evaporation equivalent (App. table 13).

The following formulas for the remaining coefficients were given by Christiansen (5) in his formulas 64 to 68. C_T is the coefficient for air temperature (App. table 4) computed as

$$C_T = -0.0673 + 0.0132 \ TA + 0.0000367 \ TA^2.$$

C_W is the coefficient for windspeed in miles per day at pan height (App. table 6) computed as

$$C_W = 0.708 + 0.00546 \ W - 0.00001 \ W^2.$$

C_H is the coefficient for humidity (App. table 11) computed as

$$C_H = 1.250 - 0.0087 \ RH + 0.000075 \ RH^2 - 0.0000000085 \ RH^4,$$

where the value of RH enters the formula as a whole number. C_S is the coefficient for percentage of possible sunshine (App. table 10) computed as

$$C_S = 0.542 + 0.0080 \ S - 0.000078 \ S^2 + 0.00000062 \ S^3,$$

where S enters the formula as a whole number. C_E is the coefficient for the elevation of the site (1,180 feet) and is computed as $C_E = 0.970 + 0.030 \ (1.18) = 1.0054$, a constant for this study. C_M is a monthly vegetative coefficient determined empirically. Data from Indiana were taken from a publication by Christiansen (6) and extrapolated to a full year. These values were plotted on a chart at the midpoint of each month, and a smooth curve was fitted through the points. Daily values were then read from the smooth curve (App. table 17).

The computing equation is

$$PET = 0.473 * REX * (-0.0673 + 0.0132 * TA + 0.0000367 *$$
$$TA ** 2) * (0.708 + 0.00546 * W - 0.00001 * W ** 2)$$
$$* (1.250 - 0.0087 * RH + 0.000075 * RH ** 2$$
$$- 0.0000000085 * RH ** 4) * (0.542 + 0.0080 * S$$
$$- 0.000078 * S ** 2 + 0.00000062 * S ** 3)$$
$$* 1.0054 * CM.$$

In this equation, REX is extraterrestrial radiation (App. table 13), S is percent of possible sunshine (App. table 10) and enters the equation as a whole number, and W is windspeed (App. table 6). Using July 1 data,

$$PET = 0.473 * 0.663 * (-0.0673 + 0.0132 * 71.0$$
$$+ 0.0000367 * 71.0 * 71.0) * (0.708 + 0.00546$$
$$* 63.2 - 0.00001 * 63.2 * 63.2) * (1.250$$
$$- 0.0087 * 74 + 0.000075 * 74 * 74 - 0.0000000085$$
$$* 74 * 74 * 74 * 74) * (0.542 + 0.0080 * 67$$
$$- 0.000078 * 67 * 67 + 0.00000062 * 67 * 67 * 67)$$
$$* 1.0054 * 0.87 = 0.204.$$

The Christiansen method was devised to compute monthly values and was modified as above to give daily estimates. Daily computed values are given in Appendix table 28.

Penman Method

Penman (*36, 37*) combined the energy balance and aerodynamic equations into a single equation for estimating *PET*. His equation is

$$PET = (\Delta H + E_a \gamma) / (\Delta + \gamma),$$

where *PET* is evaporation from a free water surface in millimeters per day, Δ is the slope of the saturated vapor pressure-temperature curve at the mean air temperature, and γ is the psychrometric constant, 0.27 for degrees Fahrenheit and millimeters of mercury. The E_a and H terms are defined below. To take advantage of tabled values of Δ/γ (App. table 18). the equation is divided through by γ giving

$$PET = ((\Delta/\gamma) H + E_a) / ((\Delta/\gamma) + 1).$$

The E_a term of Penman's equation contains the vapor pressure deficit and the wind terms as

$$E_a = 0.35 (e_s - e_d) (1 + u/100),$$

where e_s and e_d are the saturated and actual vapor pressure of the air in millimeters mercury and u is the wind at a height of 2 meters in miles per day. Because the windspeed data in Appendix table 6 are from an anemometer set at a height of 2 feet (61 centimeters), the correction

$$u = (\ln 200/\ln 61) W = 1.29 W$$

was used to convert the *W* values of Appendix table 6 to windspeeds at a height of 2 meters. This is the original Penman (*38*) aerodynamic term, which allows for the extra roughness of a crop as compared with open water. Air and dewpoint temperatures from Appendix tables 4 and 5 are used to enter Marvin's tables (*29*) to obtain the saturated and actual vapor pressures, *VPTA* and *VPTD*, respectively.

The remaining term of Penman's equation, H, is made up of two

parts dealing with incoming short wave radiation, the A term, and outgoing long wave radiation, B. The A term is usually computed as

$$A = R_a \; (1-r) \; (0.18 + 0.55 \; n/N),$$

where A is in units of millimeters of evaporation equivalent per day, R_a is extraterrestrial radiation in the same units as A, r is the albedo, and n/N is the ratio of actual to possible hours of sunshine. When solar radiation values are available (App. table 8), this simplifies to

$$A = RI \; (1-r).$$

Outgoing long wave radiation, B, is estimated as

$$B = \sigma \; TK^4 \; (0.56-0.092 \; e_d^{0.5}) \; (0.10 + 0.9 \; n/N),$$

where σ is the Stefan-Boltzmann constant (0.00000000201), TK is mean air temperature in degrees Kelvin, and e_d is the actual vapor pressure of the air in millimeters of mercury. The H term consists of A minus B.

The computing formula for the pressure-wind term is

$$EA=0.35 * (25.4) * (VPTA - VPTD) * (1 + 0.0129 * W),$$

where the 25.4 converts pressure to millimeters of mercury. Using July 1 data, TA = 71.0 (App. table 4) so $VPTA$ = 0.757; TD = 62.2 (App. table 5) so $VPTD$ = 0.559; W = 63.2 (App. table 6), and

$$EA = 0.35 * (25.4) * (0.757 - 0.559) * (1 + 0.0129 * 63.2) \text{ and}$$

$$EA = 3.1953 \text{ mm. for July 1.}$$

The short wave radiation term is computed as

$$A = 0.0171 \; RI \; (1-ALB),$$

where the 0.0171 converts langleys to millimeters of evaporation equivalent, RI is solar radiation from Appendix table 8, and ALB is from Appendix table 12. Using July 1 data, RI = 581, ALB = 0.20, and

$$A = 0.0171 * (581) * (1 - 0.20) \text{ and}$$

$$A = 7.9481 \text{ mm. for July 1.}$$

The long wave outgoing radiation term is computed as

$$B = \sigma \; TK^4 \; (0.56 - 0.092 \; VPTD^{0.5}) \; (0.10 + 0.9S)$$

where the S values from Appendix table 10 are entered as decimals, and the other terms are as previously defined. Using July 1 data, TA = 71.0 (App. table 4) and

$$\sigma \ TK^4 = 0.00000000201 \ * \ (5 \ * \ (71.0 - 32.0)/9 + 273) \ ** \ 4$$
$$= 15.153749.$$

$VPTD = 0.559$; converting to millimeters, $25.4 \ * \ (0.559) = 14.1986$; $(14.1986) \ ** \ 0.5 = 3.7681$, and

$$(0.56 - 0.092 \ * \ (3.7681)) = 0.213335.$$

Since $S = 0.67$ (App. table 10)

$$(0.10 + 0.9 \ * \ (0.67)) = 0.703$$

and B is computed as

$$15.153749 \ * \ (0.213335) \ * \ (0.703) = 2.2727 \ \text{mm}.$$

Since $H = A - B$, $H = 5.6754$ mm. for July 1.

Entering Appendix table 18 with $21.67°$ C. (from $TA = 71.0°$ F. on July 1), $\Delta/\gamma = 2.342$. Substituting in the basic equation

$$PET = (((2.342) \ * \ 5.6754) + 3.1953) \ / \ (2.342 + 1) \ \text{and}$$

$PET = 4.9333$ mm. or 0.194 inches for July 1.

The Δ/γ term gives more weight to the H term than to the EA term during the summer when PET is high. Results from this method of calculation are listed in Appendix table 29.

Van Bavel Method

Van Bavel (53) improved the combination equation over the Penman version to the point where the van Bavel version does not contain any empirical constants or functions. The van Bavel version is

$$PET = ((\Delta/\gamma)(H/L) + BV \ PD)/((\Delta/\gamma) + 1).$$

The Δ/γ term was defined in the Penman method. H is the same as defined in the Penman method but is now in units of langleys (ly.). L is the latent heat of vaporization, 583 ly. cm.$^{-3}$. PD is the vapor pressure deficit in millibars. BV is the transport factor and is found from

$$BV = (0.01222 \ W/(ln \ z_a/z_o)^2)298/TK,$$

where W is daily windspeed at 2 meters in kilometers per day; z_a is the height above the surface where temperature, humidity, and wind are measured (200 cm.); z_o is a roughness parameter (1 cm. for alfalfa); and TK is the temperature of the air in degrees Kelvin.

The computing formula for BV is

$$BV = (0.01222 \ * \ W \ * \ 1.29 \ * \ 1.609 \ * \ 298/ \ (28.0722 \ * \ (5 \ * \ (TA - 32) \ / \ 9) + 273)$$
$$= 0.2693 \ * \ W/((5 \ * \ (TA-32) \ / \ 9) + 273).$$

In this formula, 0.01222 is a constant computed from the density of the air, the Von Karman constant, and the ambient pressure; 1.29 converts wind data from 2 feet to 2 m.; 1.609 converts wind from miles to kilometers; and 28.0722 is the value of $(ln\ 200/1)^2$. Using July 1 data

$$BV = (0.2693 * 63.2)\ /\ ((5 * (71.0{-}32.0)\ /\ 9) + 273)$$
$$= 0.0578\ cm.$$

In the absence of measured net radiation, the H term used is the same as the one used by Penman; thus, for July 1, $H = 5.6754$ mm., which, when divided by 0.0171, converts to 332 ly. Values of H are given in Appendix table 9. The vapor pressure deficit term is computed as

$$PD = (VPTA - VPTD) * 33.864$$

where 33.864 converts units from inches of mercury to millibars. Using July 1 data,

$$PD = (0.757 - 0.559) * 33.864$$
$$= 6.7051\ mb.$$

Substituting in the basic equation,

$$PET = (2.342\ (332/583) + 0.0578\ (6.7051))/(2.342 +1)$$
$$= 0.5150\ cm.\ or\ 0.203\ inches\ for\ July\ 1.$$

Computed daily values are given in Appendix table 30.

Lake Evaporation

Kohler, Nordenson, and Fox (23) modified the combination method and presented nomograms for computing both lake and class A pan evaporation. Lamoreux (24) adapted the formula for computer use and his derivation is briefed in the following. The basic Penman equation may be written as

$$PET = (Q_n\ \Delta + E_a\gamma)\ /\ (\Delta + \gamma)$$

where Q_n is net radiation and γ has the value of 0.0105 in. of Hg per °F.

The E_a term of this equation is

$$E_a = (c_s - c_e)^{0.88}\ (0.37 + 0.0041W).$$

The $Q_n\Delta$ term is computed as

$$Q_n\Delta = EXP\ [(TA - 212)\ (0.1024{-}0.01066\ ln\ RI)] - 0.0001.$$

The computing equation for lake evaporation is then written as

$$PET = [EXP \ (TA-212) \ (0.1024-0.01066 \ ln \ RI)] - 0.0001$$
$$+ \ 0.0105 \ (e_s \ -e_a)^{0.88} \ (0.37 + 0.0041W) \ [0.015$$
$$+ \ (TA + 398.36)^{-2} \ (6.8554) \ (10^{10}) \ EXP$$
$$(-7482.6 \ / \ (TA + 398.36))]^{-1}$$

In these equations, TA and TD are air and dewpoint temperatures (App. tables 4 and 5), respectively, R is solar radiation in langleys (App. table 8), and W is windspeed at pan height in miles per day (App. table 6).

Computation with this formula is complex and is best done on an electronic computer. A program that calculates both lake and pan evaporation is available from the USWB. If only a few values are needed, the nomograms given by Kohler, Nordenson, and Fox (23) are easy to use. Computed daily values are given in Appendix table 31.

Pan Evaporation

The pan evaporation amounts were computed with the same program that was used for computing lake evaporation. Again, for a few values, the nomograph given in Kohler, Nordenson, and Fox (23) is easy to use. Computed daily values are given in Appendix table 32.

APPENDIX B—DAILY VALUES OF CLIMATIC DATA AND COMPUTED CURVES

This Appendix of the report contains tabular data. Tables 4 to 15 contain climatic data useful in computing PET. Tables 16 to 18 contain crop and meteorological data needed in several of the computations. Tables 19 to 32 contain daily PET values computed by the 14 methods discussed in the text, and table 33 contains the daily values that comprise the "standard" lysimeter curve.

Harmonic curves for smoothing the data given in tables 4, 5, 6, 7, 8, 15, and 33 were computed using the BMD04R computer program (9). Pertinent statistics are given in table 34. The program performs harmonic analysis using the regression function

$$Y_t = a_0 + \sum_{i=1}^{n} [a_i \cos(2\pi \ it/K) + b_i \sin(2\pi \ it/K)],$$

where Y_t is the value estimated for day t ($t = 0, 1, 2, \ldots, 365$), a_0 is the mean of the values, n is the number of harmonics, a_i and b_i are coefficients fitted by the program, 2π equals 6.283185 radians, and K equals 366. An excellent description of the technique was given by Bliss (4).

The number of harmonics used in fitting each curve was determined by analysis-of-variance. The reduction in unexplained variability was examined after fitting each harmonic, and the process was discontinued when a nonsignificant result was obtained. Values of the mean, the a_i and b_i coefficients, and the standard deviations from regression for the seven curves fitted are given in table 34.

TABLE 4.—MEAN DAILY AIR TEMPERATURE

DATA ARE FROM 4-TERM HARMONIC CURVE FITTED TO AVERAGE OF 1948-65 DATA
LESS 1956, 1957, 1964, AND PERIODS WHEN HAY CUT RESTRICTED PET ESTIMATE.

