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1975 EVAPOTRANSPIRATION AND CLIMATIC DATA FOR THE SILVER CREEK - BELLEVUE TRIANGLE BLAINE COUNTY, IDAHO

By

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SECTION I

SUMMARY

Evapotranspiration (ET) was estimated from climatic data measured at the Bellevue Triangle to determine water requirements of irrigated crops in the area and to provide input data for a hydrologic model. The Bellevue Triangle is a triangular-shaped mountain valley located in central Blaine County, Idaho just south of Bellevue. ET is an important component of the hydrologic model and must be known to evaluate the potential impacts of impending changes in land use in the area on the flow of the famous Silver Creek.

A climatological station was established on the Harvey Bickett farm in the south central part of the triangle in November 1974 and meteorological measurements were made through December 1975. These included solar radiation, air temperature and humidity, windspeed and direction. Daily estimates of potential ET and lake evaporation were calculated from the climatological data by several different methods. Potential ET obtained with a modified Penman equation and crop coefficients were used to estimate the ET for the major crops grown in the area. Summaries of these results are included. Estimated potential ET was about 845 mm for the period May through September, 1975, and ET for alfalfa during the same period was about 715 mm (33 and 28 inches, respectively). This is higher than some previous estimates for the area, but was considered to be more accurate based on comparisons with actual measurements obtained at Kimberly, Idaho. These results also are expected to be useful in evaluating the water requirements of pasture and other crops grown in high mountain valleys.

ACKNOWLEDGEMENTS

We express appreciation to Harvey Bickett for offering his farm as a measurement site, for generously providing the needed electricity, and for his support and cooperation and also to John Stevenson and William Sherbine for providing alternate sites. Many others in the study area also helped provide background information on the area and assisted in other ways.

The technical assistance of James E. Chapman and John L. Stevens, who were largely responsible for maintaining and reading the instruments and reducing the data, also is gratefully acknowledged.

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SECTION II

INTRODUCTION

The determination of evapotranspiration for the Bellevue Triangle was undertaken to provide part of the data base needed for a complete hydrologic study of the basin. Evapotranspiration (ET), which is the evaporation and transfer of water from the soil surface and plants to the atmosphere, is an important component of a complete water balance. While it is difficult to measure ET directly for a large area, procedures are available to estimate ET from climatic and meteorological data. Such data were not previously available for the study area.

This report describes the procedures used and contains results of the measured meteorological and climatic parameters, and estimated ET for the Bellevue Triangle. The ET data will be used as input to a hydrologic model being used to evaluate impacts of impending changes in land use and irrigation practices. Results of other aspects of the study such as precipitation are reported separately by other cooperating agencies.

Location:

The "Bellevue Triangle" is a mountain valley located in central Blaine County, Idaho at an elevation of about 1500 m (4921 ft). Bellevue is located at the northern point, foothills border the east and west sides, and the Picabo and Timmerman Hills border the south side roughly forming a triangle. The Big Wood River enters the area at Bellevue and flows along the western side. Small grains, alfalfa, and irrigated pasture are the principle crops grown on approximately 218 square kilometers (84 square miles) of land in the valley. Silver Creek originates from springs in the southern portion of the area and flows to the southeast eventually joining the Little Wood River. An extensive artesian aquifer underlies the area. Recharge of this aquifer is augmented by large amounts of irrigation water applied to very porous soils in the upper portion of the triangle. Numerous springs exist in the lower portion of the triangle.

Silver Creek is known as one of the best fly-fishing trout streams in the United States. As a tributary to the Little Wood River it also provides water for irrigation downstream. Agriculture and recreation are the leading industries in Blaine County. Because of these factors impending changes that could affect the flow of Silver Creek are of considerable importance to the future economy and land use of the area.

Nature of the Problem:

The Sun Valley resort complex, located north of the study area, has experienced considerable growth and as a result services and housing developments are encroaching into the Bellevue Triangle. At the same time surface flood irrigation systems on the gravelly soils in the valley are being converted to sprinkler irrigation. While this may be a desirable shift agriculturally, it greatly reduces the water applied to the soil and is expected to reduce the annual recharge of the underlying aquifer and subsequently reduce the flow of Silver Creek. A comparable increase in the flow of the Big Wood River into Magic Reservoir would be expected. This could greatly alter water supplies to downstream users in the respective irrigated areas.

Residents of the area are concerned about the effects of these changes on both the quality and quantity of water in Silver Creek and the Little Wood River. A hydrologic computer model developed to study groundwater problems in other areas in Idaho is being used to evaluate management alternatives for the Triangle. Once calibrated this model can be used to evaluate and predict possible long range effects of converting irrigated land to housing or business developments and the effect of substituting sprinkler systems for surface irrigation. Other alternatives, such as the establishment of artificial groundwater recharge sites can also be studied.

The purpose of this portion of the study was to determine the rate of ET for the various crops grown in the study area. ET is a major input component of the hydrologic model. Direct measurement of ET was not feasible so it was estimated from measured climatic data and cropping conditions using well-established procedures.

SECTION III

METHODS

Climatological Stations:

A climatological station was established on the Harvey Bickett farm bordering Highway 20 in the southcentral part of the Triangle, approximately 2.5 miles east of the junction of highways US 93 and Idaho 68. This site provided convenient access to AC power and minimum interference from farm buildings and tall trees. The surrounding land is relatively flat and used primarily for barley. The Bickett farm is in the region of small spring-fed streams forming Silver Creek.

Meteorological instruments were installed in late November 1974 and were operated continuously through December 1975. Complete records were obtained for each day except for occasional omissions caused by power or instrument failures. Measurements included solar radiation, and air temperature, humidity, windspeed and direction at 2 m above the ground.

An additional substation was installed on a farm of John Stevenson, approximately 4 miles north and 1 mile west of the Bickett station. Windspeed and direction were recorded at this site using a mechanical weather station and air temperature and humidity were measured with a hygrothermograph.

Attempts to measure soil water content with a neutron meter on the William Sherbine farm were unsuccessful because of the large rocks present in the deeper soil layers which prevented the installation of aluminum access tubing to the necessary depths.

Instrumentation:1/

The primary climatological station at Bickett's farm was equipped with the following instruments.

1. An Eppley Model 50 (50 junction) pyranometer to measure solar radiation. It was calibrated to an Eppley Precision Pyranometer, Model 15, maintained at the Snake River Conservation Research Center (SRCRC) solely for calibration purposes.

1/ Trade names and model numbers are provided for the convenience of the reader and do not imply endorsement or recommendation by the U. S. Department of Agriculture.

2. An electronic millivolt integrator (SRCRC design) with an accuracy of approximately ± 0.5% to record the solar radiation. It was equipped with a Sodeco Printing Counter, Model PL-205, which recorded the month, day and time of the hourly integrated solar radiation.

3. Mechanical weather station to record windspeed and direction and temperature (Meteorological Research Incorporated, MRI, Model No. 1072).

4. Aspirated temperature and humidity sensor (SRCRC design) using copper-constantan thermocouples to sense temperature and a lithium chloride dewprobe (Honeywell Model SSP 129B Dewprobe) for humidity.

5. A multichannel strip chart, millivolt recorder (Leeds and Northrup Speedomax "W") to provide a continuous record of temperature and humidity.

6. A hygrothermograph with 7-day chart to provide a backup record of air temperature and relative humidity.

The strip chart recorder, millivolt integrator, and printer were housed in a well-insulated instrument shelter located nearby. The temperature in the shelter was thermostatically controlled with light bulbs for heating and fan for cooling to minimize temperature effects on sensitive electronic circuits.

Data were manually tabulated from the strip charts and other records for analysis. These included maximum, minimum, and 0800-hour air temperatures, and the temperature of the dewprobe at 0800 and at the time of maximum air temperature. Dewpoint temperature, corresponding vapor pressure and relative humidity were calculated from the dewprobe data. Wind travel and average wind direction were tabulated for each hour from the MRI records. Daily wind direction was the direction with greatest wind travel. Solar radiation was recorded hourly (except for 2-hour periods initially) from which daily totals were calculated. Whenever records for any of the primary variables were missing, data were substituted from other records directly or by interpolation since it was necessary to have a complete data set for the ET computations.