DEGREES FAHRENHEIT

DAY	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
1	27.2	27.5	31.7	42.9	55.5	65.0	71.0	73.4	68.8	59.8	46.7	33.6
2	27.1	27.6	32.0	43.3	56.3	65.2	71.1	73.4	68.6	59.4	46.2	33.2
3	27.1	27.7	32.2	43.8	56.7	65.5	71.3	73.3	68.3	59.1	45.7	32.9
4	27.0	27.8	32.5	44.2	57.0	65.7	71.5	73.3	68.1	58.7	45.3	32.6
5	27.0	27.9	32.7	44.7	57.4	65.9	71.6	73.2	67.8	58.3	44.8	32.3
6	27.0	27.9	33.0	45.1	57.7	66.1	71.8	73.1	67.6	58.0	44.3	31.9
7	26.9	28.0	33.3	45.6	58.1	66.3	71.9	73.1	67.3	57.6	43.9	31.6
8	26.9	28.1	33.6	46.1	58.4	66.6	72.0	73.0	67.0	57.2	43.4	31.4
9	26.9	28.2	33.9	46.5	58.8	66.8	72.2	72.9	66.3	56.8	42.9	31.1
10	26.9	28.3	34.2	47.0	59.1	67.0	72.3	72.3	66.5	56.4	42.4	30.8
11	26.8	28.4	34.5	47.4	59.4	67.2	72.4	72.7	66.2	56.0	42.0	30.5
12	26.8	28.6	34.9	47.9	59.7	67.4	72.5	72.5	65.9	55.6	41.5	30.3
13	26.8	28.7	35.2	48.4	60.0	67.6	72.6	72.4	65.6	55.2	41.1	30.0
14	26.8	28.8	35.5	48.8	60.3	67.8	72.7	72.3	65.3	54.8	40.6	29.8
15	26.8	28.9	35.9	49.2	60.6	68.0	72.8	72.2	65.1	54.3	40.1	29.6
16	26.9	29.1	36.3	49.7	60.9	68.2	72.9	72.0	64.8	53.9	39.7	29.4
17	26.9	29.2	36.6	50.1	61.2	68.4	73.0	71.9	64.5	53.5	39.2	29.2
18	26.9	29.4	37.0	50.6	61.5	68.6	73.1	71.7	64.1	53.1	38.8	29.0
19	26.9	29.5	37.4	51.0	61.8	68.8	73.2	71.5	63.8	52.6	38.4	28.8
20	26.9	29.7	37.8	51.5	62.0	69.0	73.2	71.4	63.5	52.2	37.9	28.6
21	27.0	29.9	38.2	51.9	62.3	69.2	73.3	71.2	63.2	51.7	37.5	28.3
22	27.0	30.0	38.6	52.3	62.6	69.4	73.3	71.0	62.9	51.3	37.1	28.3
23	27.0	30.2	39.0	52.7	62.8	69.6	73.4	70.8	62.6	50.9	36.7	28.1
24	27.1	30.4	39.4	53.2	63.1	69.3	73.4	70.6	62.2	50.4	36.3	28.0
25	27.1	30.6	39.8	53.6	63.3	69.9	73.4	70.4	61.9	49.9	35.8	27.9
26	27.2	31.8	40.2	54.0	63.6	70.1	73.5	70.2	61.6	49.5	35.5	27.8
27	27.2	31.0	40.7	54.4	63.8	70.3	73.5	70.0	61.2	49.0	35.1	27.6
28	27.3	31.2	41.1	54.8	64.1	70.5	73.5	69.8	60.9	48.6	34.7	27.5
29	27.3	31.5	41.5	55.2	64.3	70.6	73.5	69.5	60.5	48.1	34.3	27.5
30	27.4		42.0	55.6	64.5	70.8	73.5	69.3	60.2	47.6	33.9	27.4
31	27.5		42.4		64.8		73.4	69.1		47.2		27.3
AVERAGE	27.0	29.1	36.8	49.4	60.7	68.0	72.7	71.7	64.3	53.8	40.1	29.2

TABLE 5.--MEAN DAILY DEW POINT TEMPERATURE

DATA ARE FROM 3-TERM HARMONIC CURVE FITTED TO AVERAGE OF 1948-65 DATA
LESS 1956, 1957, 1964, AND PERIODS WHEN HAY CUT RESTRICTED PET ESTIMATE.

DEGREES FAHRENHEIT

DAY	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
1	21.1	19.9	23.7	33.4	45.7	56.2	62.2	64.1	60.4	50.8	37.8	27.2
2	21.1	20.0	23.9	33.8	46.1	56.5	62.4	64.1	60.2	50.4	37.4	27.0
3	20.9	20.0	24.1	34.2	46.5	56.8	62.5	64.0	60.0	50.0	37.0	26.7
4	20.8	20.1	24.4	34.6	46.8	57.0	62.6	64.0	59.7	49.6	36.6	26.4
5	20.7	20.1	24.6	35.0	47.2	57.3	62.7	64.0	59.5	49.2	36.2	26.2
6	20.6	20.2	24.9	35.4	47.6	57.5	62.8	63.9	59.2	48.8	35.8	25.9
7	20.6	20.3	25.1	35.8	48.0	57.8	63.0	63.9	59.0	48.4	35.4	25.7
8	20.5	20.3	25.4	36.2	48.4	58.0	63.1	63.8	58.7	48.0	35.0	25.4
9	20.4	20.4	25.7	36.6	48.8	58.3	63.2	63.7	58.4	47.6	34.6	25.2
10	20.3	20.5	25.9	37.0	49.1	58.5	63.2	63.7	58.1	47.1	34.2	25.0
11	20.2	20.6	26.2	37.4	49.5	58.7	63.3	63.6	57.8	46.7	33.8	24.7
12	20.2	20.7	26.5	37.9	49.9	58.9	63.4	63.5	57.5	46.3	33.5	24.5
13	20.1	20.8	26.8	38.3	50.2	59.2	63.5	63.4	57.2	45.9	33.1	24.3
14	20.1	20.9	27.1	38.7	50.5	59.4	63.6	63.3	56.9	45.4	32.7	24.1
15	20.0	21.0	27.4	39.1	50.9	59.6	63.6	63.2	56.6	45.0	32.4	23.9
16	20.0	21.2	27.7	39.5	51.3	59.8	63.7	63.1	56.3	44.6	32.0	23.7
17	19.9	21.3	28.1	39.9	51.6	60.0	63.8	63.0	56.0	44.2	31.7	23.5
18	19.9	21.5	28.4	40.3	52.0	60.2	63.8	62.9	55.6	43.7	31.3	23.3
19	19.9	21.6	28.7	40.8	52.3	60.4	63.9	62.7	55.3	43.3	31.0	23.1
20	19.8	21.8	29.1	41.2	52.6	60.5	63.9	62.6	55.0	42.9	30.6	22.9
21	19.8	21.9	29.4	41.6	53.0	60.7	64.0	62.5	54.6	42.4	30.3	22.8
22	19.8	22.1	29.7	42.0	53.3	60.9	64.0	62.3	54.3	42.0	30.0	22.6
23	19.8	22.3	30.1	42.4	53.6	61.1	64.0	62.2	53.9	41.6	29.6	22.4
24	19.8	22.5	30.4	42.8	53.9	61.2	64.1	62.0	53.5	41.1	29.3	22.3
25	19.8	22.6	30.8	43.2	54.2	61.4	64.1	61.8	53.2	40.7	29.0	22.1
26	19.8	22.8	31.2	43.6	54.5	61.5	64.1	61.6	52.8	40.3	28.7	22.0
27	19.8	23.0	31.5	44.1	54.8	61.7	64.1	61.5	52.4	39.9	28.4	21.8
28	19.8	23.2	31.9	44.5	55.1	61.8	64.1	61.3	52.0	39.5	28.1	21.7
29	19.8	23.5	32.3	44.9	55.4	62.0	64.1	61.1	51.6	39.0	27.8	21.5
30	19.9		32.7	45.3	55.7	62.1	64.1	60.9	51.2	38.6	27.5	21.4
31	19.9		33.0		56.0		64.1	60.6		38.2		21.3
AVERAGE	20.2	21.3	27.2	39.3	51.1	59.9	63.5	62.9	56.2	44.6	32.4	23.9

TABLE 6.—MEAN DAILY WIND MOVEMENT AT PAN HEIGHT

DATA ARE FROM 3-TERM HARMONIC CURVE FITTED TO AVERAGE OF 1948-65 DATA LESS 1956, 1957, 1964, AND PERIODS WHEN HAY CUT RESTRICTED PET ESTIMATE.

MILES

DAY	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
1	93.6	93.0	94.9	92.4	82.0	70.0	63.2	59.8	60.3	69.0	83.8	93.1
2	93.6	93.1	94.9	92.1	81.6	69.7	63.1	59.7	60.4	69.4	84.3	93.2
3	93.5	93.1	94.9	91.9	81.1	69.4	62.5	59.7	60.6	69.9	84.7	93.4
4	93.4	93.2	95.0	91.6	80.7	69.1	62.8	59.6	60.7	70.3	85.2	93.5
5	93.4	93.2	95.0	91.4	80.3	68.8	62.7	59.5	60.9	70.8	85.6	93.6
6	93.3	93.3	95.0	91.1	79.9	68.5	62.5	59.5	61.1	71.3	86.0	93.7
7	93.3	93.3	95.0	90.8	79.5	68.3	62.4	59.4	61.3	71.7	86.4	93.8
8	93.2	93.4	95.0	90.5	79.0	68.0	62.3	59.4	61.5	72.2	86.8	93.8
9	93.2	93.5	95.0	90.2	78.6	67.7	62.1	59.3	61.7	72.7	87.2	93.9
10	93.1	93.5	95.0	89.9	78.2	67.5	62.0	59.3	61.9	73.2	87.6	94.0
11	93.1	93.6	95.0	89.6	77.8	67.2	61.9	59.3	62.1	73.6	88.0	94.0
12	93.1	93.7	94.9	89.3	77.4	67.0	61.7	59.3	62.4	74.1	88.3	94.0
13	93.0	93.7	94.9	88.9	77.0	66.7	61.6	59.2	62.6	74.6	88.7	94.1
14	93.0	93.8	94.9	88.6	76.6	66.5	61.5	59.2	62.9	75.1	89.0	94.1
15	93.0	93.9	94.8	88.3	76.2	66.2	61.4	59.2	63.2	75.6	89.3	94.1
16	92.9	94.0	94.7	87.9	75.8	66.0	61.3	59.2	63.5	76.1	89.7	94.1
17	92.9	94.0	94.7	87.5	75.4	65.8	61.2	59.2	63.8	76.6	90.0	94.1
18	92.9	94.1	94.6	87.2	75.0	65.6	61.1	59.2	64.1	77.1	90.3	94.1
19	92.9	94.2	94.5	86.8	74.6	65.4	60.9	59.3	64.4	77.6	90.6	94.1
20	92.9	94.3	94.4	86.4	74.2	65.2	60.8	59.3	64.7	78.1	90.8	94.1
21	92.8	94.3	94.3	86.0	73.8	65.0	60.7	59.3	65.1	78.6	91.1	94.1
22	92.8	94.4	94.1	85.7	73.4	64.8	60.8	59.4	65.4	79.1	91.3	94.1
23	92.8	94.5	94.0	85.3	73.1	64.6	60.5	59.4	65.8	79.5	91.6	94.0
24	92.8	94.5	93.9	84.9	72.7	64.4	60.5	59.5	66.2	80.1	91.8	94.0
25	92.9	94.6	93.7	84.5	72.4	64.2	60.4	59.5	66.5	80.6	92.0	93.9
26	92.9	94.7	93.6	84.0	72.0	64.1	60.3	59.6	66.9	81.0	92.2	93.9
27	92.9	94.7	93.4	83.6	71.7	63.9	60.2	59.7	67.3	81.5	92.4	93.9
28	92.9	94.8	93.2	83.2	71.3	63.7	60.1	59.8	67.7	82.0	92.6	93.8
29	92.9	94.8	93.0	82.8	71.0	63.6	60.0	59.9	68.2	82.5	92.8	93.8
30	93.0		92.8	82.4	70.7	63.4	59.9	60.0	68.6	82.9	92.9	93.7
31	93.0		92.6		70.3		59.9	60.1		83.4		93.7
AVERAGE	93.1	93.9	94.4	87.8	75.9	66.3	61.4	59.5	63.7	76.1	89.1	93.9

TABLE 7.—MEAN DAILY SOIL MOISTURE

DATA ARE FROM 5-TERM HARMONIC CURVE FITTED TO AVERAGE OF 1948–65 DATA
LESS 1956, 1957, 1964, AND PERIODS WHEN HAY CUT RESTRICTED PET ESTIMATE.

INCHES IN TOP 40 INCHES OF LYSIMETER.

DAY	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
1	9.7	11.6	12.2	12.2	10.9	8.5	7.2	6.1	5.3	5.4	5.8	7.3
2	9.8	11.7	12.2	12.2	10.9	8.4	7.2	6.0	5.3	5.4	5.8	7.4
3	9.9	11.7	12.2	12.2	10.8	8.3	7.2	6.0	5.3	5.4	5.9	7.5
4	9.9	11.7	12.2	12.2	10.7	8.3	7.2	6.0	5.3	5.4	5.9	7.5
5	10.0	11.8	12.2	12.2	10.6	8.2	7.1	5.9	5.3	5.4	5.9	7.6
6	10.1	11.8	12.2	12.2	10.5	8.2	7.1	5.9	5.3	5.4	6.0	7.7
7	10.2	11.8	12.2	12.1	10.5	8.1	7.1	5.8	5.3	5.4	6.0	7.8
8	10.2	11.9	12.2	12.1	10.4	8.1	7.0	5.8	5.3	5.4	6.0	7.8
9	10.3	11.9	12.2	12.1	10.3	8.0	7.0	5.8	5.3	5.4	6.1	7.9
10	10.4	11.9	12.2	12.1	10.2	8.0	7.0	5.8	5.3	5.4	6.1	8.0
11	10.5	11.9	12.2	12.0	10.1	7.9	6.9	5.7	5.3	5.4	6.2	8.1
12	10.5	12.0	12.2	12.0	10.0	7.9	6.9	5.7	5.3	5.4	6.2	8.1
13	10.6	12.0	12.2	12.0	9.9	7.8	6.9	5.7	5.3	5.4	6.3	8.2
14	10.7	12.0	12.2	11.9	9.9	7.8	6.8	5.6	5.3	5.5	6.3	8.3
15	10.7	12.0	12.2	11.9	9.8	7.7	6.8	5.6	5.3	5.5	6.4	8.3
16	10.8	12.0	12.2	11.8	9.7	7.7	6.8	5.6	5.3	5.5	6.4	8.4
17	10.9	12.0	12.3	11.8	9.6	7.7	6.7	5.6	5.3	5.5	6.5	8.5
18	10.9	12.1	12.3	11.8	9.5	7.6	6.7	5.5	5.3	5.5	6.5	8.6
19	11.0	12.1	12.3	11.7	9.4	7.6	6.6	5.5	5.3	5.5	6.6	8.7
20	11.0	12.1	12.3	11.7	9.4	7.6	6.6	5.5	5.3	5.5	6.6	8.8
21	11.1	12.1	12.3	11.6	9.3	7.5	6.6	5.5	5.3	5.5	6.7	8.8
22	11.2	12.1	12.3	11.5	9.2	7.5	6.5	5.4	5.3	5.6	6.8	8.9
23	11.2	12.1	12.3	11.5	9.1	7.5	6.5	5.4	5.3	5.6	6.8	9.0
24	11.3	12.1	12.3	11.4	9.0	7.4	6.4	5.4	5.3	5.6	6.9	9.1
25	11.3	12.1	12.3	11.4	9.0	7.4	6.4	5.4	5.3	5.6	6.9	9.2
26	11.4	12.1	12.3	11.3	8.9	7.4	6.4	5.4	5.3	5.6	7.0	9.2
27	11.4	12.2	12.3	11.2	8.8	7.4	6.3	5.4	5.3	5.7	7.1	9.3
28	11.5	12.2	12.3	11.2	8.7	7.3	6.3	5.3	5.3	5.7	7.1	9.4
29	11.5	12.2	12.2	11.1	8.7	7.3	6.2	5.3	5.3	5.7	7.2	9.5
30	11.5		12.2	11.0	8.6	7.3	6.2	5.3	5.3	5.7	7.3	9.5
31	11.6		12.2		8.5		6.1	5.3		5.8		9.6
AVERAGE	10.8	12.0	12.2	11.8	9.7	7.8	6.7	5.6	5.3	5.5	6.4	8.4

TABLE 8.—MEAN DAILY SOLAR RADIATION

DATA ARE FROM 3-TERM HARMONIC CURVE FITTED TO AVERAGE OF 1948-65 DATA
LESS 1956, 1957, 1964, AND PERIODS WHEN HAY CUT RESTRICTED PET ESTIMATE.