Potential ET was calculated on a daily basis from the climatological data by several procedures. After initial evaluation, the most reasonable daily values were summed for 7-day periods for use in the hydrologic model. Estimated ET for each crop was calculated as the product of an appropriate crop coefficient and potential ET.

Net Radiation:

Net radiation was estimated using procedures described by Wright and Jensen (1972):

$$R_n = (1 - \alpha)R_s - R_b \qquad [1]$$

where $(1 - \alpha)R_s$ represents net short-wave radiation received by the reference field, in this case, alfalfa, α is the short wave reflectance or albedo assumed to be 0.23 during May-August, R_s is solar radiation, and R_b is the net back or outgoing thermal radiation.

Net thermal radiation was estimated from:

$$R_b = \left(a \frac{R_s}{R_{so}} + b \right) R_{bo} \qquad [2]$$

where R_{bo} is the net outgoing long wave radiation on a clear day, and R_{so} is the solar radiation that would normally be expected on that day if there were no clouds. Values of R_{so} established from several years of data for Kimberly were used assuming that clear day values would be quite similar for the two areas. R_{bo} was estimated from

$$R_{bo} = \varepsilon' \sigma T^4 \qquad [3]$$

where $\varepsilon' = (0.325 - 0.044\sqrt{e_d})$ $11.71 \times 10^{-8} T^4$, for T_c greater or equal to 0°C; ε' is the net emmissivity when using only screen height temperature, e_d is the saturation vapor pressure at 0800 in mb and 11.71×10^{-8} is the Stefan-Boltzman constant in cal cm^{-2} day^{-1} $°K^{-4}$, and T is the shelter or screen temperature in degrees Kelvin (temperature in °Kelvin is $T = 273.15 + °C$).

For temperatures below zero °C, net emissivity was calculated using an equation suggested by Idso and Jackson (1969).

$$\varepsilon' = -0.02 + 0.261 \exp[-7.77 \times 10^{-4} (273 - T)^2] \qquad [4]$$

Potential Evapotranspiration

Potential evapotranspiration was estimated by several methods, the principle method adopted was that developed by Penman (1948, 1963).

$$E_{tp} = \frac{\Delta}{\Delta+\gamma}(R_n - G) + \frac{\gamma}{\Delta+\gamma}\ 15.36(1.0 + 0.0062u_2)\ (e_z^o - e_z) \qquad [5]$$

where u_2 is windspeed at 2 m in km day^{-1} and e is in mb based on 0800-hour dewpoint temperature (for windspeed in miles day^{-1} use $0.01u_2$). Values of $\Delta/(\Delta+\gamma)$ versus temperature (°C) for an elevation of 1500 m (4921 ft) are respectively: -10, 0.292; -5, 0.367; 0, 0.445; 5, 0.523; 10, 0.595; 15, 0.661; 20, 0.719; and 25, 0.769. The term $\gamma/(\Delta+\gamma)$ equals $(1 - \Delta/(\Delta+\gamma))$.

According to recent evaluations at several locations, the Penman equation tends to overestimate ET during cool, spring, winter, and fall, conditions. Originally Penman recommended corrections ranging from 0.6 to 0.8 to adjust for these deviations. Furthermore, recent evaluations of the Penman equation for arid conditions during warm seasons have shown that it tends to under estimate potential evapotranspiration. Consequently, we adjusted the Penman estimates in a manner proportional to that originally recommended in 1948 using a normal distribution function.

$$C_c = 0.7 + 0.4\ \exp\ (-(((m + N/30)30)-210)/120)^2) \qquad [6]$$

where C_c is the seasonal correction factor, m is the month, N day of the month, and the value 210 is used to obtain a peak correction value of 1.1 on June 30.

Potential ET was also estimated for advective conditions using coefficients developed in extensive studies for Kimberly as described by Wright and Jensen (1972). In this case the term $(1.0 + 0.0062u_2)$ in equation [5] was replaced by $(0.75 + 0.0109u_2)$. These estimates of ET represent the maximum rate expected for a well-watered, actively growing crop in an irrigated area surrounded by arid lands.

Estimates of lake evaporation were made using the Kohler, Nordenson, and Fox (1955) equation. Also, evaluations indicate that these estimates closely approximate cool season ET.

$$E_L = 0.7\left(\frac{R_n\Delta + \gamma_\ell E_a}{\Delta + \gamma_\ell}\right) \qquad [7]$$

$$E_L = 0.7 \left(\frac{R_n \Delta}{\Delta + \gamma_\ell} + \frac{\gamma_\ell E_a}{\Delta + \gamma_\ell} \right) \quad [8]$$

$$E_a = (e_z^o - e_z)^{0.88} (0.37 + 0.0041W) \quad [9]$$

where the vapor pressure deficit is in inches Hg, W is in miles day^{-1} at 61 cm, R_n is net radiation expressed as the equivalent depth of evaporation in inches, γ_ℓ = 0.000367P in inches Hg./°F, and E_L is estimated lake evaporation in inches.

Another equation used to estimate evapotranspiration under non-advective evaporation conditions was that of Priestley and Taylor (1972). They correlated maximum ET and the first term of the combination equation under non-advective conditions and found that a single constant, α, averaging 1.26 adequately adjusted the relationship.

$$ET_{max} = \alpha \frac{\Delta}{\Delta + \gamma} (R_n - G) \quad [10]$$

Estimates of ET were also made with the Jensen-Haise equation using correlations for elevation (Jensen, et al., 1970).

$$E_{tp} = C_T (T - T_x) R_s \quad [11]$$

where E_{tp} is potential ET, C_T is a temperature coefficient, T_x is the intercept of the temperature axis, T is average air temperature, and R_s is daily solar radiation expressed in evaporation equivalents. The coefficients are constant for a given area and are defined as:

$$C_T = 1/(C_1 + C_2 C_H)$$

$$C_H = (50\ \text{mbar})/(e_2 - e_1)$$

where e_2 and e_1 are the saturation vapor pressures at the mean maximum and mean minimum temperature for the warmest month of the year in an area, and C_2 = 7.6°C. C_1 = 38 - (2°C x elev. in m/305) and T_x = -2.5 - 0.14 $(e_2 - e_1)$°C/mb - elev. (m)/550.

An estimate of ET for wet meadows at high elevations was made with the empirical equation of Kruse and Haise (1974). They derived coefficients for equation [11] from water use studies on wet meadows at several locations in Colorado.

$$E_t = (0.0123T - 0.147)R_s \qquad [12]$$

where T is average daily temperature (°F) and R_s is total daily solar radiation expressed in evaporation equivalents.

Crop Coefficients and ET Estimates

Crop coefficients were developed from information presented by Jensen (1974), and the recent FAO report on Crop Water Requirements (Doorenbos and Pruitt, 1975). A crop coefficient of 0.75 was selected for willows as recommended by Blaney (1961). Estimates of ET were compared with values reported in the recent ASCE Report on Consumptive Use of Water (Jensen, 1974); the University of Idaho Bulletin 516, Consumptive Irrigation Requirements for Crops in Idaho, July 1970; and Vegetative Water Use in California, Bulletin 113-3, State of California, April 1975.

Computations

The reduction and conversion of the climatic measurements and the calculation of potential ET and lake evaporation by the several methods was accomplished with a programmable calculator (HP 9830). The program, written in BASIC computer language, permitted the evaluation of a large amount of data in a relatively short period of time. The program is not included as a part of this report but is available upon request to those who may be interested.

SECTION IV

RESULTS

Daily Data

The measured and computed daily climatic data obtained for the Bickett station for December 1974 through December 1975 are presented in Appendix A. The computed values of net radiation, soil heat flux, and estimates of transpiration and lake evaporation by the six different methods previously discussed are also included. These constitute the data base for the computations of water-use for the several crops grown in the area.