LANGLEYS

DAY	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
1	153.	211.	286.	383.	484.	566.	581.	538.	459.	354.	233.	155.
2	154.	213.	289.	386.	490.	568.	581.	536.	456.	350.	229.	154.
3	156.	216.	292.	389.	493.	569.	580.	534.	453.	346.	226.	153.
4	157.	218.	295.	393.	496.	571.	579.	532.	450.	342.	222.	152.
5	158.	220.	297.	396.	499.	572.	578.	530.	447.	338.	219.	150.
6	160.	223.	300.	400.	502.	573.	578.	528.	444.	334.	216.	149.
7	161.	225.	303.	403.	506.	574.	577.	526.	440.	330.	212.	149.
8	163.	228.	306.	407.	509.	576.	576.	523.	437.	326.	209.	148.
9	164.	230.	309.	410.	512.	577.	575.	521.	434.	322.	206.	147.
10	166.	233.	312.	414.	515.	578.	574.	519.	430.	318.	203.	146.
11	167.	235.	315.	417.	518.	579.	573.	516.	427.	314.	200.	146.
12	169.	238.	318.	421.	521.	579.	571.	514.	424.	310.	197.	145.
13	171.	240.	321.	424.	522.	580.	570.	511.	420.	306.	194.	145.
14	173.	243.	324.	428.	526.	581.	569.	509.	417.	302.	191.	145.
15	174.	245.	327.	431.	529.	581.	568.	507.	413.	298.	189.	144.
16	176.	248.	330.	435.	532.	582.	566.	504.	410.	294.	186.	144.
17	178.	251.	334.	438.	534.	582.	565.	501.	406.	290.	183.	144.
18	180.	253.	337.	442.	537.	583.	563.	499.	403.	286.	181.	144.
19	182.	256.	340.	445.	539.	583.	562.	496.	399.	282.	178.	144.
20	184.	259.	343.	449.	542.	583.	560.	494.	395.	278.	176.	145.
21	186.	261.	346.	452.	544.	583.	559.	491.	392.	274.	174.	145.
22	188.	264.	349.	456.	547.	583.	557.	488.	388.	270.	171.	145.
23	190.	267.	353.	459.	549.	583.	555.	485.	384.	266.	169.	146.
24	193.	269.	356.	463.	551.	583.	554.	483.	380.	262.	167.	146.
25	195.	272.	359.	466.	553.	583.	552.	480.	377.	259.	165.	147.
26	197.	275.	362.	470.	555.	583.	550.	477.	373.	255.	163.	148.
27	199.	278.	366.	473.	557.	583.	548.	474.	369.	251.	162.	148.
28	201.	280.	369.	476.	559.	583.	546.	471.	365.	247.	160.	149.
29	204.	283.	372.	480.	561.	582.	544.	468.	361.	244.	158.	150.
30	206.		376.	483.	563.	582.	542.	465.	357.	240.	157.	151.
31	208.		379.		565.		540.	462.		236.		152.
AVERAGE	178.	246.	331.	433.	530.	579.	564.	503.	410.	294.	190.	148.

TABLE 9.--MEAN DAILY NET RADIATION

(SEE TEXT OF PENMAN METHOD IN APPENDIX A FOR DERIVATION)

LANGLEYS

DAY	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
1	20.	67.	120.	181.	244.	318.	332.	304.	235.	150.	65.	29.
2	21.	69.	122.	179.	248.	313.	333.	302.	236.	146.	64.	29.
3	23.	69.	122.	180.	251.	315.	332.	301.	237.	146.	64.	28.
4	23.	71.	125.	183.	251.	316.	331.	299.	234.	142.	62.	27.
5	24.	72.	124.	186.	254.	316.	331.	297.	231.	140.	60.	27.
6	26.	75.	127.	189.	258.	317.	331.	296.	228.	136.	57.	26.
7	27.	76.	129.	192.	259.	319.	331.	294.	226.	133.	56.	27.
8	28.	79.	132.	195.	262.	321.	330.	293.	223.	131.	53.	28.
9	29.	81.	134.	198.	265.	323.	330.	291.	220.	127.	53.	27.
10	31.	83.	134.	195.	268.	322.	329.	290.	216.	123.	50.	26.
11	32.	85.	137.	197.	269.	323.	328.	287.	213.	119.	47.	26.
12	34.	88.	140.	201.	272.	324.	327.	285.	212.	118.	49.	25.
13	35.	89.	139.	203.	274.	325.	327.	282.	208.	114.	47.	25.
14	37.	90.	142.	204.	275.	327.	326.	281.	205.	110.	44.	23.
15	38.	91.	144.	207.	278.	327.	325.	279.	201.	108.	45.	22.
16	39.	94.	147.	211.	281.	328.	324.	276.	198.	105.	42.	22.
17	41.	97.	151.	211.	283.	329.	323.	275.	196.	103.	40.	22.
18	43.	98.	147.	215.	284.	330.	322.	273.	193.	99.	40.	22.
19	44.	101.	150.	217.	286.	331.	321.	270.	189.	96.	37.	22.
20	46.	101.	153.	218.	290.	331.	319.	269.	185.	94.	37.	23.
21	48.	103.	155.	221.	292.	330.	319.	266.	182.	91.	38.	20.
22	49.	103.	157.	225.	295.	330.	317.	263.	180.	87.	35.	20.
23	51.	106.	161.	225.	295.	331.	316.	260.	176.	88.	33.	21.
24	54.	107.	163.	229.	298.	331.	315.	260.	172.	85.	34.	19.
25	53.	110.	166.	230.	300.	332.	315.	257.	169.	84.	32.	20.
26	55.	110.	165.	233.	302.	332.	314.	254.	165.	81.	30.	21.
27	56.	113.	166.	236.	302.	332.	312.	252.	163.	79.	32.	18.
28	58.	114.	169.	237.	304.	332.	310.	249.	159.	76.	30.	19.
29	61.	117.	172.	240.	307.	332.	309.	246.	155.	73.	28.	18.
30	62.		175.	243.	309.	333.	307.	243.	151.	69.	27.	18.
31	64.		177.		311.		306.	241.		68.		19.
AVERAGE	40.	92.	147.	209.	280.	326.	322.	271.	195.	107.	44.	23.

TABLE   10.—MEAN DAILY PERCENT OF POSSIBLE SUNSHINE

DAY	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
1	38.	39.	43.	47.	56.	64.	67.	66.	62.	56.	46.	35.
2	38.	39.	43.	47.	56.	64.	67.	66.	62.	56.	45.	35.
3	38.	40.	44.	46.	56.	64.	67.	66.	62.	56.	45.	35.
4	38.	40.	44.	43.	57.	64.	67.	66.	62.	56.	44.	35.
5	38.	40.	44.	48.	57.	65.	67.	66.	62.	55.	44.	34.
6	38.	40.	44.	46.	57.	65.	67.	66.	62.	55.	44.	34.
7	38.	40.	44.	48.	58.	65.	67.	66.	61.	55.	43.	34.
8	38.	40.	44.	48.	58.	65.	67.	65.	61.	54.	43.	33.
9	38.	40.	44.	48.	58.	65.	67.	65.	61.	54.	42.	33.
10	38.	40.	45.	49.	58.	66.	67.	65.	61.	54.	42.	33.
11	38.	40.	45.	49.	59.	66.	67.	65.	61.	54.	42.	33.
12	38.	40.	45.	49.	59.	66.	67.	65.	60.	53.	41.	33.
13	38.	40.	45.	49.	59.	66.	67.	65.	60.	53.	41.	33.
14	38.	41.	45.	50.	60.	66.	67.	65.	60.	53.	41.	34.
15	38.	41.	45.	50.	60.	66.	67.	65.	60.	52.	40.	34.
16	38.	41.	45.	50.	60.	66.	67.	65.	60.	52.	40.	34.
17	38.	41.	45.	51.	60.	66.	67.	64.	59.	51.	40.	34.
18	38.	41.	46.	51.	61.	66.	67.	64.	59.	51.	39.	34.
19	38.	41.	46.	51.	61.	66.	67.	64.	59.	51.	39.	34.
20	38.	41.	46.	52.	61.	66.	67.	64.	59.	50.	39.	34.
21	38.	41.	46.	52.	61.	67.	67.	64.	59.	50.	38.	35.
22	38.	42.	46.	52.	61.	67.	67.	64.	58.	50.	38.	35.
23	38.	42.	46.	53.	62.	67.	67.	64.	58.	49.	38.	35.
24	38.	42.	46.	53.	62.	67.	67.	63.	58.	-9.	37.	36.
25	39.	42.	46.	54.	62.	67.	66.	63.	58.	48.	37.	36.
26	39.	43.	46.	54.	62.	67.	66.	63.	58.	48.	37.	36.
27	39.	43.	47.	54.	63.	67.	66.	63.	57.	47.	36.	37.
28	39.	43.	47.	55.	63.	67.	66.	63.	57.	47.	36.	37.
29	39.	43.	47.	55.	63.	67.	66.	63.	57.	47.	36.	38.
30	39.		47.	55.	63.	67.	66.	63.	57.	47.	36.	38.
31	39.		47.		63.		66.	62.		46.		38.
AVERAGE	38.	4..	45.	51.	51.	66.	67.	64.	62.	52.	40.	35.

TABLE 11.—MEAN DAILY RELATIVE HUMIDITY

PERCENT

DAY	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
1	78.	73.	71.	69.	68.	73.	74.	73.	75.	72.	71.	77.
2	78.	73.	71.	69.	69.	74.	74.	73.	75.	72.	71.	78.
3	77.	73.	72.	69.	69.	74.	74.	73.	75.	72.	71.	78.
4	77.	72.	72.	69.	69.	74.	74.	73.	75.	72.	71.	78.
5	77.	72.	72.	69.	69.	74.	74.	73.	75.	72.	71.	78.
6	76.	72.	72.	69.	69.	74.	74.	73.	75.	72.	72.	78.
7	76.	72.	72.	69.	69.	74.	74.	73.	75.	72.	72.	78.
8	76.	72.	72.	68.	69.	74.	74.	73.	75.	71.	72.	78.
9	76.	72.	71.	68.	69.	74.	74.	73.	75.	71.	72.	78.
10	76.	72.	71.	68.	70.	74.	73.	73.	75.	71.	72.	78.
11	76.	72.	71.	68.	70.	74.	73.	73.	75.	71.	72.	78.
12	76.	72.	71.	68.	70.	74.	73.	73.	75.	71.	72.	79.
13	76.	72.	71.	68.	70.	75.	73.	74.	75.	71.	72.	79.
14	76.	72.	71.	68.	70.	75.	73.	74.	74.	71.	73.	79.
15	75.	72.	71.	68.	70.	75.	73.	74.	74.	71.	74.	79.
16	75.	72.	71.	68.	71.	75.	73.	74.	74.	71.	74.	79.
17	75.	72.	71.	68.	71.	75.	73.	74.	74.	71.	74.	79.
18	75.	72.	71.	68.	71.	75.	73.	74.	74.	71.	74.	79.
19	75.	72.	70.	68.	71.	75.	73.	74.	74.	71.	74.	79.
20	75.	72.	70.	68.	71.	75.	73.	74.	74.	71.	75.	79.
21	74.	72.	70.	68.	71.	75.	73.	74.	73.	71.	75.	79.
22	74.	72.	70.	68.	72.	75.	73.	74.	73.	70.	75.	79.
23	74.	72.	70.	68.	72.	75.	73.	74.	74.	70.	75.	79.
24	74.	72.	70.	68.	72.	75.	73.	74.	73.	70.	75.	79.
25	74.	72.	70.	68.	72.	75.	73.	74.	73.	70.	75.	79.
26	73.	72.	70.	68.	72.	75.	73.	74.	73.	71.	75.	79.
27	73.	72.	70.	68.	73.	75.	73.	74.	73.	71.	76.	79.
28	73.	72.	70.	68.	73.	75.	73.	75.	73.	71.	77.	79.
29	73.	72.	70.	68.	73.	75.	73.	75.	73.	71.	77.	78.
30	73.		69.	68.	73.	74.	73.	75.	72.	71.	77.	78.
31	73.		69.		73.		73.	75.		71.		78.
AVERAGE	75.	72.	71.	68.	71.	75.	73.	74.	74.	71.	74	79.

TABLE 12.—DAILY VALUES OF ALBEDO FOR MEADOW

BY INTERPOLATION IN TABLE OF MONTHLY AVERAGE ALBEDO OF MEADOWLAND NEAR VIENNA. IN GEIGER (12), TABLE 5, PAGE 16.

DAY	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
1	13.	13.	14.	18.	20.	20.	20.	20.	20.	19.	17.	13.
2	13.	13.	14.	19.	20.	20.	20.	20.	20.	19.	17.	13.
3	13.	13.	14.	19.	20.	20.	20.	20.	19.	18.	16.	13.
4	13.	13.	14.	19.	20.	20.	20.	20.	19.	18.	16.	13.
5	13.	13.	15.	19.	20.	20.	20.	20.	19.	18.	16.	13.
6	13.	13.	15.	19.	20.	20.	20.	20.	19.	18.	16.	13.
7	13.	13.	15.	19.	20.	20.	20.	20.	19.	18.	16.	13.
8	13.	13.	15.	19.	20.	20.	20.	20.	19.	18.	16.	13.
9	13.	13.	15.	19.	20.	20.	20.	20.	19.	18.	16.	13.
10	13.	13.	15.	20.	20.	20.	20.	20.	19.	18.	16.	13.
11	13.	13.	15.	20.	20.	20.	20.	20.	19.	18.	16.	13.
12	13.	13.	15.	20.	20.	20.	20.	20.	19.	18.	15.	13.
13	13.	13.	16.	20.	20.	20.	20.	20.	19.	18.	15.	13.
14	13.	13.	16.	20.	20.	20.	20.	20.	19.	18.	15.	13.
15	13.	13.	16.	20.	20.	20.	20.	20.	19.	18.	15.	13.
16	13.	13.	16.	20.	20.	20.	20.	20.	19.	18.	15.	13.
17	13.	13.	16.	20.	20.	20.	20.	20.	19.	18.	15.	13.
18	13.	13.	17.	20.	20.	20.	20.	20.	19.	18.	15.	13.
19	13.	13.	17.	20.	20.	20.	20.	20.	19.	18.	15.	13.
20	13.	14.	17.	20.	20.	20.	20.	20.	19.	18.	14.	13.
21	13.	14.	17.	20.	20.	20.	20.	20.	19.	18.	14.	13.
22	13.	14.	17.	20.	20.	20.	20.	20.	19.	18.	14.	13.
23	13.	14.	17.	20.	20.	20.	20.	20.	19.	17.	14.	13.
24	13.	14.	17.	20.	20.	20.	20.	20.	19.	17.	14.	13.
25	13.	14.	17.	20.	20.	20.	20.	20.	19.	17.	14.	13.
26	13.	14.	18.	20.	20.	20.	20.	20.	19.	17.	14.	13.
27	13.	14.	18.	20.	20.	20.	20.	20.	19.	17.	14.	13.
28	13.	14.	18.	20.	20.	20.	20.	20.	19.	17.	14.	13.
29	13.	14.	18.	20.	20.	20.	20.	20.	19.	17.	14.	13.
30	13.		18.	20.	20.	20.	20.	20.	19.	17.	14.	13.
31	13.		18.		20.		20.	20.		17.		13.
AVERAGE	13.	13.	16.	20.	20.	20.	20.	20.	19.	18.	15.	13.