The development of water-use data for use in the hydrologic model was one of the primary objectives of this study. The ET data were therefore summarized in a manner suitable to its needs for 7-day computational periods beginning with November 9, 1974. Since the climatic station was not established by November 1, 1974, November 1975 data were substituted for the first few periods.

General weather and cropping patterns observed in the Bellevue Triangle during this study are summarized in Table 1. The winter of 1974-75 deviated from normal in some respects and snow accumulation was light until February after which near record amounts fell and snow cover lasted until mid-April. Spring weather was very cool delaying hay growth and the planting of grain.

Weekly Evapotranspiration

Computed estimates of potential ET and ET for each crop calculated with appropriate crop coefficients are presented in Table 2 for 7-day periods beginning with period 23, April 12-18, through period 51, October 25-31. There was a general rain the week of May 18 so an average crop coefficient of 0.6 was used for most crops for period 28 since the soil surface was wet much of the time. Data for the non-growing season when evaporation was taken to be similar over the entire area are presented separately in Table 2.

Curves showing estimates of the average daily potential ET and lake evaporation for the 7-day periods are presented in Figure 1. The curve based on Penman estimates represents the upper level of mean daily ET expected for a growing crop in the area. The EKE curve developed

Table 1. Summary of general climatic and crop conditions in the Bellevue Triangle Study Area during late 1974 and 1975

Dates	Conditions
1974	
Nov 15-Dec 15	Meteorological instruments installed at Bickett and Stevenson sites
Dec	Snowfalls were light with intermittent snow cover
1975	
Feb	Major snow accumulation began
Feb 20	Approx. time of deepest snow depth, 60 cm (24 in.), at Bickett site
Apr 20-28	Snow cover receeded rapidly with some exposure of soil surface.
Apr 25-May 5	Intermittent snow showers
May 12	Soil surface mostly dry
May 15-20	Spring grain being planted
June	Spring grain approximately 10 cm tall
July 10-15	Grain began heading
July 8-20	First crop hay cut
July 25	Grain in full head
Aug 10	Grain started ripening
Aug 29	First frost (minimum air temperature -1.1°C)
Sep 5-15	Second crop hay cut
Sep 5-25	Grain harvested
Nov 12	Light snow cover
Dec 1	Snow cover, 15 cm (6 in.)
Dec 15	Snow cover, 5 cm (2 in.)

Table 2. Estimated potential evapotranspiration E_{tp} and ET for several crops summed for 7-day periods beginning November 9, 1974, Bellevue Triangle Idaho. During the nongrowing season evaporation was assumed uniform for all crops.

Period	Beginning day	E_{tp} (mm)	ET (mm)	Period	Beginning day	E_{tp} (mm)	ET (mm)
1	11/09	6.1	5.2	13	02/01	4.0	3.4
2	11/16	4.8	4.1	14	02/08	5.8	4.9
3	11/23	4.6	3.9	15	02/15	4.3	3.7
4	11/30	4.6	3.9	16	02/22	3.2	2.8
5	12/07	3.0	2.6	17	03/01	6.4	5.4
6	12/14	3.0	2.5	18	03/08	6.2	5.3
7	12/21	2.6	2.2	19	03/15	7.0	6.0
8	12/28	1.6	1.4	20	03/22	8.5	7.2
9	01/04	1.4	1.2	21	03/29	6.4	5.4
10	01/11	1.7	1.4	22	04/05	9.2	7.8
11	01/18	3.8	3.3				
12	01/25	3.4	2.9	52	11/01	9.2	7.8

Period	Beginning day	E_{tp}	Evapotranspiration (mm)					
			Alfalfa	Small grain	Irrigated pasture	Potato	Willows	Waste
23	4/12	9.2	7.8	7.8	7.8	7.8	7.8	7.8
24	4/19	11.7	9.8	9.8	9.8	9.8	9.8	9.7
25	4/26	18.6	9.3	9.3	9.3	9.3	9.3	9.3
26	5/03	19.5	15.6	15.6	15.6	15.6	15.6	15.0
27	5/10	42.2	19.4	10.1	25.3	10.1	25.3	25.3
28	5/17	36.2	22.8	22.8	22.8	22.8	27.2	22.8
29	5/24	42.2	33.3	10.1	31.6	10.1	31.6	23.2
30	5/31	49.5	46.0	10.9	37.1	10.4	37.1	21.8
31	6/07	50.2	50.2	20.1	37.6	10.5	37.6	5.0
32	6/14	41.6	41.6	27.8	31.2	10.0	31.2	4.2
33	6/21	36.0	36.0	32.1	27.0	9.0	27.0	7.2
34	6/28	47.6	47.6	47.6	35.7	13.3	35.7	7.1
35	7/05	47.4	33.6	49.3	35.5	16.6	35.5	4.7
36	7/12	43.7	21.8	45.4	32.8	19.7	32.8	2.2
37	7/19	46.4	32.9	47.3	34.8	25.5	34.8	4.6
38	7/26	38.9	35.8	37.3	29.1	25.3	29.1	1.9
39	8/02	46.6	46.6	38.2	35.0	35.0	35.0	2.3
40	8/09	41.6	41.6	27.8	31.2	33.2	31.2	2.1
41	8/16	31.1	31.1	15.5	23.3	27.0	23.3	3.1
42	8/23	35.6	35.6	10.0	26.7	31.7	26.7	7.1
43	8/30	33.9	33.9	6.8	25.4	30.5	25.4	1.7
44	9/06	34.1	22.5	6.8	25.6	29.3	25.6	1.7
45	9/13	31.4	17.6	6.3	23.6	24.5	23.6	1.6
46	9/20	28.4	23.0	6.3	21.3	17.1	21.3	1.4
47	9/27	25.9	24.6	6.0	19.4	10.4	19.4	1.3
48	10/04	21.0	20.0	8.4	15.8	8.4	15.8	8.4
49	10/11	14.6	13.9	12.4	10.9	12.4	10.9	3.6
50	10/18	16.3	9.0	9.0	9.0	9.0	9.0	5.7
51	10/25	6.2	5.0	5.0	5.0	5.0	5.0	5.0
TOTAL		947.6	787.9	561.8	695.2	499.3	699.6	216.8

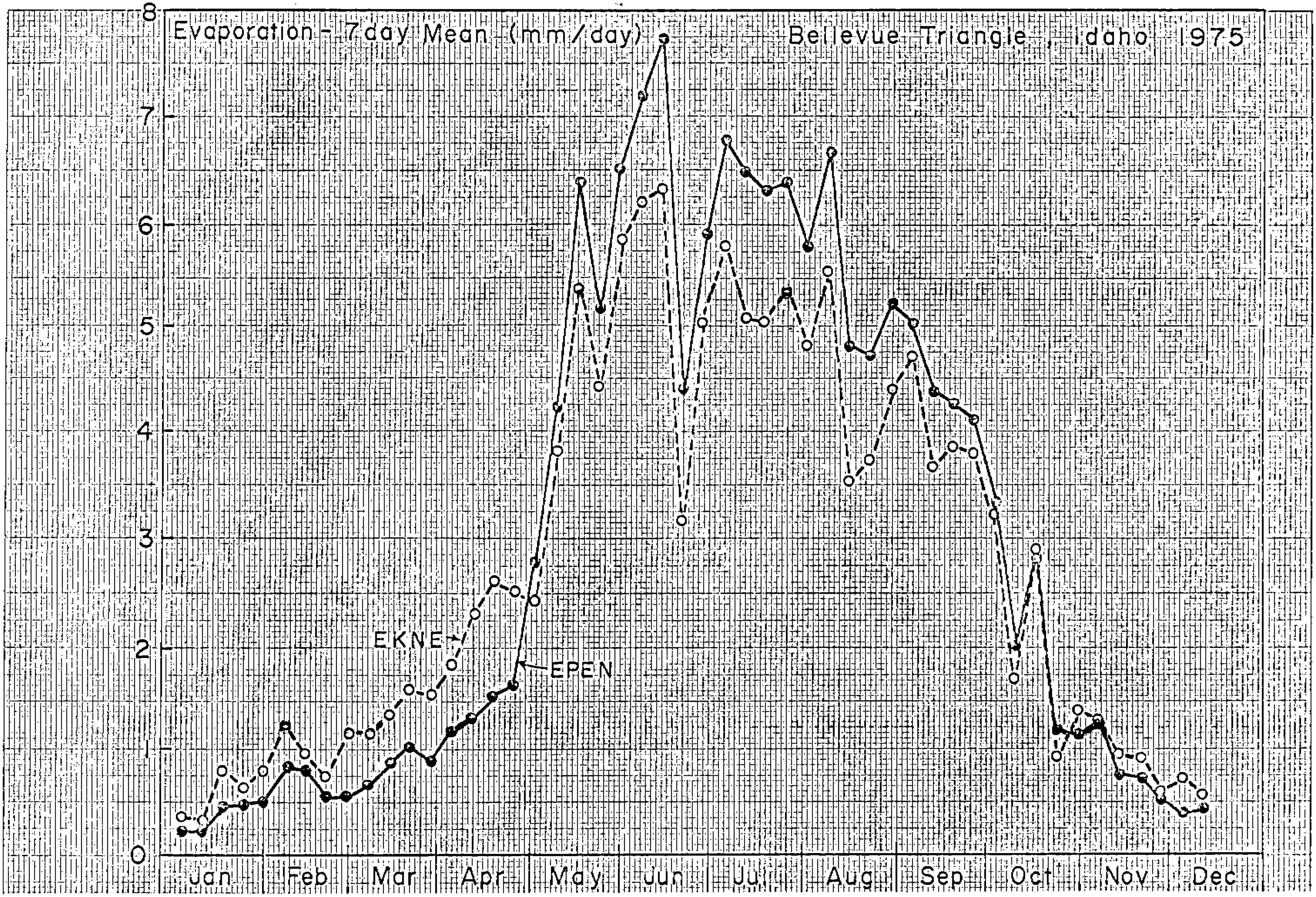

Fig. 1. Estimates of average daily potential ET (EPEN) calculated by the Penman method and lake evaporation (EKNE) calculated by Kohler-Nordenson-Fox equation for 7-day periods.

by the Kohler-Nordenson-Fox equation represents expected evaporation from the surface of a body of water such as a lagoon or a lake. The data graphically show that evaporation levels are relatively low during winter and early spring but increase dramatically during May because of high levels of radiation, warming temperatures, relatively dry air, and high windspeeds. Comparing April to May (using data in Appendix A) average air temperature increased from -1.2°C to 7.9°C, relative humidity during midday dropped from 60% to 36%, net radiation increased from 100 to 280 ly/day, and windspeed increased from 2.5 to 3.4 m/sec. During June there was a period of cool weather accompanied by decreased windspeed. During the summer months ET values are lower than for some days in May and early June even though temperatures are higher because of greatly reduced windspeed.

Average daily values of potential ET and ET for alfalfa, small grains, and irrigated pastures for the 7-day periods are presented in Figure 2. ET for alfalfa was assumed to equal potential ET once cover was established in the spring except for about 2 weeks following each cutting. ET for row crops and small grains was low until full cover was achieved except for periods of rain because of the high proportion of exposed bare soil from which evaporation occurs at a low rate when the surface is dry. Small grains ripen rather quickly so the water use curve dropped off rapidly after maturity.

Solar Radiation

A comparison of the average daily solar radiation for each month measured at the Bickett station and at Kimberly during 1975 is presented in Figure 3. (The unit ly is equivalent to 1 cal/cm^2 or 4.184 J/cm^2 and 1 J = 1 watt-sec). These results show that during winter and early spring, solar radiation was higher at the Bellevue Triangle station than at Kimberly. This agrees with casual observations in that frequently during the winter and spring skies were cloudy over Kimberly and the Snake River Valley but were clear over the Bellevue area. This is probably a typical situation. During July, August and September high pressure conditions predominate the weather pattern and sky conditions are very similar at both locations. The similarity of the measured values during this time is especially encouraging. Since the Bellevue

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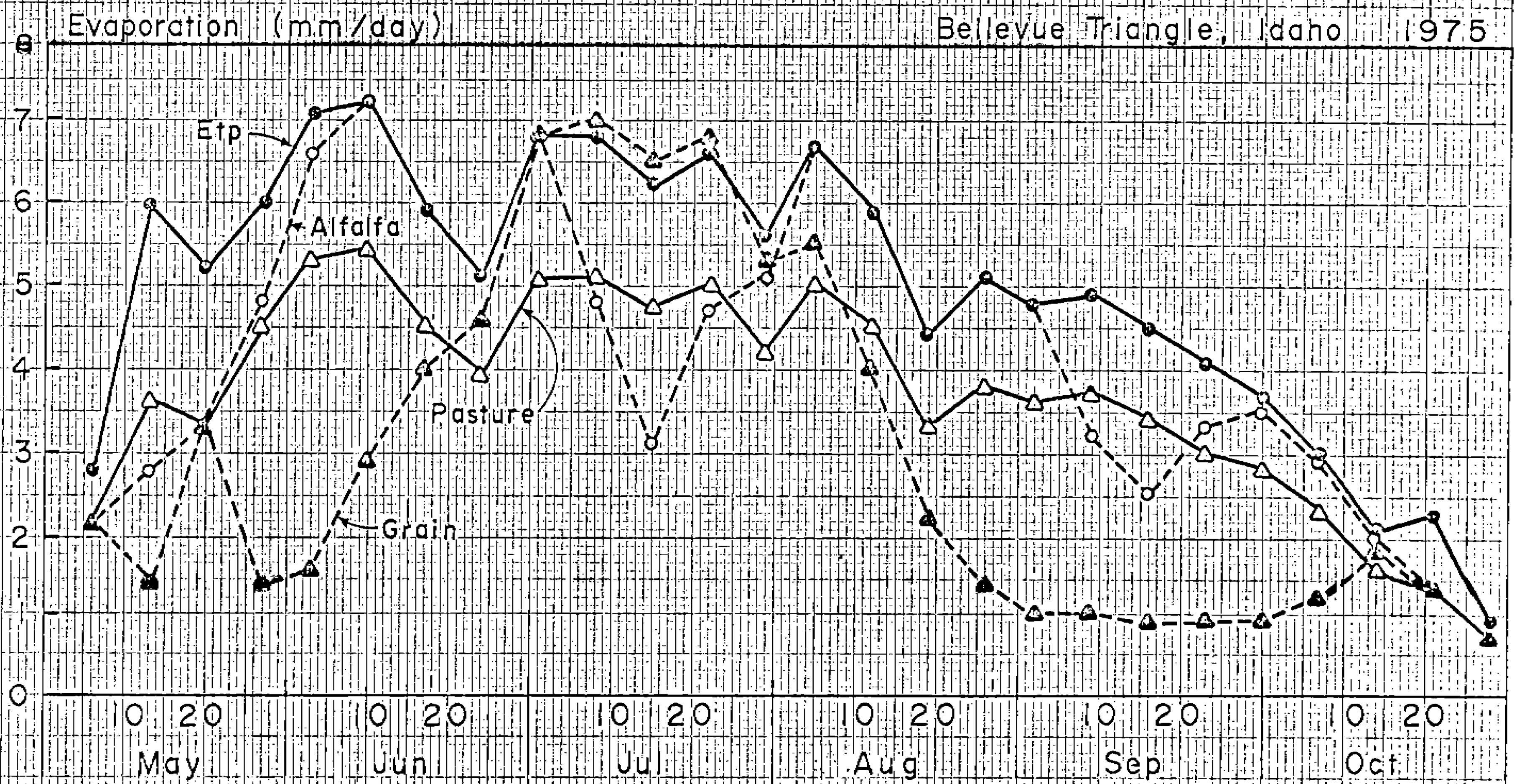