TABLE 13.—DAILY EXTRA-TERRESTRIAL RADIATION

AT 40 DEGREES NORTH LATITUDE

INCHES OF EVAPORATION EQUIVALENT

DAY	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
1	.214	.285	.398	.501	.585	.656	.663	.613	.536	.423	.316	.233
2	.214	.289	.392	.503	.588	.658	.661	.610	.534	.419	.313	.231
3	.215	.293	.395	.505	.591	.660	.659	.607	.531	.415	.310	.229
4	.216	.298	.399	.507	.594	.661	.658	.604	.529	.411	.307	.227
5	.217	.303	.403	.509	.597	.663	.657	.602	.527	.407	.303	.226
6	.219	.308	.407	.511	.600	.664	.656	.599	.524	.403	.300	.224
7	.220	.313	.411	.513	.603	.664	.655	.596	.521	.399	.297	.222
8	.222	.318	.414	.516	.606	.665	.653	.593	.518	.395	.294	.220
9	.223	.322	.418	.518	.609	.665	.652	.591	.515	.391	.291	.218
10	.225	.327	.421	.521	.612	.666	.651	.589	.512	.387	.288	.216
11	.227	.331	.425	.524	.615	.667	.650	.586	.509	.383	.285	.215
12	.229	.335	.429	.527	.618	.668	.645	.584	.506	.379	.282	.214
13	.231	.338	.432	.530	.620	.669	.648	.583	.502	.375	.278	.212
14	.233	.342	.436	.533	.622	.670	.646	.582	.498	.371	.275	.212
15	.235	.345	.440	.536	.625	.670	.645	.580	.494	.367	.272	.212
16	.237	.348	.444	.539	.627	.671	.643	.578	.491	.363	.269	.211
17	.239	.351	.448	.542	.629	.671	.641	.576	.487	.359	.265	.211
18	.241	.354	.452	.546	.631	.672	.639	.574	.483	.355	.262	.211
19	.243	.357	.456	.550	.633	.672	.637	.572	.479	.351	.259	.210
20	.245	.360	.460	.554	.635	.672	.636	.570	.474	.348	.256	.210
21	.248	.363	.463	.557	.637	.672	.634	.568	.469	.345	.253	.210
22	.251	.367	.467	.560	.639	.672	.632	.565	.464	.342	.250	.210
23	.254	.370	.471	.563	.641	.672	.630	.563	.460	.340	.248	.210
24	.257	.373	.475	.566	.643	.672	.628	.560	.456	.338	.246	.211
25	.260	.376	.478	.569	.645	.671	.626	.557	.451	.335	.244	.211
26	.262	.379	.481	.572	.646	.670	.624	.554	.446	.332	.242	.212
27	.265	.382	.485	.574	.647	.669	.622	.551	.441	.329	.241	.212
28	.269	.384	.488	.576	.649	.667	.620	.548	.437	.326	.239	.213
29	.273	.386	.491	.579	.651	.666	.618	.545	.432	.324	.237	.213
30	.277		.494	.582	.653	.665	.617	.542	.427	.321	.235	.214
31	.281		.498		.654		.615	.535		.319		.214
AVERAGE	.240	.341	.444	.539	.624	.667	.641	.577	.488	.366	.272	.216

TABLE 14.—DAILY VALUES OF DAY LENGTH

FROM MARVIN'S (29) SUNSHINE TABLES FOR LATITUDE 40 NORTH.

HOURS

DAY	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
1	9.4	10.2	11.3	12.7	13.9	14.8	15.0	14.3	13.1	11.8	10.5	9.5
2	9.4	10.2	11.4	12.7	13.9	14.8	15.0	14.2	13.0	11.7	10.4	9.5
3	9.4	10.2	11.4	12.8	14.0	14.9	14.9	14.2	13.0	11.7	10.4	9.5
4	9.4	10.3	11.4	12.8	14.0	14.9	14.9	14.2	13.0	11.6	10.4	9.5
5	9.4	10.3	11.5	12.8	14.0	14.9	14.9	14.1	12.9	11.6	10.3	9.5
6	9.5	10.4	11.5	12.9	14.1	14.9	14.9	14.1	12.9	11.6	10.3	9.5
7	9.5	10.4	11.6	12.9	14.1	14.9	14.9	14.1	12.8	11.5	10.3	9.4
8	9.5	10.4	11.6	13.0	14.2	14.9	14.9	14.0	12.8	11.5	10.2	9.4
9	9.5	10.5	11.7	13.0	14.2	14.9	14.9	14.0	12.7	11.4	10.2	9.4
10	9.5	10.5	11.7	13.1	14.2	15.0	14.8	14.0	12.7	11.4	10.1	9.4
11	9.6	10.6	11.7	13.1	14.3	15.0	14.8	13.9	12.6	11.4	10.1	9.4
12	9.6	10.6	11.8	13.1	14.3	15.0	14.8	13.9	12.6	11.3	10.1	9.4
13	9.6	10.6	11.8	13.2	14.3	15.0	14.8	13.8	12.6	11.2	10.0	9.4
14	9.6	10.7	11.9	13.2	14.4	15.0	14.8	13.8	12.5	11.2	10.0	9.4
15	9.7	10.7	11.9	13.3	14.4	15.0	14.7	13.8	12.5	11.2	10.0	9.3
16	9.7	10.8	12.0	13.3	14.4	15.0	14.7	13.7	12.4	11.1	9.9	9.3
17	9.7	10.8	12.0	13.4	14.4	15.0	14.7	13.7	12.4	11.1	9.9	9.3
18	9.7	10.8	12.1	13.4	14.5	15.0	14.7	13.6	12.3	11.0	9.9	9.3
19	9.8	10.9	12.1	13.4	14.5	15.0	14.6	13.6	12.3	11.0	9.8	9.3
20	9.8	10.9	12.1	13.5	14.5	15.0	14.6	13.6	12.2	11.0	9.8	9.3
21	9.8	11.0	12.2	13.5	14.6	15.0	14.6	13.5	12.2	10.9	9.8	9.3
22	9.8	11.0	12.2	13.6	14.6	15.0	14.6	13.5	12.2	10.9	9.8	9.3
23	9.9	11.0	12.3	13.6	14.6	15.0	14.5	13.4	12.1	10.8	9.7	9.3
24	9.9	11.1	12.3	13.6	14.6	15.0	14.5	13.4	12.1	10.8	9.7	9.3
25	9.9	11.1	12.4	13.7	14.7	15.0	14.5	13.4	12.0	10.8	9.7	9.3
26	10.0	11.2	12.4	13.7	14.7	15.0	14.4	13.3	12.0	10.7	9.7	9.3
27	10.0	11.2	12.5	13.8	14.7	15.0	14.4	13.3	12.0	10.7	9.6	9.3
28	10.0	11.3	12.5	13.8	14.7	15.0	14.4	13.2	11.9	10.6	9.6	9.3
29	10.1	11.3	12.5	13.9	14.8	15.0	14.4	13.2	11.9	10.6	9.6	9.4
30	10.1		12.6	13.9	14.8	15.0	14.3	13.2	11.8	10.6	9.6	9.4
31	10.1		12.6		14.8		14.3	13.1		10.5		9.4
AVERAGE	9.7	10.7	12.0	13.3	14.4	15.0	14.7	13.7	12.4	11.1	10.0	9.4

TABLE 15.--DIFFERENCES BETWEEN DAILY MAXIMUM AND MEAN AIR TEMPERATURES

DATA ARE FROM 3-TERM HARMONIC CURVE FITTED TO AVERAGE OF 1948-65 DATA
LESS 1956, 1957, 1964, AND PERIODS WHEN HAY CUT RESTRICTED PET ESTIMATE

DEGREES FAHRENHEIT

DAY	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
1	6.8	7.4	8.1	9.1	10.2	10.6	10.2	10.1	10.7	10.5	8.9	7.2
2	6.8	7.4	8.1	9.1	10.2	10.6	10.2	10.1	10.7	10.5	8.8	7.2
3	6.8	7.4	8.2	9.2	10.2	10.6	10.2	10.2	10.7	10.4	8.8	7.1
4	6.8	7.5	8.2	9.2	10.2	10.6	10.2	10.2	10.7	10.4	8.7	7.1
5	6.8	7.5	8.2	9.2	10.3	10.6	10.2	10.2	10.7	10.4	8.6	7.1
6	6.8	7.5	8.3	9.3	10.3	10.6	10.2	10.2	10.7	10.3	8.6	7.0
7	6.9	7.5	8.3	9.3	10.3	10.6	10.2	10.2	10.7	10.3	8.5	7.0
8	6.9	7.6	8.3	9.3	10.3	10.6	10.1	10.2	10.7	10.2	8.4	7.0
9	6.9	7.6	8.3	9.4	10.4	10.5	10.1	10.2	10.7	10.2	8.4	7.0
10	6.9	7.6	8.4	9.4	10.4	10.5	10.1	10.3	10.7	10.2	8.3	6.9
11	6.9	7.6	8.4	9.5	10.4	10.5	10.1	10.3	10.8	10.1	8.2	6.9
12	6.9	7.7	8.4	9.5	10.4	10.5	10.1	10.3	10.8	10.1	8.2	6.9
13	7.0	7.7	8.5	9.5	10.4	10.5	10.1	10.3	10.8	10.0	8.1	6.9
14	7.0	7.7	8.5	9.6	10.5	10.5	10.1	10.3	10.8	10.0	8.1	6.8
15	7.0	7.7	8.5	9.6	10.5	10.5	10.1	10.3	10.8	9.9	8.0	6.8
16	7.0	7.8	8.5	9.6	10.5	10.5	10.1	10.4	10.7	9.9	7.9	6.8
17	7.0	7.8	8.6	9.7	10.5	10.4	10.1	10.4	10.7	9.8	7.9	6.8
18	7.1	7.8	8.6	9.7	10.5	10.4	10.1	10.4	10.7	9.7	7.8	6.8
19	7.1	7.8	8.6	9.8	10.5	10.4	10.1	10.4	10.7	9.7	7.8	6.8
20	7.1	7.9	8.7	9.8	10.6	10.4	10.1	10.4	10.7	9.6	7.7	6.8
21	7.1	7.9	8.7	9.8	10.6	10.4	10.1	10.5	10.7	9.6	7.7	6.8
22	7.2	7.9	8.7	9.9	10.6	10.4	10.1	10.5	10.7	9.5	7.6	6.8
23	7.2	7.9	8.8	9.9	10.6	10.4	10.1	10.5	10.7	9.5	7.6	6.8
24	7.2	8.0	8.8	9.9	10.6	10.3	10.1	10.5	10.7	9.4	7.5	6.8
25	7.2	8.0	8.8	10.0	10.6	10.3	10.1	10.5	10.6	9.3	7.5	6.8
26	7.2	8.0	8.9	10.0	10.6	10.3	10.1	10.6	10.6	9.3	7.4	6.8
27	7.3	8.0	8.9	10.0	10.6	10.3	10.1	10.6	10.6	9.2	7.4	6.8
28	7.3	8.1	8.9	10.1	10.6	10.3	10.1	10.6	10.6	9.1	7.3	6.8
29	7.3	8.1	9.0	10.1	10.6	10.3	10.1	10.6	10.5	9.1	7.3	6.8
30	7.3		9.0	10.1	10.6	10.2	10.1	10.6	10.5	9.0	7.2	6.8
31	7.4		9.0		10.6		10.1	10.6		8.9		6.8
AVERAGE	7.0	7.7	8.6	9.6	10.5	10.5	10.1	10.4	10.7	9.8	8.0	6.9

TABLE 16.--DAILY VALUES OF BLANEY-CRIDDLE CROP GROWTH STAGE COEFFICIENTS

FROM ALFALFA CURVE, FIGURE 2, IN SCS TECH. RELEASE NO. 21 (44)

DAY	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
1	0.60	0.68	0.80	0.93	1.04	1.12	1.12	1.09	1.03	0.96	0.86	0.70
2	0.60	0.68	0.80	0.94	1.05	1.12	1.12	1.08	1.03	0.96	0.85	0.70
3	0.60	0.69	0.81	0.94	1.05	1.12	1.12	1.08	1.03	0.96	0.85	0.69
4	0.60	0.69	0.81	0.94	1.05	1.12	1.12	1.08	1.03	0.95	0.84	0.69
5	0.60	0.69	0.82	0.95	1.05	1.12	1.12	1.08	1.02	0.95	0.84	0.68
6	0.61	0.70	0.82	0.95	1.06	1.12	1.12	1.08	1.02	0.95	0.83	0.68
7	0.61	0.70	0.82	0.96	1.06	1.13	1.12	1.08	1.02	0.94	0.83	0.67
8	0.61	0.70	0.83	0.96	1.06	1.13	1.12	1.08	1.02	0.94	0.82	0.67
9	0.61	0.71	0.83	0.97	1.07	1.13	1.12	1.07	1.02	0.94	0.82	0.67
10	0.61	0.71	0.84	0.97	1.07	1.13	1.12	1.07	1.01	0.94	0.81	0.66
11	0.62	0.72	0.84	0.97	1.07	1.13	1.12	1.07	1.01	0.93	0.81	0.66
12	0.62	0.72	0.85	0.98	1.08	1.13	1.12	1.07	1.01	0.93	0.80	0.66
13	0.62	0.72	0.85	0.98	1.08	1.13	1.11	1.07	1.01	0.93	0.79	0.65
14	0.62	0.73	0.85	0.98	1.08	1.13	1.11	1.07	1.00	0.92	0.79	0.65
15	0.63	0.73	0.86	0.99	1.08	1.13	1.11	1.06	1.00	0.92	0.78	0.64
16	0.63	0.74	0.86	0.99	1.09	1.13	1.11	1.06	1.00	0.92	0.77	0.64
17	0.63	0.74	0.87	0.99	1.09	1.13	1.11	1.06	1.00	0.91	0.77	0.64
18	0.63	0.74	0.87	1.00	1.09	1.13	1.11	1.06	0.99	0.91	0.76	0.64
19	0.64	0.75	0.88	1.00	1.09	1.13	1.11	1.06	0.99	0.91	0.75	0.63
20	0.64	0.75	0.88	1.01	1.10	1.13	1.10	1.06	0.99	0.90	0.75	0.63
21	0.64	0.76	0.89	1.01	1.10	1.13	1.10	1.05	0.99	0.90	0.74	0.62
22	0.64	0.76	0.89	1.01	1.10	1.13	1.10	1.05	0.99	0.90	0.74	0.62
23	0.65	0.77	0.89	1.02	1.10	1.13	1.10	1.05	0.98	0.89	0.73	0.62
24	0.65	0.77	0.90	1.02	1.10	1.13	1.10	1.05	0.98	0.89	0.73	0.62
25	0.65	0.77	0.90	1.02	1.11	1.13	1.10	1.05	0.98	0.88	0.72	0.61
26	0.66	0.78	0.90	1.03	1.11	1.13	1.09	1.04	0.97	0.88	0.72	0.61
27	0.66	0.78	0.91	1.03	1.11	1.13	1.09	1.04	0.97	0.88	0.71	0.61
28	0.66	0.79	0.92	1.03	1.11	1.13	1.09	1.04	0.97	0.87	0.71	0.60
29	0.67	0.79	0.92	1.04	1.11	1.13	1.09	1.04	0.97	0.87	0.71	0.60
30	0.67		0.92	1.04	1.11	1.13	1.09	1.04	0.96	0.86	0.70	0.60
31	0.68		0.93		1.12		1.09	1.03		0.86		0.60
AVERAGE	0.63	0.73	0.86	0.99	1.08	1.13	1.11	1.06	1.00	0.91	0.78	0.64