Fig. 2. Average daily values for 7-day periods of potential ET (Etp) and ET calculated with appropriate crop coefficients for alfalfa, pasture, and grain. There was a general rain the week of May 18. Alfalfa was cut July 10-20 and September 10-20

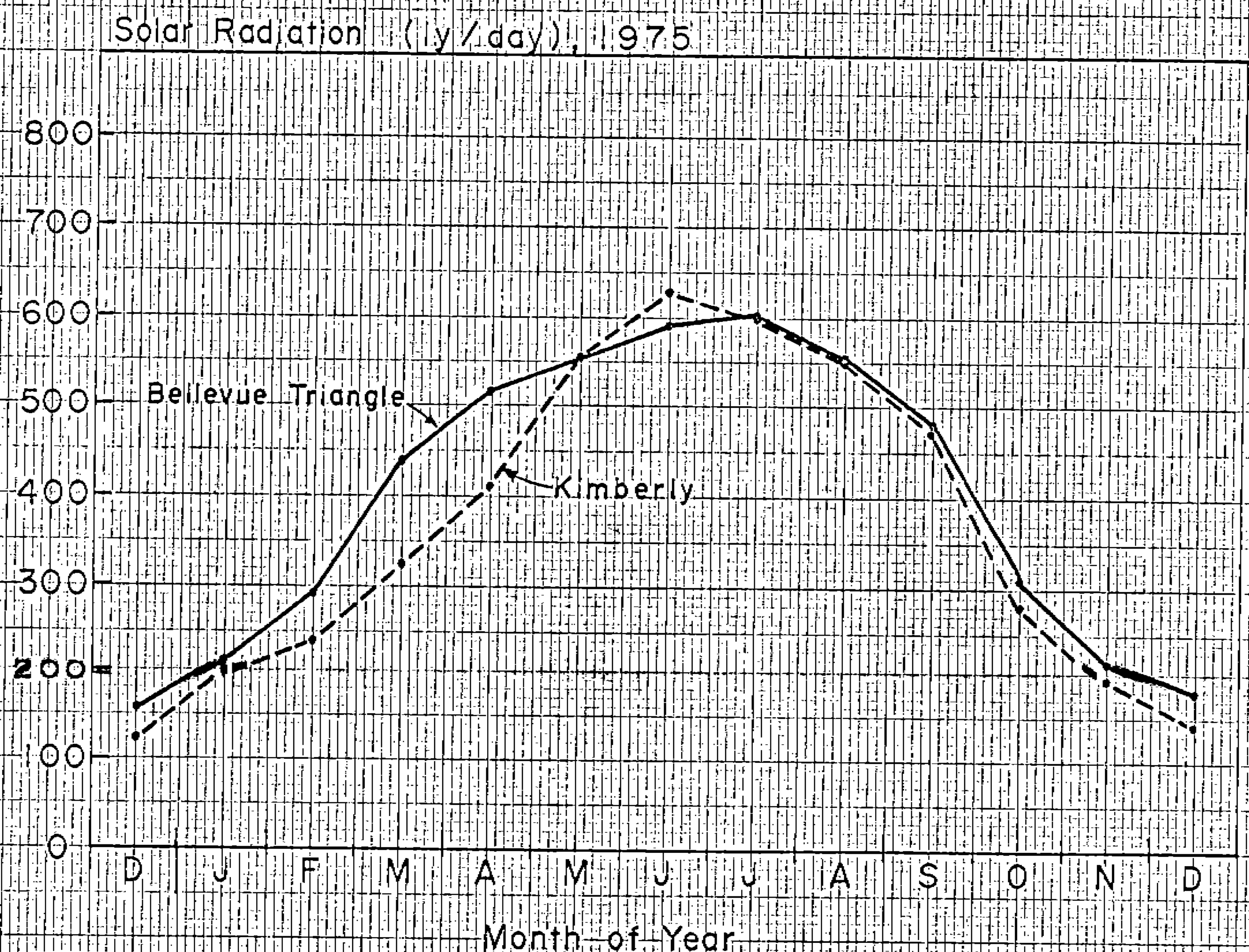

Fig. 3. Comparison of the average daily solar radiation for each month of 1975 measured at the Bickett site in the Bellevue Triangle and at Kimberly, Idaho.

site is approximately 300 m (984 ft) higher in elevation than Kimberly and has somewhat less industrial haze, higher radiation would be expected with clear skies. The higher latitude would decrease the potential radiation only a small amount.

These results justify the use of clear day solar values established for Kimberly in the computation of net radiation for Bellevue using equation [2]. Several years of data accumulated at Kimberly were used to obtain the expected clear day values whereas only limited data were available from the one year of measurements at the Bickett site.

Monthly Evapotranspiration

Estimated ET for several of the crops in this study were compared with results of previous studies. The University of Idaho Bulletin 516 (Sutter and Corey, 1970) contains a tabulation of estimated consumptive use for various crops for locations throughout Idaho for which some climatic data were available. The consumptive use values were computed with a modified Blaney-Criddle equation and data were included for Hailey, which is about 6 miles north, and Fairfield, which is 25 miles west of the Bellevue Triangle. The data for Hailey were used to compare with data obtained in this study. A comparison of monthly totals of ET as calculated in this study with consumptive use data reported in Bulletin 516 is presented in Table 3 for several crops. Also presented are alfalfa ET data measured at Kimberly with a sensitive weighing lysimeter in 1975.

Data in Table 3 reveal that the consumptive use data in Bulletin 516 appear to be much too low for the area. Bulletin 516 reported a value of 555 mm (21.8 in.) for alfalfa which is only 78% of our value of 715 mm (28.2 in.) which compares well with the 793 mm-measurement at Kimberly. The two different estimates for small grains and potatoes were quite close as shown in Table 3, but the Blaney-Criddle estimates for irrigated pasture were much lower, 450 mm versus 625 mm (72%). The estimates of ET for alfalfa and pasture presented in Bulletin 516 are probably too low because of the effects of higher altitudes where temperatures are low but solar radiation levels are high.

Table 3. Comparison of monthly ET (mm) estimated for 1975 for several crops for the Bellevue Triangle with that previously estimated for Hailey, Idaho with the Blaney-Criddle method, and ET measured for alfalfa with a weighing lysimeter at Kimberly, Idaho.

Crop	Estimate	Monthly ET (mm)							Total*
		Apr	May	Jun	Jul	Aug	Sep	Oct	
Alfalfa	ARS	34	101	186	152	172	104	52	715
	UI**	--	36	120	173	143	46	19	555
	LYS***	52	138	166	180	163	145	--	793
Small grain	ARS	34	59	97	201	101	28	38	486
	UI	--	44	118	194	66	1	--	423
Irrigated pasture	ARS	34	106	142	149	129	99	45	625
	UI	10	52	103	148	112	35	7	450
Willows	(Same as irrigated pasture)								
Potatoes	ARS	34	65	43	89	141	96	38	434
	UI	--	1	49	165	178	60	--	453
Waste (Dry-land)	ARS	34	98	41	18	16	7	25	180

*Total for May through September

** Data from University of Idaho, Bulletin No. 516, July 1970 for Hailey.

*** Measurements at Kimberly with weighing lysimeter, 1975. Cutting dates for Kimberly were July 23, August 13, and September 20 and for the Bellevue Triangle, June 15 and September 15.

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APPENDIX A

Daily Climatic and Evapotranspiration Data

This Appendix consists of Table A-1 which contains daily data on facing pages for each month. Measured and computed climatic variables for the Bickett station in the Bellevue Triangle, calculated net radiation, soil heat flux, and evaporation estimated by six different methods are included. Averages for each month are shown at the bottom of each table. Notes give the source of data when primary measurements were missing.

Column notations are explained as follows:

TMAX	Maximum air temperature, midnight to midnight, read from strip chart
TMIN	Minimum air temperature as for TMAX
0800 TDPT	Dewpoint temperature at 0800 hours, calculated from dewprobe temperature read from strip chart
0800 RH	Relative humidity at 0800 hours
TMAX RH	Relative humidity at time of TMAX
RSOL	Daily total solar radiation obtained from integrator printout
WIND SPEED	Average daily windspeed calculated from MRI srip chart data
WIND DIR	Wind direction of greatest daily wind travel calculated from MRI strip charts
TAVG	Average daily air temperature calculated from TMAX and TMIN
VPRS	Vapor pressure in millibars calculated from dewprobe temperature at 0800 hours
RNET	Daily net radiation calculated from measured solar radiation (RSOL) and assumed clear day solar radiation, Eq [1] to [4]
ESTG	Estimated daily soil heat flux calculated with TAVG
EJ-H	ET computed by Jensen-Haise method, Eq [11]
EPEN	ET computed by Penman method, Eq [5] to [6]
EJLW	EPEN with coefficients for Kimberly, Idaho (page 8)
EP-T	Evaporation by the Priestley-Taylor approach, Eq [10]
EKNE	Lake evaporation by the Kohler-Nordenson-Fox approach, Eq [7] to [9]
ECOL	ET by the Kruse-Haise equation, [12]

The variable "ALBEDO" is the α term of Eq. [1] and is the albedo or reflectance. The value was varied from 0.23 for the summer to 0.55 for the winter with snow cover.

CLIMATIC DATA (BICKETT STATION) DEC 1974

DAY	TMAX C	TMIN C	0800 TDPT C	0800 RH %	TMAX RH %	RSOL LY	-WIND- SPEED M/S	DIR
1	4.4	-9.4	-12.7	68	40	259	3.74	-
2	5.6	-8.3	-12.3	70	32	228	4.95	-
3	5.0	-2.8	-7.9	57	39	84	3.02	-
4	0.9	-0.6	-0.4	93	62	76	1.45	E
5	0.6	-3.3	-3.1	90	85	224	1.71	W
6	-0.6	-6.1	-10.1	73	73	156	1.12	W
7	1.7	-6.7	-7.9	87	78	119	1.17	S
8	-1.1	-10.6	-11.4	82	68	215	1.40	E
9	-1.7	-11.7	-14.8	74	64	204	1.15	E
10	-0.6	-11.1	-14.0	79	57	242	0.93	NW
11	1.1	-7.8	-7.1	89	76	120	1.30	NW
12	1.1	-9.9	-13.1	71	51	179	2.48	E
13	-0.6	-8.9	-8.4	74	59	165	7.25	W
14	-1.7	-11.7	-11.4	78	67	112	1.53	W
15	0.0	-7.2	-8.4	71	70	114	2.09	W
16	1.7	-11.7	-9.3	89	76	153	1.06	E
17	0.6	-8.9	-5.7	77	72	204	5.77	W
18	-2.2	-13.3	-12.7	84	48	62	1.96	W
19	0.6	-11.7	-15.6	72	65	173	2.83	W
20	3.3	-6.1	-7.1	85	79	137	3.17	SW
21	2.8	-8.3	-5.3	90	65	63	4.27	W
22	-5.0	-14.4	-14.4	77	63	181	5.29	W
23	-5.0	-15.0	-16.8	57	53	204	1.58	E
24	-6.7	-15.0	-14.8	81	62	143	1.21	E
25	-6.1	-15.0	-13.6	78	68	120	0.88	E
26	-6.1	-15.0	-18.4	72	68	170	1.70	N
27	-3.3	-11.1	-8.4	84	70	42	3.11	E
28	-4.4	-16.7	-9.7	86	91	117	1.73	E
29	-13.3	-30.0	-33.3	73	70	225	0.82	NW
30	-10.0	-25.6	-16.8	78	80	132	0.82	NW
31	-17.8	-29.4	-29.8	87	78	233	0.60	NW
AVERAGES	-1.7	-11.7	-12.1	77.5	63.8	157	2.33	

NOTES:

a. Dec. 1-16: Solar radiation data calculated from Kimberly data

b. Dec. 1-3: Wind data from Stevenson site

CLIMATIC DATA (BICKETT STATION)   JAN 1975

DAY	TMAX C	TMIN C	0800 TDPT C	0800 RH %	TMAX RH %	RSOL LY	-WIND- SPEED M/S	DIR
1	-11.7	-28.9	-30.1	73	77	191	1.04	W
2	-14.4	-28.9	-28.6	84	77	209	0.95	NW
3	-8.3	-22.8	-23.1	73	71	179	1.08	N
4	-1.1	-14.4	-10.6	84	68	217	5.23	W
5	-6.1	-16.7	-16.4	68	84	115	0.89	SW
6	0.0	-17.2	-6.6	72	65	145	3.73	W
7	-3.3	-17.8	-16.8	82	68	215	2.07	-
8	-0.6	-15.0	-5.3	80	89	193	4.30	-
9	-7.8	-15.6	-14.8	77	63	201	2.12	-
10	-10.6	-24.4	-20.6	78	84	315	1.68	-
11	-11.1	-26.1	-25.0	67	57	265	1.56	-
12	-11.7	-26.7	-26.0	68	50	181	1.88	-
13	-4.4	-11.7	-14.4	77	54	159	0.71	-
14	-4.4	-15.0	-17.2	76	74	218	1.15	W
15	2.8	-14.4	-6.6	75	63	137	1.79	W
16	2.2	-13.3	-5.3	90	78	196	1.40	SW
17	4.4	-8.3	-8.8	88	64	195	2.81	W
18	6.1	-10.0	0.0	79	55	255	4.08	W
19	-1.7	-15.6	-16.8	75	64	258	0.93	NW
20	5.6	-11.7	-10.6	84	54	263	4.97	W
21	-3.3	-18.3	-22.1	66	47	264	1.86	NW
22	-2.8	-16.7	-21.4	61	51	205	1.49	NW
23	0.6	-15.0	-17.2	69	85	159	1.42	NW
24	1.7	-2.2	-3.9	72	92	140	3.78	W
25	3.9	-5.0	-0.9	87	71	169	4.36	W
26	4.4	-7.8	-3.5	80	64	243	7.93	W
27	-7.2	-18.3	-14.8	81	85	240	1.25	NW
28	-8.9	-23.9	-25.6	77	62	278	1.36	NW
29	-7.2	-18.3	-21.7	65	56	304	2.64	W
30	-8.3	-22.2	-26.6	59	45	331	1.70	N
31	-5.0	-16.1	-18.8	69	72	244	3.28	E
AVERAGES	-3.5	-16.7	-15.5	75.1	66.4	216	2.43	

NOTES:

a. Jan. 7-11: Wind data from Stevenson site

CLIMATIC DATA (BICKETT STATION)   FEB 1975

DAY	TMAX C	TMIN C	0800 TDPT C	0800 RH %	TMAX RH %	RSOL LY	-WIND- SPEED M/S	DIR
1	1.1	-5.6	-7.5	83	58	198	4.15	E
2	3.3	-3.3	-6.6	64	51	154	4.14	E
3	0.0	-14.4	-4.8	86	75	258	1.29	S
4	-2.2	-7.8	-7.1	79	82	149	3.59	-
5	-3.3	-17.8	-14.8	74	73	302	4.71	-
6	2.2	-21.1	-21.0	76	73	267	0.93	-
7	1.7	-7.8	-9.7	79	73	229	4.10	W
8	2.2	-3.3	-5.3	80	73	287	5.92	W
9	7.2	-7.8	-9.7	79	75	177	2.12	W
10	-1.1	-5.0	-7.1	79	73	301	7.19	W
11	3.3	-11.1	-9.7	79	74	343	3.04	W
12	3.3	-6.1	-7.1	79	74	149	1.42	E
13	8.3	-5.6	-7.1	79	74	147	2.61	W
14	7.8	-8.9	-9.7	79	74	238	1.56	-
15	2.8	-16.7	-14.8	81	72	274	1.73	-
16	-0.6	-17.8	-14.8	81	73	271	1.38	-
17	0.0	-22.2	-21.0	76	72	352	1.12	-
18	-10.6	-17.8	-18.0	78	73	366	0.75	-
19	-3.3	-15.0	-13.1	71	89	246	1.47	-
20	-2.2	-19.4	-8.8	81	85	398	7.88	W
21	-9.4	-22.8	-25.3	47	46	434	1.73	W
22	-10.0	-28.9	-27.4	66	61	410	0.99	-
23	-8.9	-26.1	-23.7	79	69	425	0.99	-
24	-4.4	-22.2	-25.0	74	58	415	0.89	-
25	-8.9	-26.1	-28.3	78	82	432	0.76	-
26	-6.1	-25.0	-28.3	64	71	362	0.91	-
27	-2.8	-10.0	-9.3	89	86	307	0.65	-
28	2.2	-3.9	-3.5	91	85	314	1.04	-
AVERAGES	-1.0	-14.3	-13.9	76.4	71.7	293	2.47	