TABLE 17.—DAILY VALUES REPLACING CHRISTIANSEN'S MONTHLY COEFFICIENTS

VALUES OBTAINED BY INTERPOLATION AND EXTRAPOLATION OF CHRISTIANSEN'S
MEAN MONTHLY COEFFICIENTS FOR INDIANA

DAY	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
1	1.12	1.04	.96	.89	.89	.87	.87	.89	.95	1.04	1.10	1.15
2	1.12	1.04	.96	.89	.88	.87	.87	.89	.95	1.04	1.11	1.15
3	1.12	1.03	.96	.89	.88	.87	.88	.89	.96	1.04	1.11	1.15
4	1.11	1.03	.96	.89	.88	.87	.88	.89	.96	1.04	1.11	1.15
5	1.11	1.03	.95	.89	.88	.87	.88	.89	.96	1.05	1.12	1.15
6	1.11	1.02	.95	.89	.88	.87	.88	.85	.96	1.05	1.12	1.15
7	1.11	1.02	.95	.89	.88	.87	.88	.90	.97	1.05	1.12	1.15
8	1.10	1.02	.95	.89	.88	.87	.88	.90	.97	1.05	1.12	1.16
9	1.10	1.02	.94	.89	.88	.87	.88	.90	.97	1.06	1.12	1.16
10	1.10	1.02	.94	.89	.88	.87	.88	.90	.98	1.06	1.13	1.16
11	1.10	1.01	.94	.89	.88	.87	.88	.90	.98	1.06	1.13	1.16
12	1.09	1.01	.94	.89	.88	.87	.88	.90	.98	1.06	1.13	1.16
13	1.09	1.01	.93	.89	.88	.87	.88	.90	.98	1.07	1.13	1.16
14	1.09	1.01	.93	.89	.88	.87	.88	.91	.99	1.07	1.13	1.16
15	1.09	1.00	.93	.89	.88	.87	.88	.91	.99	1.07	1.13	1.16
16	1.08	1.00	.93	.89	.88	.87	.88	.91	.99	1.07	1.13	1.16
17	1.08	1.00	.93	.89	.88	.87	.88	.91	1.00	1.07	1.13	1.16
18	1.08	1.00	.92	.89	.88	.87	.88	.92	1.00	1.08	1.14	1.16
19	1.08	.99	.92	.89	.88	.87	.88	.92	1.00	1.08	1.14	1.16
20	1.07	.99	.92	.89	.88	.87	.88	.92	1.01	1.08	1.14	1.16
21	1.07	.99	.92	.89	.88	.87	.88	.92	1.01	1.08	1.14	1.16
22	1.07	.99	.92	.89	.88	.87	.88	.92	1.01	1.08	1.14	1.16
23	1.07	.98	.91	.89	.88	.87	.88	.93	1.01	1.09	1.14	1.17
24	1.06	.98	.91	.89	.88	.87	.88	.93	1.02	1.09	1.14	1.17
25	1.06	.98	.91	.89	.87	.87	.88	.93	1.02	1.09	1.14	1.17
26	1.06	.97	.91	.89	.87	.87	.89	.94	1.02	1.09	1.14	1.17
27	1.05	.97	.91	.89	.87	.87	.89	.94	1.02	1.09	1.15	1.17
28	1.05	.97	.91	.89	.87	.87	.89	.94	1.03	1.09	1.15	1.17
29	1.05	.97	.91	.89	.87	.87	.89	.94	1.03	1.10	1.15	1.17
30	1.05		.90	.89	.87	.87	.89	.94	1.03	1.10	1.15	1.17
31	1.04		.90		.87		.89	.95		1.10		1.17
AVG.	1.08	1.00	.93	.89	.88	.87	.88	.91	.99	1.07	1.13	1.16

TABLE 18.--DELTA / GAMMA DIMENSIONLESS VS. TEMPERATURE IN DEGREES CELSIUS FURNISHED BY U.S. WATER CONSERVATION LABORATORY, USDA, ARS, SWC, PHOENIX, ARIZ.

TC	D/G	TC	D/G	TC	D/G	TC	D/G	TC	D/G	TC	D/G
-5.0	.487	-2.0	.592	1.0	.716	4.0	.862	7.0	1.033	10.0	1.232
-4.9	.491	-1.9	.596	1.1	.721	4.1	.868	7.1	1.039	10.1	1.239
-4.8	.494	-1.8	.599	1.2	.725	4.2	.873	7.2	1.045	10.2	1.246
-4.7	.497	-1.7	.603	1.3	.730	4.3	.878	7.3	1.052	10.3	1.254
-4.6	.501	-1.6	.607	1.4	.735	4.4	.884	7.4	1.058	10.4	1.261
-4.5	.504	-1.5	.611	1.5	.739	4.5	.889	7.5	1.064	10.5	1.268
-4.4	.508	-1.4	.615	1.6	.744	4.6	.895	7.6	1.071	10.6	1.275
-4.3	.511	-1.3	.618	1.7	.748	4.7	.900	7.7	1.077	10.7	1.283
-4.2	.514	-1.2	.623	1.8	.753	4.8	.905	7.8	1.083	10.8	1.290
-4.1	.517	-1.1	.627	1.9	.758	4.9	.911	7.9	1.090	10.9	1.297
-4.0	.520	-1.0	.631	2.0	.762	5.0	.916	8.0	1.096	11.0	1.305
-3.9	.524	-0.9	.635	2.1	.767	5.1	.922	8.1	1.102	11.1	1.312
-3.8	.527	-0.8	.639	2.2	.772	5.2	.928	8.2	1.109	11.2	1.320
-3.7	.531	-0.7	.643	2.3	.777	5.3	.933	8.3	1.116	11.3	1.328
-3.6	.534	-0.6	.647	2.4	.782	5.4	.939	8.4	1.122	11.4	1.335
-3.5	.537	-0.5	.651	2.5	.787	5.5	.945	8.5	1.129	11.5	1.343
-3.4	.541	-0.4	.655	2.6	.791	5.6	.950	8.6	1.136	11.6	1.351
-3.3	.544	-0.3	.660	2.7	.796	5.7	.956	8.7	1.142	11.7	1.359
-3.2	.548	-0.2	.664	2.8	.801	5.8	.962	8.8	1.149	11.8	1.366
-3.1	.551	-0.1	.668	2.9	.806	5.9	.967	8.9	1.155	11.9	1.374
-3.0	.555	0.0	.672	3.0	.811	6.0	.973	9.0	1.162	12.0	1.382
-2.9	.558	0.1	.677	3.1	.816	6.1	.979	9.1	1.169	12.1	1.390
-2.8	.562	0.2	.681	3.2	.821	6.2	.985	9.2	1.176	12.2	1.398
-2.7	.566	0.3	.686	3.3	.826	6.3	.991	9.3	1.183	12.3	1.406
-2.6	.569	0.4	.690	3.4	.831	6.4	.997	9.4	1.190	12.4	1.414
-2.5	.573	0.5	.694	3.5	.837	6.5	1.003	9.5	1.197	12.5	1.422
-2.4	.577	0.6	.699	3.6	.842	6.6	1.009	9.6	1.204	12.6	1.430
-2.3	.580	0.7	.703	3.7	.847	6.7	1.015	9.7	1.211	12.7	1.438
-2.2	.584	0.8	.707	3.8	.852	6.8	1.021	9.8	1.218	12.8	1.446
-2.1	.588	0.9	.712	3.9	.857	6.9	1.027	9.9	1.225	12.9	1.454

TABLE 18 CONT.

TC	C/G	TC	C/G	TC	C/G	TC	D/G	TC	D/G	TC	D/G
13.0	1.462	16.0	1.727	19.0	2.033	22.0	2.382	25.0	2.781	28.0	3.232
13.1	1.470	16.1	1.737	19.1	2.044	22.1	2.395	25.1	2.795	28.1	3.249
13.2	1.479	16.2	1.747	19.2	2.055	22.2	2.408	25.2	2.809	28.2	3.265
13.3	1.487	16.3	1.757	19.3	2.066	22.3	2.420	25.3	2.824	28.3	3.281
13.4	1.496	16.4	1.766	19.4	2.078	22.4	2.433	25.4	2.838	28.4	3.298
13.5	1.504	16.5	1.776	19.5	2.089	22.5	2.446	25.5	2.853	28.5	3.314
13.6	1.513	16.6	1.786	19.6	2.100	22.6	2.459	25.6	2.867	28.6	3.330
13.7	1.521	16.7	1.796	19.7	2.111	22.7	2.471	25.7	2.882	28.7	3.347
13.8	1.529	16.8	1.805	19.8	2.122	22.8	2.484	25.8	2.896	28.8	3.363
13.9	1.538	16.9	1.815	19.9	2.133	22.9	2.497	25.9	2.910	28.9	3.380
14.0	1.546	17.0	1.825	20.0	2.145	23.0	2.509	26.0	2.925	29.0	3.396
14.1	1.555	17.1	1.835	20.1	2.156	23.1	2.523	26.1	2.940	29.1	3.413
14.2	1.564	17.2	1.845	20.2	2.168	23.2	2.536	26.2	2.955	29.2	3.430
14.3	1.573	17.3	1.856	20.3	2.179	23.3	2.549	26.3	2.970	29.3	3.447
14.4	1.582	17.4	1.866	20.4	2.191	23.4	2.563	26.4	2.985	29.4	3.464
14.5	1.591	17.5	1.876	20.5	2.203	23.5	2.576	26.5	3.000	29.5	3.481
14.6	1.600	17.6	1.886	20.6	2.214	23.6	2.589	26.6	3.015	29.6	3.498
14.7	1.609	17.7	1.896	20.7	2.226	23.7	2.602	26.7	3.030	29.7	3.515
14.8	1.618	17.8	1.906	20.8	2.237	23.8	2.616	26.8	3.046	29.8	3.532
14.9	1.627	17.9	1.917	20.9	2.249	23.9	2.629	26.9	3.061	29.9	3.549
15.0	1.635	18.0	1.927	21.0	2.261	24.0	2.642	27.0	3.076	30.0	3.566
15.1	1.645	18.1	1.937	21.1	2.273	24.1	2.656	27.1	3.091	30.1	3.584
15.2	1.654	18.2	1.948	21.2	2.285	24.2	2.670	27.2	3.107	30.2	3.602
15.3	1.663	18.3	1.959	21.3	2.297	24.3	2.684	27.3	3.123	30.3	3.620
15.4	1.672	18.4	1.969	21.4	2.309	24.4	2.698	27.4	3.138	30.4	3.638
15.5	1.681	18.5	1.980	21.5	2.321	24.5	2.711	27.5	3.154	30.5	3.656
15.6	1.691	18.6	1.990	21.6	2.334	24.6	2.725	27.6	3.170	30.6	3.674
15.7	1.700	18.7	2.001	21.7	2.346	24.7	2.739	27.7	3.185	30.7	3.692
15.8	1.709	18.8	2.012	21.8	2.358	24.8	2.753	27.8	3.201	30.8	3.710
15.9	1.718	18.9	2.022	21.9	2.370	24.9	2.767	27.9	3.217	30.9	3.727

TABLE 18 CONT.

TC	C/G	TC	C/G	TC	C/G	TC	D/G	TC	D/G	TC	D/G
31.0	3.745	33.5	4.222	36.0	4.746	38.5	5.325	41.0	5.958	43.5	6.654
31.1	3.764	33.6	4.242	36.1	4.768	38.6	5.349	41.1	5.985	43.6	6.683
31.2	3.782	33.7	4.262	36.2	4.791	38.7	5.373	41.2	6.012	43.7	6.713
31.3	3.801	33.8	4.282	36.3	4.813	38.8	5.397	41.3	6.039	43.8	6.742
31.4	3.819	33.9	4.302	36.4	4.836	38.9	5.421	41.4	6.066	43.9	6.771
31.5	3.838	34.0	4.322	36.5	4.858	39.0	5.445	41.5	6.093	44.0	6.800
31.6	3.856	34.1	4.343	36.6	4.881	39.1	5.470	41.6	6.120	44.1	6.830
31.7	3.874	34.2	4.364	36.7	4.903	39.2	5.496	41.7	6.147	44.2	6.860
31.8	3.893	34.3	4.384	36.8	4.925	39.3	5.521	41.8	6.174	44.3	6.890
31.9	3.911	34.4	4.405	36.9	4.948	39.4	5.546	41.9	6.201	44.4	6.920
32.0	3.930	34.5	4.426	37.0	4.970	39.5	5.571	42.0	6.228	44.5	6.950
32.1	3.949	34.6	4.447	37.1	4.994	39.6	5.596	42.1	6.256	44.6	6.980
32.2	3.968	34.7	4.467	37.2	5.017	39.7	5.622	42.2	6.284	44.7	7.011
32.3	3.987	34.8	4.488	37.3	5.041	39.8	5.647	42.3	6.312	44.8	7.041
32.4	4.007	34.9	4.509	37.4	5.064	39.9	5.672	42.4	6.340	44.9	7.071
32.5	4.026	35.0	4.530	37.5	5.087	40.0	5.697	42.5	6.368		
32.6	4.045	35.1	4.551	37.6	5.111	40.1	5.723	42.6	6.396		
32.7	4.065	35.2	4.573	37.7	5.134	40.2	5.749	42.7	6.424		
32.8	4.084	35.3	4.595	37.8	5.158	40.3	5.776	42.8	6.452		
32.9	4.103	35.4	4.616	37.9	5.181	40.4	5.802	42.9	6.480		
33.0	4.122	35.5	4.638	38.0	5.204	40.5	5.828	43.0	6.508		
33.1	4.142	35.6	4.660	38.1	5.228	40.6	5.854	43.1	6.538		
33.2	4.162	35.7	4.681	38.2	5.253	40.7	5.880	43.2	6.567		
33.3	4.182	35.8	4.703	38.3	5.277	40.8	5.906	43.3	6.596		
33.4	4.202	35.9	4.724	38.4	5.301	40.9	5.932	43.4	6.625		

TABLE 19.—MEAN DAILY POTENTIAL EVAPOTRANSPIRATION, THORNTHWAITE

INCHES

DAY	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
1	.000	.000	.000	.029	.087	.138	.172	.177	.140	.088	.036	.002
2	.000	.000	.000	.031	.088	.140	.172	.177	.138	.086	.034	.002
3	.000	.000	.000	.033	.089	.141	.174	.174	.136	.084	.032	.002
4	.000	.000	.001	.034	.091	.142	.174	.174	.135	.082	.031	.001
5	.000	.000	.001	.036	.094	.144	.174	.174	.134	.080	.029	.001
6	.000	.000	.002	.037	.095	.144	.175	.172	.132	.080	.028	.000
7	.000	.000	.003	.040	.096	.145	.176	.172	.130	.077	.028	.000
8	.000	.000	.003	.041	.099	.148	.176	.172	.129	.076	.026	.000
9	.000	.000	.004	.043	.100	.149	.177	.172	.127	.074	.024	.000
10	.000	.000	.004	.046	.101	.151	.176	.169	.125	.073	.023	.000
11	.000	.000	.005	.048	.105	.152	.180	.169	.124	.071	.021	.000
12	.000	.000	.006	.049	.106	.154	.178	.168	.122	.068	.019	.000
13	.000	.000	.006	.052	.108	.154	.175	.168	.120	.068	.018	.000
14	.000	.000	.007	.053	.109	.155	.180	.166	.118	.066	.017	.000
15	.000	.000	.008	.055	.112	.156	.180	.164	.116	.065	.016	.000
16	.000	.000	.009	.058	.114	.158	.181	.163	.115	.063	.015	.000
17	.000	.000	.010	.059	.115	.159	.179	.162	.113	.061	.013	.000
18	.000	.000	.011	.061	.117	.159	.179	.161	.111	.059	.013	.000
19	.000	.000	.012	.063	.119	.160	.180	.158	.110	.057	.012	.000
20	.000	.000	.013	.065	.120	.161	.180	.158	.107	.056	.010	.000
21	.000	.000	.014	.067	.121	.162	.180	.157	.106	.054	.010	.000
22	.000	.000	.015	.069	.123	.164	.180	.154	.105	.052	.009	.000
23	.000	.000	.016	.071	.124	.165	.180	.153	.102	.051	.008	.000
24	.000	.000	.017	.073	.126	.166	.180	.152	.101	.050	.007	.000
25	.000	.000	.018	.075	.127	.168	.180	.152	.100	.048	.006	.000
26	.000	.000	.020	.078	.128	.168	.180	.150	.097	.045	.006	.000
27	.000	.000	.022	.079	.130	.169	.179	.149	.096	.044	.005	.000
28	.000	.000	.023	.080	.133	.170	.179	.148	.094	.042	.004	.000
29	.000	.000	.024	.083	.134	.170	.179	.145	.092	.040	.004	.000
30	.000		.026	.094	.135	.171	.177	.144	.091	.039	.003	.000
31	.000		.028		.136		.177	.143		.038		.000
TOTAL	.000	.006	.329	1.692	3.482	4.683	5.514	5.017	3.466	1.937	.507	.008

TABLE 20.--MEAN DAILY POTENTIAL EVAPOTRANSPIRATION, BLANEY-CRIDDLE

INCHES

DAY	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
1	.010	.013	.019	.049	.118	.196	.244	.245	.182	.109	.047	.015
2	.010	.013	.020	.050	.121	.197	.245	.241	.180	.107	.044	.015
3	.010	.013	.020	.052	.124	.201	.246	.240	.178	.105	.043	.014
4	.010	.013	.020	.054	.126	.202	.247	.240	.176	.102	.042	.014
5	.010	.013	.021	.056	.128	.203	.248	.238	.172	.100	.040	.014
6	.010	.014	.021	.058	.132	.205	.249	.237	.170	.099	.038	.014
7	.010	.014	.021	.060	.134	.208	.250	.237	.167	.095	.037	.013
8	.010	.014	.022	.062	.137	.210	.251	.235	.166	.094	.036	.013
9	.010	.014	.022	.064	.141	.212	.252	.232	.163	.091	.034	.013
10	.010	.014	.023	.067	.142	.215	.252	.231	.160	.090	.033	.013
11	.011	.015	.023	.068	.145	.216	.252	.229	.157	.087	.032	.013
12	.011	.015	.024	.071	.148	.218	.252	.227	.155	.085	.030	.013
13	.011	.015	.024	.073	.150	.220	.252	.225	.153	.083	.029	.012
14	.011	.015	.024	.075	.153	.221	.252	.224	.149	.080	.028	.012
15	.011	.015	.025	.078	.155	.223	.252	.221	.148	.079	.027	.012
16	.011	.016	.026	.080	.158	.224	.252	.218	.145	.076	.025	.012
17	.011	.016	.027	.082	.160	.226	.252	.217	.144	.074	.024	.012
18	.011	.016	.028	.085	.163	.227	.253	.214	.139	.072	.023	.012
19	.011	.016	.030	.087	.165	.229	.253	.213	.137	.070	.022	.011
20	.011	.016	.031	.091	.168	.230	.252	.212	.135	.068	.021	.011
21	.011	.017	.032	.093	.171	.232	.252	.207	.133	.066	.020	.011
22	.011	.017	.033	.095	.173	.234	.252	.206	.132	.065	.020	.011
23	.012	.017	.034	.098	.174	.235	.251	.203	.128	.062	.019	.011
24	.012	.017	.036	.100	.176	.237	.251	.202	.126	.061	.018	.011
25	.012	.018	.037	.103	.181	.238	.251	.201	.123	.058	.017	.011
26	.012	.018	.038	.106	.183	.239	.247	.196	.121	.057	.017	.011
27	.012	.018	.040	.109	.184	.241	.247	.194	.119	.055	.016	.011
28	.012	.019	.042	.111	.186	.242	.247	.192	.116	.053	.016	.010
29	.012	.019	.043	.114	.189	.243	.247	.190	.115	.051	.016	.010
30	.012		.045	.117	.190	.244	.246	.189	.111	.050	.015	.010
31	.013		.047		.194		.245	.184		.048		.010
TOTAL	.341	.450	.898	2.408	4.869	6.668	7.743	6.740	4.400	2.391	.829	.375

TABLE 21.--MEAN DAILY POTENTIAL EVAPOTRANSPIRATION, HAMON

INCHES

DAY	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
1	.013	.016	.023	.045	.084	.130	.162	.159	.115	.069	.035	.018
2	.013	.016	.024	.045	.086	.131	.163	.157	.113	.067	.034	.017
3	.013	.016	.024	.047	.088	.134	.161	.156	.112	.067	.033	.017
4	.013	.016	.024	.048	.089	.135	.162	.156	.111	.065	.033	.017
5	.013	.016	.025	.048	.090	.136	.163	.154	.108	.064	.031	.017
6	.013	.017	.025	.050	.092	.136	.164	.153	.107	.063	.031	.017
7	.013	.017	.026	.051	.094	.137	.165	.153	.105	.061	.030	.016
8	.013	.017	.026	.052	.096	.139	.165	.150	.104	.060	.029	.016
9	.013	.017	.027	.053	.097	.140	.166	.150	.101	.059	.029	.016
10	.013	.017	.027	.055	.098	.142	.164	.149	.100	.058	.028	.015
11	.014	.018	.028	.056	.101	.143	.165	.147	.098	.057	.027	.015
12	.014	.018	.029	.057	.102	.144	.165	.146	.097	.055	.027	.015
13	.014	.018	.029	.059	.103	.145	.166	.143	.096	.054	.026	.015
14	.014	.018	.030	.060	.105	.146	.167	.143	.094	.053	.025	.015
15	.014	.018	.030	.061	.106	.147	.165	.143	.093	.052	.025	.014
16	.014	.019	.031	.062	.107	.148	.165	.140	.091	.050	.024	.014
17	.014	.019	.032	.064	.108	.149	.166	.139	.090	.050	.024	.014
18	.014	.019	.033	.065	.111	.150	.166	.138	.087	.048	.023	.014
19	.014	.020	.033	.066	.112	.151	.165	.135	.086	.047	.023	.014
20	.014	.020	.034	.068	.113	.152	.165	.135	.084	.047	.022	.014
21	.014	.020	.035	.069	.116	.153	.165	.132	.083	.045	.022	.014
22	.014	.020	.035	.071	.117	.154	.165	.131	.082	.044	.021	.014
23	.015	.021	.036	.072	.118	.155	.163	.128	.080	.043	.021	.013
24	.015	.021	.037	.074	.119	.156	.163	.128	.079	.042	.020	.013
25	.015	.021	.038	.076	.121	.156	.163	.127	.077	.041	.020	.013
26	.015	.022	.039	.077	.122	.157	.162	.124	.076	.040	.020	.013
27	.015	.022	.040	.079	.123	.158	.162	.123	.075	.039	.019	.013
28	.015	.023	.040	.080	.124	.159	.162	.121	.073	.038	.019	.013
29	.015	.023	.041	.081	.127	.160	.162	.120	.072	.036	.019	.013
30	.015		.043	.084	.128	.161	.159	.119	.070	.037	.018	.013
31	.015		.043		.129		.159	.116		.036		.013
TOTAL	.433	.545	.987	1.875	3.326	4.404	5.075	4.313	2.759	1.587	.758	.455

TABLE 22.--MEAN DAILY POTENTIAL EVAPOTRANSPIRATION, PAPADAKIS

INCHES

DAY	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
01	.021	.025	.030	.043	.082	.106	.124	.135	.119	.091	.053	.027
02	.021	.025	.031	.049	.083	.107	.124	.135	.118	.090	.052	.027
03	.021	.025	.031	.050	.084	.107	.125	.135	.116	.087	.051	.026
04	.021	.025	.031	.051	.085	.108	.126	.135	.116	.087	.049	.026
05	.021	.025	.031	.052	.085	.108	.127	.134	.114	.086	.048	.026
06	.021	.025	.032	.053	.087	.109	.128	.134	.114	.085	.047	.025
07	.021	.025	.032	.054	.088	.109	.128	.134	.113	.082	.046	.024
08	.022	.026	.033	.056	.099	.111	.127	.134	.112	.083	.045	.025
09	.022	.026	.033	.056	.090	.110	.129	.133	.111	.082	.044	.024
10	.022	.026	.034	.058	.090	.111	.129	.133	.110	.081	.042	.023
11	.022	.026	.034	.059	.092	.112	.130	.133	.110	.079	.042	.023
12	.022	.026	.035	.060	.092	.112	.130	.132	.109	.078	.041	.023
13	.022	.026	.035	.061	.093	.113	.131	.131	.108	.076	.040	.023
14	.022	.027	.035	.063	.095	.113	.131	.131	.107	.076	.039	.023
15	.022	.027	.036	.063	.095	.114	.132	.130	.107	.074	.037	.022
16	.022	.027	.036	.064	.096	.115	.132	.130	.105	.073	.037	.022
17	.023	.027	.037	.066	.097	.115	.133	.130	.104	.072	.036	.022
18	.023	.028	.037	.067	.097	.115	.134	.128	.103	.071	.035	.022
19	.023	.027	.038	.068	.098	.116	.134	.128	.102	.069	.034	.022
20	.023	.028	.039	.070	.099	.117	.134	.127	.101	.068	.033	.022
21	.023	.028	.040	.071	.100	.118	.134	.127	.101	.067	.033	.022
22	.024	.023	.040	.072	.101	.118	.134	.126	.100	.065	.032	.022
23	.024	.028	.041	.073	.101	.119	.135	.125	.099	.065	.032	.021
24	.024	.029	.042	.075	.102	.119	.135	.124	.098	.063	.031	.021
25	.024	.029	.042	.076	.102	.120	.135	.123	.096	.061	.030	.022
26	.024	.029	.043	.077	.103	.120	.135	.123	.096	.060	.030	.022
27	.024	.029	.044	.077	.103	.121	.136	.122	.095	.059	.029	.021
28	.025	.030	.045	.079	.105	.122	.136	.121	.094	.058	.028	.021
29	.025	.030	.045	.080	.105	.122	.136	.120	.092	.057	.028	.021
30	.024	.	.046	.081	.105	.123	.136	.119	.092	.055	.027	.021
31	.025	.	.047	.	.106	-	.135	.119	.	.054	.	.021
TOTAL	.703	.782	1.155	1.929	2.950	3.430	4.076	3.991	3.162	2.254	1.151	.712

TABLE 23.--MEAN DAILY POTENTIAL EVAPOTRANSPIRATION, GRASS

INCHES

DAY	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
1	.047	.064	.090	.130	.179	.220	.232	.219	.182	.133	.081	.049
2	.047	.065	.091	.131	.181	.221	.234	.218	.181	.132	.079	.049
3	.048	.066	.092	.133	.182	.222	.233	.217	.179	.130	.078	.049
4	.048	.067	.093	.135	.184	.223	.233	.216	.178	.128	.077	.048
5	.048	.067	.094	.136	.185	.223	.233	.215	.176	.126	.075	.047
6	.049	.068	.095	.138	.187	.224	.233	.215	.175	.125	.074	.047
7	.049	.069	.096	.139	.189	.225	.233	.214	.173	.123	.072	.047
8	.050	.070	.098	.141	.190	.226	.233	.212	.172	.121	.071	.046
9	.050	.071	.099	.142	.192	.226	.232	.211	.170	.119	.070	.046
10	.050	.072	.100	.144	.193	.227	.232	.211	.168	.117	.069	.046
11	.051	.072	.101	.146	.195	.228	.232	.209	.167	.116	.067	.046
12	.051	.073	.102	.148	.196	.228	.231	.208	.166	.114	.066	.045
13	.052	.074	.104	.149	.197	.229	.231	.207	.164	.112	.065	.045
14	.053	.075	.105	.151	.199	.229	.231	.206	.162	.111	.064	.045
15	.053	.076	.106	.152	.200	.230	.230	.205	.160	.109	.063	.045
16	.054	.077	.107	.154	.202	.230	.230	.204	.159	.107	.062	.045
17	.054	.078	.108	.156	.203	.230	.229	.202	.157	.105	.061	.045
18	.055	.078	.110	.158	.204	.231	.229	.201	.156	.104	.060	.044
19	.055	.079	.111	.159	.206	.231	.228	.200	.154	.102	.059	.044
20	.056	.080	.113	.161	.207	.232	.228	.199	.152	.100	.058	.045
21	.057	.081	.114	.162	.208	.232	.227	.197	.151	.098	.057	.045
22	.057	.082	.115	.164	.210	.232	.227	.196	.149	.097	.056	.045
23	.058	.083	.117	.166	.211	.232	.226	.195	.147	.095	.055	.045
24	.059	.084	.118	.168	.212	.233	.225	.194	.145	.093	.054	.045
25	.059	.085	.119	.169	.213	.233	.225	.192	.144	.092	.053	.045
26	.060	.086	.121	.171	.214	.233	.224	.191	.142	.090	.053	.045
27	.061	.087	.123	.173	.215	.233	.223	.189	.140	.089	.052	.045
28	.061	.088	.124	.174	.216	.234	.222	.188	.138	.087	.052	.045
29	.062	.089	.125	.176	.217	.233	.222	.186	.137	.085	.051	.046
30	.063		.127	.178	.218	.234	.221	.185	.135	.084	.050	.046
31	.064		.128		.219		.220	.184		.032		.046
TOTAL	2.206		4.604		6.864		6.286		3.326		1.421	
	1.681		3.346		6.224		7.090		4.779		1.904	

TABLE 24.—MEAN DAILY POTENTIAL EVAPOTRANSPIRATION, STEPHENS-STEWART

INCHES

DAY	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
1	.003	.005	.013	.041	.087	.129	.152	.148	.114	.071	.030	.009
2	.003	.005	.014	.042	.089	.131	.152	.147	.113	.069	.029	.008
3	.003	.005	.014	.044	.090	.132	.153	.146	.112	.068	.028	.008
4	.003	.006	.015	.045	.092	.133	.153	.146	.111	.066	.027	.008
5	.003	.006	.015	.047	.093	.134	.153	.145	.109	.065	.026	.007
6	.003	.006	.016	.048	.095	.134	.154	.144	.108	.064	.025	.007
7	.003	.006	.017	.049	.097	.135	.154	.144	.106	.062	.024	.007
8	.003	.006	.017	.051	.098	.137	.154	.142	.105	.061	.023	.007
9	.003	.006	.018	.052	.100	.138	.154	.142	.104	.059	.022	.006
10	.003	.007	.019	.054	.101	.138	.154	.141	.102	.058	.021	.006
11	.003	.007	.020	.055	.102	.139	.154	.140	.100	.056	.021	.006
12	.003	.007	.020	.057	.104	.140	.154	.135	.099	.055	.020	.006
13	.003	.007	.021	.058	.105	.141	.154	.138	.097	.054	.019	.005
14	.003	.007	.022	.060	.107	.142	.154	.137	.096	.052	.018	.005
15	.003	.008	.023	.061	.108	.142	.154	.136	.095	.051	.017	.005
16	.004	.008	.024	.063	.110	.143	.154	.135	.093	.049	.017	.005
17	.004	.008	.025	.064	.111	.144	.154	.133	.092	.048	.016	.005
18	.004	.009	.025	.066	.113	.145	.154	.132	.090	.047	.015	.005
19	.004	.009	.026	.068	.114	.145	.154	.131	.089	.045	.015	.004
20	.004	.009	.027	.070	.115	.146	.153	.130	.087	.044	.014	.004
21	.004	.010	.028	.071	.116	.147	.153	.129	.086	.043	.014	.004
22	.004	.010	.029	.073	.118	.147	.153	.128	.084	.042	.013	.004
23	.004	.010	.031	.074	.119	.148	.152	.126	.083	.040	.012	.004
24	.004	.011	.032	.076	.120	.149	.152	.125	.081	.039	.012	.004
25	.004	.011	.033	.078	.121	.149	.152	.124	.080	.038	.011	.004
26	.004	.011	.034	.079	.123	.150	.151	.123	.078	.037	.011	.004
27	.004	.012	.035	.081	.124	.150	.151	.121	.077	.035	.011	.004
28	.005	.012	.036	.082	.125	.151	.150	.120	.075	.034	.010	.004
29	.005	.013	.037	.084	.126	.151	.150	.119	.074	.032	.010	.004
30	.005		.039	.086	.127	.152	.149	.117	.072	.032	.009	.003
31	.005		.040		.129		.148	.116		.031		.003
TOTAL	.113	.237	.765	1.879	3.380	4.262	4.733	4.144	2.812	1.547	.540	.165