NOTES:

a. Feb. 5-17: Temperature data from M.R.I. unit.

b. Feb. 13: Solar data calculated from Kimberly data

c. Feb. 5-18: Humidity data estimated

CLIMATIC DATA (BICKETT STATION)   MAR 1975

DAY	TMAX C	TMIN C	0800 TDPT C	0800 RH %	TMAX RH %	RSOL LY	-WIND- SPEED M/S	DIR
1	3.9	-4.4	-4.8	82	73	366	1.12	-
2	3.3	-5.0	-3.9	92	61	430	3.84	W
3	0.6	-11.1	-11.0	85	69	441	1.36	W
4	0.6	-8.3	-12.3	67	72	404	1.45	W
5	0.6	-14.4	-14.0	83	67	457	1.27	NW
6	1.7	-6.7	-7.9	77	73	383	1.04	NW
7	2.2	-8.3	-8.4	77	70	325	2.92	E
8	2.2	-6.1	-2.2	92	75	384	0.93	NW
9	1.1	-7.8	-6.6	88	67	373	0.84	NW
10	1.1	-7.8	-4.4	89	69	416	1.47	W
11	-0.6	-10.0	-8.8	71	78	371	1.32	NW
12	-1.1	-13.3	-15.6	61	73	438	1.23	NW
13	1.7	-8.9	-10.1	70	56	427	2.22	SE
14	0.6	-12.2	-15.6	72	63	524	1.01	NW
15	1.7	-10.0	-14.0	58	44	402	0.95	NW
16	2.8	-6.7	-2.2	89	68	427	5.83	W
17	-2.2	-16.1	-17.2	79	63	366	1.49	NW
18	2.2	-3.9	-4.4	92	83	282	1.49	W
19	2.8	-1.1	-2.2	92	77	279	2.76	W
20	3.3	-8.9	-8.8	78	43	499	2.37	-
21	0.0	-8.9	-11.9	69	65	311	2.59	-
22	0.0	-11.1	-7.5	83	63	526	5.12	W
23	0.0	-18.9	-17.6	84	59	558	3.48	W
24	2.2	-6.7	-8.8	75	73	510	1.47	W
25	1.1	-3.3	-1.3	95	60	353	3.25	E
26	-3.9	-18.3	-8.8	81	60	521	5.22	-
27	-6.1	-17.2	-18.0	47	42	569	4.99	-
28	-7.2	-20.0	-18.4	60	38	618	2.78	-
29	-2.8	-17.8	-13.1	57	53	587	2.76	-
30	6.1	-10.0	-2.6	58	59	553	3.73	-
31	-3.9	-12.8	-4.4	168	76	458	2.81	W
AVERAGES	0.4	-10.2	-9.3	77.9	63.4	437	2.42	

NOTES:

a. March 31: Solar data calculated from Kimberly data

b. March 20-21, 26-30: Wind data from Stevenson site

c. March 4: Humidity data estimated

CLIMATIC DATA (BICKETT STATION) APR 1975

DAY	TMAX C	TMIN C	0800 TDPT C	0800 RH %	TMAX RH %	RSOL LY	-WIND- SPEED M/S	DIR
1	-2.2	-14.4	-11.9	83	48	439	2.40	W
2	-3.3	-17.2	-17.2	63	70	543	1.30	NW
3	1.7	-4.4	-3.5	91	76	359	1.97	E
4	1.7	-12.8	-11.4	82	49	549	1.49	-
5	1.7	-3.3	-5.7	83	68	445	2.87	-
6	-0.6	-3.9	-4.4	85	78	339	3.28	-
7	-0.6	-5.0	-6.6	88	64	585	4.23	W
8	1.7	-5.6	-7.5	83	62	534	6.17	W
9	-0.6	-6.7	-6.2	81	86	447	1.71	W
10	1.7	-8.3	-8.4	80	66	607	1.86	E
11	2.8	-6.1	-9.7	64	57	645	2.64	N
12	3.9	-8.9	-12.7	57	55	671	1.40	NW
13	5.6	-7.8	-11.9	64	44	650	1.32	NW
14	3.3	-4.4	-5.7	71	53	311	2.12	E
15	3.3	-2.2	-1.3	84	72	386	1.86	N
16	1.7	-3.3	-2.2	92	81	475	1.79	-
17	2.8	-3.9	-4.4	85	63	567	1.70	E
18	2.8	-8.3	-9.3	85	54	665	2.16	W
19	4.4	-7.2	-7.9	65	64	568	2.61	W
20	3.9	-6.1	-6.2	95	60	669	2.22	W
21	7.2	-5.0	-8.8	66	45	444	1.77	E
22	8.3	-3.3	-3.1	80	63	544	3.37	-
23	5.0	-1.7	-3.5	80	60	610	4.15	W
24	9.4	-5.0	-6.2	81	52	395	1.94	E
25	2.8	-1.7	-3.1	83	63	371	4.47	W
26	3.3	-3.9	-3.9	88	55	468	1.88	-
27	6.1	-1.1	-1.7	95	65	517	5.25	W
28	5.0	-3.9	-8.8	61	39	638	2.83	W
29	5.6	-2.2	-4.4	78	59	478	1.62	E
30	6.1	-1.1	-3.5	77	59	543	2.16	W
AVERAGES	3.1	-5.6	-6.7	78.4	60.0	515	2.55	

NOTES:

a. April 28–30: Temperature data from M.R.I. unit

b. April 5, 6, 16, 22, 26: Wind data from Stevenson site

c. April 29–30: Humidity data estimated

CLIMATIC DATA (BICKETT STATION) MAY 1975

DAY	TMAX C	TMIN C	0800 TDPT C	0800 RH %	TMAX RH %	RSOL LY	-WIND- SPEED M/S	DIR
1	6.7	-2.2	-4.4	78	59	657	2.83	W
2	10.0	0.6	-1.7	78	60	613	1.88	W
3	9.4	-2.2	-4.4	78	59	213	2.96	W
4	2.8	-2.8	-4.4	78	59	194	3.05	W
5	6.1	0.0	-1.7	78	45	446	2.51	E
6	8.9	-1.1	-3.5	77	41	376	4.45	W
7	9.4	1.7	-0.9	80	59	282	4.12	W
8	9.4	1.7	-0.9	80	59	273	2.24	E
9	15.0	3.3	1.3	80	60	573	1.94	E
1	18.9	2.8	1.3	80	60	631	1.96	N
11	13.3	3.3	1.3	80	60	523	2.81	SW
12	17.8	1.1	-0.9	80	61	[illegible]	2.38	-
13	20.0	1.1	1.8	77	22	657	3.58	-
14	25.0	5.6	0.5	51	18	638	5.29	-
15	24.4	7.2	0.9	49	28	634	2.78	SW
16	23.3	5.6	1.3	61	24	616	4.08	W
17	20.6	-0.6	1.3	87	28	721	3.30	SW
18	21.1	0.0	0.0	65	22	626	4.71	W
19	11.1	1.7	-3.1	48	45	373	6.78	W
20	8.3	-1.1	-3.1	80	39	482	2.35	SE
21	8.3	2.2	-1.3	78	59	387	3.26	S
22	12.8	1.1	1.8	89	58	519	2.14	S
23	17.2	1.1	1.8	68	38	627	4.45	SW
24	12.8	-1.1	-2.6	52	20	740	6.65	SW
25	12.8	-7.2	-10.1	50	22	724	4.04	W
26	16.1	-4.4	-7.1	50	15	546	2.12	SW
27	16.7	0.0	-0.4	63	27	621	2.10	-
28	17.2	2.8	1.3	64	22	641	3.05	-
29	20.0	1.7	-2.6	50	22	735	3.50	-
30	22.8	-0.6	-0.9	50	26	695	3.19	-
31	22.8	6.1	0.9	53	23	686	3.41	-
AVERAGES	14.9	0.9	-1.2	67.4	36.0	553	3.35	