TABLE 25.--MEAN DAILY POTENTIAL EVAPOTRANSPIRATION, TURC

INCHES

DAY	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
1	.000	.000	.000	.064	.130	.178	.193	.184	.152	.106	.052	.006
2	.000	.000	.000	.066	.122	.176	.193	.183	.150	.104	.050	.004
3	.000	.000	.001	.069	.134	.177	.193	.182	.149	.102	.048	.003
4	.000	.000	.003	.071	.136	.178	.193	.182	.148	.101	.046	.002
5	.000	.000	.005	.074	.137	.179	.193	.181	.146	.099	.045	.001
6	.000	.000	.006	.076	.139	.180	.193	.180	.145	.097	.043	.000
7	.000	.000	.008	.078	.141	.180	.193	.179	.143	.095	.041	.000
8	.000	.000	.010	.081	.143	.182	.193	.178	.142	.094	.040	.000
9	.000	.000	.012	.083	.145	.182	.193	.176	.141	.092	.038	.000
10	.000	.000	.014	.086	.146	.183	.193	.177	.139	.090	.036	.000
11	.000	.000	.016	.088	.148	.184	.193	.176	.138	.088	.035	.000
12	.000	.000	.018	.090	.149	.184	.192	.175	.136	.087	.033	.000
13	.000	.000	.020	.092	.151	.185	.192	.174	.135	.085	.032	.000
14	.000	.000	.022	.095	.152	.186	.192	.173	.133	.083	.030	.000
15	.000	.000	.025	.097	.154	.186	.192	.172	.132	.081	.028	.000
16	.000	.000	.027	.099	.155	.187	.192	.171	.130	.080	.027	.000
17	.000	.000	.029	.101	.157	.187	.191	.170	.129	.078	.025	.000
18	.000	.000	.031	.104	.158	.188	.191	.169	.127	.076	.024	.000
19	.000	.000	.034	.106	.160	.189	.191	.167	.125	.074	.023	.000
20	.000	.000	.036	.108	.161	.189	.190	.167	.124	.072	.021	.000
21	.000	.000	.038	.110	.162	.189	.190	.165	.122	.071	.020	.000
22	.000	.000	.040	.112	.164	.190	.190	.164	.121	.069	.018	.000
23	.000	.000	.043	.114	.165	.190	.189	.163	.119	.067	.017	.000
24	.000	.000	.045	.117	.166	.191	.189	.162	.117	.065	.015	.000
25	.000	.000	.047	.118	.167	.191	.188	.161	.116	.064	.014	.000
26	.000	.000	.050	.121	.168	.191	.188	.159	.114	.062	.013	.000
27	.000	.000	.052	.122	.169	.192	.187	.158	.112	.060	.011	.000
28	.000	.000	.055	.124	.171	.192	.186	.157	.111	.058	.010	.000
29	.000	.000	.057	.126	.172	.192	.186	.155	.109	.057	.008	.000
30	.000		.059	.128	.173	.192	.185	.154	.107	.055	.007	.000
31	.000		.062		.174		.184	.153		.053		.000
TOTAL	.000	.000	.865	2.920	4.779	5.567	5.908	5.269	3.912	2.465	.850	.016

TABLE 26.—MEAN DAILY POTENTIAL EVAPOTRANSPIRATION, JENSEN-HAISE

INCHES

DAY	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
1	.001	.002	.014	.059	.135	.206	.244	.238	.183	.111	.045	.010
2	.001	.002	.015	.061	.138	.207	.245	.237	.181	.109	.043	.010
3	.001	.003	.016	.064	.141	.209	.245	.236	.179	.107	.041	.009
4	.001	.003	.017	.066	.143	.211	.246	.235	.177	.104	.039	.009
5	.001	.003	.018	.068	.146	.213	.246	.234	.174	.101	.038	.008
6	.001	.003	.019	.070	.148	.214	.247	.232	.172	.099	.036	.008
7	.001	.003	.020	.073	.151	.216	.247	.231	.169	.097	.035	.007
8	.001	.004	.021	.075	.153	.218	.247	.229	.167	.095	.033	.007
9	.001	.004	.022	.078	.156	.219	.248	.228	.165	.092	.032	.006
10	.001	.004	.023	.080	.159	.221	.248	.227	.162	.090	.031	.006
11	.001	.004	.024	.082	.161	.222	.248	.225	.160	.087	.029	.006
12	.001	.005	.025	.085	.163	.224	.248	.223	.158	.085	.028	.005
13	.001	.005	.027	.086	.165	.225	.248	.221	.155	.083	.027	.005
14	.001	.005	.028	.090	.168	.226	.248	.220	.153	.081	.026	.005
15	.001	.006	.029	.092	.170	.228	.248	.219	.150	.078	.024	.004
16	.001	.006	.031	.095	.173	.229	.248	.216	.148	.076	.023	.004
17	.001	.007	.032	.098	.175	.230	.248	.215	.146	.074	.022	.004
18	.001	.007	.034	.101	.177	.232	.248	.213	.143	.072	.021	.003
19	.001	.007	.035	.103	.180	.233	.248	.211	.140	.070	.020	.003
20	.001	.008	.037	.106	.182	.234	.247	.209	.138	.068	.019	.003
21	.001	.009	.038	.108	.184	.235	.247	.207	.136	.065	.018	.003
22	.001	.009	.040	.111	.186	.236	.246	.205	.133	.063	.017	.003
23	.001	.009	.042	.114	.188	.237	.246	.203	.131	.061	.016	.002
24	.001	.010	.044	.117	.190	.238	.245	.201	.128	.059	.016	.002
25	.001	.011	.045	.119	.192	.239	.244	.199	.126	.057	.015	.002
26	.001	.011	.047	.122	.194	.240	.244	.197	.124	.055	.014	.002
27	.001	.012	.049	.125	.196	.241	.243	.195	.121	.053	.013	.002
28	.002	.013	.051	.127	.198	.242	.242	.192	.119	.052	.012	.002
29	.002	.014	.053	.130	.200	.242	.241	.190	.116	.048	.012	.002
30	.002		.055	.133	.202	.243	.240	.188	.114	.048	.011	.001
31	.002		.057		.204		.239	.186		.046		.001
TOTAL	.015	.189	1.028	2.840	5.318	6.810	7.619	6.662	4.468	2.386	.756	.144

TABLE 27.—MEAN DAILY POTENTIAL EVAPOTRANSPIRATION, MAKKINK

INCHES

DAY	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
1	.021	.030	.042	.073	.115	.152	.162	.153	.125	.086	.045	.022
2	.021	.030	.043	.074	.116	.150	.163	.153	.124	.085	.044	.021
3	.021	.031	.044	.075	.117	.151	.163	.152	.122	.083	.043	.021
4	.021	.031	.045	.077	.119	.152	.162	.151	.121	.082	.042	.021
5	.021	.032	.045	.078	.120	.152	.162	.151	.120	.081	.041	.020
6	.022	.032	.046	.079	.122	.153	.163	.150	.119	.079	.040	.020
7	.022	.032	.047	.081	.123	.153	.163	.149	.118	.078	.039	.020
8	.022	.033	.048	.082	.124	.154	.162	.148	.116	.077	.038	.020
9	.022	.033	.048	.083	.125	.155	.162	.148	.115	.075	.037	.020
10	.023	.034	.049	.085	.127	.156	.162	.147	.114	.074	.036	.019
11	.023	.034	.050	.086	.128	.156	.162	.146	.113	.072	.035	.019
12	.023	.035	.051	.088	.129	.156	.162	.145	.112	.071	.034	.019
13	.023	.035	.052	.089	.130	.157	.161	.144	.110	.070	.033	.019
14	.024	.035	.053	.091	.131	.158	.161	.143	.109	.068	.033	.019
15	.024	.036	.054	.092	.133	.158	.161	.143	.108	.067	.032	.019
16	.024	.036	.055	.093	.134	.159	.161	.142	.107	.066	.031	.019
17	.025	.037	.056	.075	.125	.159	.161	.141	.105	.064	.030	.019
18	.025	.037	.057	.076	.136	.159	.160	.140	.104	.063	.029	.019
19	.025	.038	.058	.097	.137	.160	.160	.139	.102	.061	.029	.019
20	.026	.038	.059	.099	.138	.160	.159	.138	.101	.060	.028	.019
21	.026	.038	.060	.100	.139	.160	.159	.137	.100	.059	.027	.019
22	.026	.039	.061	.102	.140	.161	.159	.136	.098	.058	.027	.019
23	.027	.039	.062	.103	.141	.161	.158	.134	.097	.056	.026	.019
24	.027	.040	.063	.105	.142	.161	.158	.134	.096	.055	.025	.019
25	.027	.040	.064	.106	.143	.161	.157	.133	.095	.054	.025	.020
26	.028	.041	.065	.108	.144	.162	.157	.132	.093	.053	.024	.020
27	.028	.041	.067	.109	.145	.162	.156	.130	.092	.051	.024	.020
28	.028	.042	.068	.110	.146	.162	.156	.129	.090	.050	.023	.020
29	.029	.042	.069	.112	.147	.162	.155	.128	.089	.049	.023	.020
30	.029		.070	.113	.147	.162	.154	.127	.087	.048	.022	.020
31	.030		.072		.149		.154	.126		.047		.020
TOTAL	.668	.673	1.773	2.794	4.122	4.725	4.958	4.370	3.206	2.044	.966	.574

TABLE 28.—MEAN DAILY POTENTIAL EVAPOTRANSPIRATION, CHRISTIANSEN

INCHES

DAY	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
1	.023	.031	.049	.089	.149	.185	.204	.200	.163	.124	.073	.033
2	.023	.031	.050	.091	.147	.184	.204	.199	.162	.122	.072	.032
3	.023	.032	.051	.093	.149	.185	.206	.198	.162	.120	.070	.031
4	.023	.033	.052	.094	.152	.186	.206	.197	.161	.118	.068	.030
5	.023	.034	.052	.096	.153	.188	.206	.196	.160	.117	.067	.030
6	.023	.034	.053	.097	.155	.189	.207	.194	.159	.115	.065	.029
7	.023	.035	.054	.099	.158	.189	.207	.195	.158	.113	.063	.028
8	.023	.035	.055	.102	.159	.191	.206	.193	.156	.112	.062	.028
9	.023	.036	.057	.103	.161	.191	.206	.192	.155	.111	.060	.027
10	.024	.037	.058	.106	.161	.193	.209	.191	.155	.109	.059	.027
11	.024	.037	.059	.107	.163	.194	.209	.190	.153	.108	.058	.026
12	.024	.038	.061	.109	.165	.195	.209	.188	.150	.105	.056	.025
13	.024	.038	.061	.111	.166	.193	.209	.185	.149	.104	.055	.025
14	.024	.039	.062	.113	.169	.193	.209	.186	.150	.102	.053	.025
15	.025	.039	.064	.115	.170	.194	.209	.185	.149	.100	.050	.025
16	.025	.040	.065	.117	.169	.195	.208	.184	.147	.098	.049	.024
17	.025	.040	.067	.119	.171	.195	.208	.182	.146	.096	.048	.024
18	.025	.041	.068	.121	.173	.196	.208	.183	.144	.095	.047	.024
19	.026	.041	.070	.123	.174	.197	.207	.181	.142	.093	.046	.024
20	.025	.042	.072	.126	.175	.197	.207	.180	.141	.091	.044	.023
21	.026	.043	.073	.128	.177	.199	.206	.179	.141	.089	.042	.023
22	.027	.044	.075	.130	.176	.200	.206	.178	.138	.089	.041	.023
23	.027	.044	.075	.132	.178	.200	.205	.178	.135	.088	.041	.023
24	.027	.045	.077	.134	.179	.201	.205	.176	.136	.086	.040	.023
25	.028	.045	.078	.137	.178	.201	.203	.174	.134	.084	.039	.023
26	.028	.046	.080	.139	.179	.201	.204	.175	.132	.082	.038	.023
27	.028	.047	.082	.140	.179	.201	.204	.173	.129	.080	.037	.023
28	.029	.047	.084	.143	.180	.201	.203	.169	.128	.078	.035	.023
29	.029	.048	.085	.145	.181	.201	.202	.167	.126	.078	.034	.024
30	.030		.087	.146	.182	.204	.202	.166	.126	.076	.034	.024
31	.030		.089		.183		.201	.165		.074		.024
TOTAL	.787	1.142	2.065	3.505	5.211	5.839	6.385	5.699	4.387	3.057	1.546	.796

TABLE 29.--MEAN DAILY POTENTIAL EVAPOTRANSPIRATION, PENMAN

INCHES

DAY	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
1	.023	.038	.058	.094	.139	.179	.194	.186	.145	.099	.055	.030
2	.023	.038	.060	.093	.141	.177	.195	.185	.144	.096	.054	.029
3	.024	.039	.060	.094	.143	.178	.195	.184	.143	.097	.053	.028
4	.023	.039	.061	.096	.143	.178	.195	.183	.142	.095	.052	.028
5	.024	.040	.061	.098	.145	.179	.195	.182	.140	.094	.051	.028
6	.025	.041	.062	.100	.147	.179	.196	.181	.139	.092	.049	.027
7	.024	.041	.063	.102	.148	.180	.195	.180	.137	.090	.048	.027
8	.025	.043	.064	.104	.149	.182	.195	.179	.135	.089	.047	.028
9	.025	.043	.065	.106	.151	.183	.196	.178	.134	.087	.046	.027
10	.026	.044	.066	.106	.153	.183	.196	.177	.132	.086	.044	.026
11	.027	.044	.067	.108	.153	.183	.196	.176	.130	.084	.043	.026
12	.027	.045	.068	.110	.154	.184	.195	.174	.130	.083	.043	.025
13	.027	.046	.068	.111	.156	.185	.195	.173	.127	.081	.042	.025
14	.028	.046	.069	.112	.157	.186	.195	.172	.126	.079	.041	.024
15	.028	.046	.070	.114	.158	.186	.195	.171	.124	.078	.040	.024
16	.029	.048	.072	.116	.160	.187	.195	.169	.122	.077	.039	.023
17	.030	.048	.073	.117	.161	.188	.194	.168	.121	.076	.037	.023
18	.030	.050	.072	.119	.162	.188	.194	.166	.120	.074	.037	.023
19	.030	.050	.074	.121	.163	.189	.194	.165	.117	.072	.036	.023
20	.031	.050	.075	.123	.163	.190	.193	.164	.115	.071	.035	.024
21	.032	.051	.077	.124	.165	.190	.193	.162	.114	.069	.036	.023
22	.033	.051	.078	.126	.167	.190	.192	.160	.113	.067	.034	.023
23	.033	.052	.080	.127	.167	.191	.192	.158	.111	.068	.033	.023
24	.034	.053	.082	.130	.169	.191	.191	.158	.109	.066	.033	.022
25	.034	.054	.083	.130	.170	.192	.191	.156	.107	.065	.032	.023
26	.035	.054	.083	.132	.171	.192	.191	.155	.106	.063	.031	.023
27	.035	.055	.084	.134	.171	.192	.190	.153	.105	.062	.032	.022
28	.036	.056	.086	.135	.172	.193	.189	.151	.103	.061	.030	.022
29	.036	.057	.087	.137	.173	.193	.189	.149	.101	.059	.029	.022
30	.037	.	.089	.138	.174	.194	.188	.148	.099	.057	.029	.022
31	.037	.	.091	.	.176	.	.187	.147	.	.056	.	.022
TOTAL	1.362	.911	3.457	2.248	5.582	4.921	5.210	5.991	2.393	3.691	.765	1.211

TABLE 30.--MEAN DAILY POTENTIAL EVAPOTRANSPIRATION, VAN BAVEL

INCHES

DAY	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
1	.033	.051	.074	.112	.156	.190	.203	.193	.152	.1C9	.070	.042
2	.034	.052	.076	.112	.159	.188	.203	.192	.15C	.1C7	.069	.041
3	.035	.052	.076	.113	.160	.189	.203	.191	.150	.108	.068	.040
4	.034	.053	.077	.114	.161	.189	.203	.19C	.149	.1C6	.067	.040
5	.035	.053	.077	.117	.163	.189	.203	.189	.147	.1C5	.066	.040
6	.036	.054	.078	.118	.164	.190	.204	.188	.146	.1C4	.064	.040
7	.035	.055	.079	.121	.165	.191	.204	.187	.144	.1C2	.063	.039
8	.036	.056	.081	.123	.166	.192	.203	.186	.143	.1C1	.061	.048
9	.036	.056	.081	.125	.167	.193	.204	.185	.141	.1C0	.060	.039
10	.038	.057	.083	.125	.169	.193	.204	.184	.139	.098	.059	.037
11	.038	.058	.084	.127	.169	.193	.204	.183	.138	.C96	.058	.037
12	.038	.060	.085	.129	.170	.194	.203	.181	.137	.096	.057	.036
13	.039	.060	.084	.130	.171	.194	.203	.179	.135	.094	.056	.036
14	.039	.060	.086	.131	.172	.195	.203	.178	.133	.C93	.055	.035
15	.040	.060	.087	.133	.173	.195	.203	.177	.132	.C92	.054	.035
16	.040	.062	.089	.136	.174	.196	.203	.175	.131	.090	.053	.033
17	.042	.063	.090	.136	.176	.197	.202	.175	.130	.C89	.051	.034
18	.042	.064	.089	.139	.176	.197	.202	.173	.128	.C88	.051	.034
19	.042	.065	.091	.140	.177	.198	.202	.171	.126	.086	.050	.034
20	.044	.065	.092	.142	.177	.199	.201	.171	.124	.085	.049	.035
21	.045	.066	.094	.143	.179	.199	.201	.168	.123	.084	.049	.033
22	.045	.066	.096	.145	.180	.199	.200	.167	.122	.082	.047	.033
23	.046	.067	.097	.145	.180	.199	.200	.165	.120	.082	.046	.034
24	.047	.068	.099	.149	.181	.200	.199	.165	.118	.081	.046	.033
25	.047	.069	.101	.149	.182	.2C0	.199	.163	.117	.C80	.045	.033
26	.047	.069	.101	.151	.183	.2C0	.199	.161	.116	.078	.044	.034
27	.048	.071	.102	.152	.183	.201	.198	.16C	.115	.C77	.044	.032
28	.049	.071	.104	.153	.184	.2C2	.197	.158	.113	.076	.043	.032
29	.050	.073	.105	.155	.185	.2C1	.196	.156	.111	.C74	.042	.033
30	.050	.	.107	.156	.186	.2C3	.195	.154	.11C	.072	.042	.033
31	.050	.	.109	.	.187	.	.194	.154	.	.C71	.	.033
TOTAL	1.776	1.280	4.021	2.774	5.866	5.375	5.419	6.238	2.806	3.940	1.110	1.629

TABLE 31.---MEAN DAILY POTENTIAL EVAPOTRANSPIRATION, COMPUTED LAKE EVAPORATION

INCHES

DAY	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
1	.018	.025	.039	.072	.120	.159	.176	.166	.126	.084	.046	.022
2	.017	.026	.040	.073	.122	.160	.176	.165	.125	.083	.045	.021
3	.018	.026	.040	.075	.124	.161	.176	.164	.123	.081	.044	.021
4	.018	.027	.041	.076	.125	.162	.176	.163	.122	.080	.043	.021
5	.018	.027	.041	.078	.127	.162	.176	.162	.121	.079	.042	.020
6	.019	.027	.042	.079	.128	.163	.177	.161	.120	.078	.041	.020
7	.018	.027	.043	.081	.130	.163	.176	.160	.117	.076	.040	.019
8	.019	.028	.044	.083	.131	.165	.176	.159	.116	.075	.039	.019
9	.019	.028	.045	.084	.133	.165	.177	.158	.115	.073	.038	.019
10	.019	.029	.046	.086	.134	.166	.177	.157	.113	.072	.037	.019
11	.019	.029	.046	.087	.135	.167	.176	.155	.112	.071	.036	.018
12	.020	.030	.048	.089	.137	.167	.176	.154	.111	.070	.035	.018
13	.020	.030	.048	.091	.138	.168	.176	.153	.109	.068	.035	.018
14	.020	.030	.049	.093	.139	.169	.176	.152	.107	.067	.034	.018
15	.020	.031	.050	.094	.141	.169	.176	.151	.106	.066	.033	.018
16	.021	.031	.052	.096	.142	.170	.175	.149	.105	.064	.032	.017
17	.021	.032	.052	.097	.143	.170	.175	.148	.103	.063	.031	.017
18	.021	.032	.054	.099	.144	.171	.175	.146	.102	.062	.030	.017
19	.021	.032	.055	.101	.146	.171	.174	.145	.100	.061	.030	.017
20	.022	.033	.056	.103	.147	.172	.174	.144	.099	.060	.029	.017
21	.022	.034	.057	.104	.148	.172	.173	.142	.098	.059	.028	.017
22	.022	.034	.058	.106	.149	.173	.173	.141	.096	.057	.027	.017
23	.022	.034	.060	.107	.150	.173	.172	.139	.095	.056	.027	.017
24	.023	.035	.061	.110	.151	.174	.172	.138	.093	.055	.026	.017
25	.023	.036	.062	.111	.152	.174	.171	.137	.092	.054	.025	.017
26	.024	.036	.063	.113	.153	.174	.171	.135	.091	.053	.025	.017
27	.024	.037	.065	.114	.154	.175	.170	.134	.089	.051	.024	.017
28	.024	.037	.066	.116	.155	.175	.169	.132	.088	.050	.024	.017
29	.024	.038	.067	.118	.156	.175	.168	.131	.086	.048	.023	.017
30	.025		.069	.119	.157	.176	.168	.129	.085	.048	.022	.017
31	.025		.070		.158		.166	.128		.047		.017
TOTAL	.646	.901	1.629	2.855	4.369	5.061	5.385	4.592	3.165	2.008	.991	.563

TABLE 32.—MEAN DAILY POTENTIAL EVAPOTRANSPIRATION, COMPUTED PAN EVAPORATION

INCHES

DAY	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
1	.031	.040	.055	.097	.156	.199	.223	.217	.168	.120	.075	.039
2	.031	.041	.056	.098	.158	.199	.223	.216	.166	.118	.073	.038
3	.032	.041	.057	.100	.160	.201	.224	.215	.164	.117	.071	.037
4	.032	.042	.057	.102	.162	.202	.225	.215	.163	.115	.070	.037
5	.032	.042	.058	.104	.164	.202	.225	.213	.160	.114	.069	.036
6	.032	.042	.059	.106	.165	.203	.226	.212	.159	.113	.067	.035
7	.032	.043	.060	.108	.167	.204	.226	.211	.157	.111	.066	.034
8	.032	.043	.061	.110	.168	.206	.225	.209	.155	.109	.065	.035
9	.033	.044	.062	.112	.170	.206	.226	.208	.154	.108	.063	.034
10	.033	.044	.063	.114	.172	.207	.227	.206	.152	.107	.062	.033
11	.033	.044	.064	.116	.173	.208	.227	.205	.150	.105	.061	.033
12	.033	.045	.066	.118	.174	.209	.226	.203	.149	.104	.059	.033
13	.034	.045	.066	.120	.176	.209	.226	.201	.147	.102	.058	.032
14	.034	.046	.067	.122	.178	.210	.226	.200	.145	.101	.057	.032
15	.034	.046	.069	.124	.179	.211	.227	.199	.144	.099	.055	.031
16	.035	.047	.071	.127	.180	.212	.226	.197	.143	.098	.054	.031
17	.035	.047	.071	.128	.182	.213	.226	.195	.141	.096	.052	.031
18	.036	.048	.073	.131	.183	.214	.227	.193	.139	.095	.052	.031
19	.036	.048	.074	.132	.184	.214	.226	.191	.137	.093	.051	.031
20	.036	.049	.076	.135	.185	.216	.226	.190	.135	.092	.049	.031
21	.037	.049	.077	.137	.186	.216	.226	.188	.134	.090	.048	.030
22	.037	.050	.079	.139	.188	.217	.225	.186	.133	.089	.047	.030
23	.037	.050	.080	.141	.189	.218	.225	.184	.131	.088	.046	.030
24	.038	.051	.082	.144	.190	.219	.224	.183	.130	.086	.045	.030
25	.038	.052	.083	.145	.191	.219	.223	.181	.128	.085	.044	.030
26	.038	.052	.085	.148	.193	.220	.223	.179	.127	.083	.043	.030
27	.039	.053	.087	.149	.193	.221	.222	.177	.125	.082	.042	.030
28	.039	.053	.089	.151	.195	.222	.222	.175	.124	.080	.041	.030
29	.039	.054	.090	.153	.195	.221	.221	.173	.122	.079	.040	.031
30	.040		.092	.155	.196	.222	.220	.171	.121	.077	.039	.031
31	.040		.094		.198		.218	.170		.076		.031
TOTAL	1.351		3.766		6.340		6.063		3.032		1.007	
		1.008		2.223		5.550		6.962		4.303		1.664

TABLE 33.--MEAN DAILY POTENTIAL EVAPOTRANSPIRATION, LYSIMETER

DATA ARE FROM 5-TERM HARMONIC CURVE FITTED TO AVERAGE OF 1948-65 DATA
LESS 1956, 1957, 1964, AND PERIODS WHEN HAY CUT RESTRICTED PET ESTIMATE.

INCHES

DAY	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
1	.020	.027	.046	.068	.154	.222	.222	.213	.150	.109	.052	.020
2	.020	.028	.046	.069	.157	.222	.222	.212	.158	.107	.050	.020
3	.020	.029	.047	.071	.161	.223	.222	.211	.155	.106	.049	.020
4	.020	.029	.047	.073	.164	.223	.222	.210	.155	.104	.047	.020
5	.020	.030	.048	.075	.167	.224	.222	.209	.153	.102	.045	.020
6	.020	.030	.048	.077	.170	.224	.222	.207	.151	.101	.044	.020
7	.020	.031	.048	.079	.174	.224	.222	.206	.149	.099	.042	.019
8	.020	.032	.049	.082	.177	.224	.222	.205	.147	.097	.040	.019
9	.020	.033	.049	.084	.180	.224	.222	.203	.145	.095	.039	.019
10	.020	.033	.049	.086	.183	.224	.222	.202	.143	.094	.037	.019
11	.020	.034	.050	.089	.186	.224	.222	.200	.142	.092	.036	.019
12	.020	.035	.050	.092	.188	.224	.222	.198	.140	.090	.035	.019
13	.020	.036	.051	.094	.191	.224	.222	.197	.138	.088	.033	.019
14	.021	.036	.051	.097	.194	.224	.222	.195	.136	.086	.032	.019
15	.021	.037	.052	.100	.196	.224	.221	.193	.135	.085	.031	.020
16	.021	.038	.052	.103	.198	.224	.221	.192	.133	.083	.030	.020
17	.021	.038	.052	.106	.201	.224	.221	.190	.131	.081	.029	.020
18	.021	.039	.053	.109	.203	.224	.221	.188	.130	.079	.028	.020
19	.021	.040	.054	.113	.205	.224	.221	.186	.128	.077	.027	.020
20	.022	.041	.054	.116	.207	.223	.220	.184	.126	.075	.026	.020
21	.022	.041	.055	.119	.209	.223	.220	.182	.125	.073	.025	.020
22	.022	.042	.056	.123	.210	.223	.220	.180	.123	.071	.025	.020
23	.023	.042	.057	.126	.212	.223	.219	.178	.122	.069	.024	.020
24	.023	.043	.058	.129	.214	.223	.220	.176	.120	.067	.023	.020
25	.023	.043	.059	.133	.215	.223	.218	.174	.119	.065	.023	.020
26	.024	.044	.060	.136	.216	.223	.218	.172	.117	.063	.022	.020
27	.024	.045	.061	.140	.217	.223	.217	.170	.115	.061	.022	.020
28	.025	.045	.062	.144	.218	.222	.218	.168	.114	.060	.021	.020
29	.025	.045	.063	.147	.219	.222	.216	.166	.112	.058	.021	.020
30	.026		.065	.150	.220	.222	.216	.164	.111	.056	.021	.020
31	.027		.066		.221		.214	.162		.054		.020
TOTAL		1.065		3.130		6.700		5.893		2.547		.612
	.672		1.657		6.027		6.825		4.034		.979	

TABLE   34.—STATISTICS FROM HARMONIC ANALYSES

MEANS, COEFFICIENTS, AND STANDARD DEVIATIONS FROM REGRESSION

TABLE NO.	FACTOR	MEAN	A 1 / B 1	A 2 / B 2	A 3 / B 3	A 4 / B 4	A 5 / B 5	STD. DEV. FROM REGR.
4	AIR TEMP	50.36	- 22.40	-1.092	0.4296	-C.0900		2.37
			- 7.87	.C19	.3926	.6583		
5	DEWPCINT	41.95	- 21.20	- .181	.5920			2.24
			- 8.16	.140	.3555			
6	WIND	79.54	16.33	-1.193	-1.0689			7.30
			9.34	-2.961	-2.1750			
7	SCIL MOIST	8.51	1.21	- .166	.1151	.1120	-0.0770	.16
			3.42	.393	- .C468	.1568	- .0311	
8	SCLAR RAD	367.41	-213.68	- .543	.CC59			29.91
			25.01	7.350	8.6176			
15	TEMP DIFF	9.15	- 1.78	- .642	.0646			.83
			- .35	- .C77	.3378			
33	LYSIM PET	.11	- .11	.016	.0028	- .CC50	.0040	.01
			- .01	- .CC1	.0C93	.0C00	.0040	

END