NOTES:

a. May 1-4: Temperature data from M.R.I.

b. May 5-12: Temperature data from hygrothermograph

c. May 3: Solar data calculated from Kimberly data

d. May 12-14, 27-31: Wind data from Stevenson site

e. May 1-12: Humidity data estimated

CLIMATIC DATA (BICKETT STATION) JUN 1975

DAY	TMAX C	TMIN C	0800 TDPT C	0800 RH %	TMAX RH %	RSOL LY	-WIND- SPEED M/S	DIR
1	23.9	5.6	1.8	57	21	731	1.77	W
2	23.9	8.9	2.6	58	26	368	3.30	W
3	20.0	5.0	4.8	78	30	731	4.38	W
4	21.7	2.2	0.5	62	32	656	2.98	SW
5	26.1	3.9	3.5	66	23	750	2.61	W
6	26.7	7.8	4.3	56	22	728	3.89	W
7	24.4	8.9	6.0	64	18	694	4.81	W
8	18.3	4.4	-2.6	44	20	758	2.98	W
9	15.6	4.4	0.5	55	36	497	2.48	NE
10	19.4	0.6	-0.9	63	22	694	1.79	SW
11	23.9	2.8	3.5	74	18	692	1.70	W
12	27.8	7.2	3.1	58	17	697	3.86	W
13	25.0	4.4	3.1	62	26	577	5.01	W
14	26.1	3.9	4.8	70	23	693	4.04	W
15	25.6	5.0	5.2	78	21	729	5.61	W
16	20.6	3.9	-4.4	42	18	722	6.31	W
17	11.1	5.0	0.9	64	27	261	2.61	W
18	8.3	3.3	3.1	91	74	220	1.66	S
19	14.4	2.8	3.9	89	45	490	1.58	SW
20	15.0	3.9	6.9	91	58	459	2.25	W
21	19.4	7.2	6.0	76	35	551	2.12	W
22	22.2	2.8	4.8	78	22	646	1.21	NW
23	22.2	5.0	7.3	75	37	396	2.76	E
24	23.9	7.2	5.6	52	23	401	4.36	W
25	10.0	3.3	0.5	75	72	143	4.54	W
26	20.6	-0.6	3.1	81	28	646	2.22	SW
27	16.1	2.8	3.5	72	40	577	3.95	W
28	20.0	-1.1	-0.9	63	32	744	1.86	SW
29	22.8	2.8	3.5	66	27	734	1.58	W
30	27.2	6.1	3.5	53	22	702	2.09	S
AVERAGES	20.7	4.3	2.9	65.9	27.9	590	3.08	

NOTES:

a. June 10: Solar data calculated from Kimberly data

b. June 28: Humidity data estimated

CLIMATIC DATA (BICKETT STATION) JUL 1975

DAY	TMAX C	TMIN C	0800 TDPT C	0800 RH %	TMAX RH %	RSOL LY	-WIND- SPEED M/S	DIR
1	25.6	5.6	7.3	69	23	723	1.60	N
2	29.4	5.6	5.6	62	18	745	2.03	SE
3	27.2	12.8	11.0	77	28	604	2.94	E
4	27.8	10.0	10.6	72	37	653	1.08	N
5	28.3	11.7	12.2	75	37	698	1.10	N
6	27.8	11.1	12.2	72	40	608	1.19	N
7	30.6	12.2	11.4	71	32	671	1.15	N
8	31.1	12.2	10.6	65	36	564	1.43	E
9	30.6	11.7	11.8	70	37	633	2.20	N
10	29.4	12.2	10.6	65	36	678	2.18	N
11	28.3	12.2	13.0	79	48	484	1.10	NW
12	27.8	13.9	14.2	77	46	425	1.43	N
13	27.8	11.1	13.8	93	51	652	1.04	NE
14	29.4	11.1	12.6	77	36	556	1.43	E
15	27.2	13.3	12.6	80	38	657	1.73	E
16	24.4	13.9	9.8	68	46	694	2.83	W
17	22.2	8.9	9.4	86	53	427	1.64	W
18	23.9	5.6	7.7	83	42	647	1.45	W
19	27.2	8.9	8.1	68	41	648	1.21	W
20	28.3	11.1	7.3	67	42	567	1.25	W
21	28.3	11.7	10.6	70	41	525	1.43	SE
22	27.2	10.0	11.8	81	36	667	1.92	W
23	27.2	7.2	7.7	71	36	689	1.51	W
24	28.9	6.7	6.9	67	33	691	1.15	W
25	29.4	8.9	6.9	56	35	682	1.36	W
26	30.0	8.3	7.7	60	29	676	0.82	E
27	32.2	10.0	9.4	69	31	667	0.69	N
28	29.4	11.7	6.9	51	35	537	1.19	SW
29	21.1	13.3	10.6	70	63	273	1.64	E
30	17.8	8.9	9.8	95	52	354	1.92	S
31	19.4	1.1	4.8	95	36	598	1.77	SW
AVERAGES	27.3	10.1	9.8	72.2	37.5	603	1.53	

CLIMATIC DATA (BICKETT STATION) AUG 1975

DAY	TMAX C	TMIN C	0800 TDPT C	0800 RH %	TMAX RH %	RSOL LY	-WIND- SPEED M/S	DIR
1	21.1	2.2	3.9	80	36	674	0.99	E
2	24.4	4.4	3.9	68	34	678	1.42	W
3	26.7	5.0	4.8	65	30	670	1.58	W
4	30.0	8.3	4.8	65	26	653	1.19	W
5	30.6	8.9	6.9	65	28	562	1.29	W
6	28.3	8.3	5.6	62	28	657	1.23	W
7	21.7	8.3	0.9	44	47	656	4.04	W
8	24.4	1.7	4.3	82	30	661	1.88	W
9	28.3	4.4	6.5	73	24	652	1.08	NW
10	28.3	6.1	6.0	64	28	608	1.51	W
11	27.8	5.0	6.0	68	26	615	1.81	W
12	26.7	1.7	3.5	69	27	573	1.49	W
13	27.8	2.8	5.6	80	24	569	1.43	W
14	25.0	6.1	6.9	81	31	415	1.36	N,
15	26.1	6.1	8.1	91	24	621	1.40	W
16	25.6	11.1	8.5	78	28	456	1.40	E
17	23.9	7.2	7.7	92	37	402	1.15	W
18	20.6	10.0	6.5	63	40	396	2.48	W
19	18.9	5.0	7.3	97	48	298	1.49	W
20	22.2	2.2	4.3	88	32	603	0.91	N.
21	23.9	6.1	7.3	93	37	432	1.60	E
22	23.3	3.9	6.9	98	32	477	1.36	W
23	18.9	1.1	6.5	88	47	200	1.21	W
24	18.3	3.3	3.5	87	38	607	3.30	W
25	22.8	0.0	1.3	77	31	586	1.88	W
26	26.1	2.2	2.6	67	24	574	1.32	NE
27	27.8	9.4	5.6	69	14	573	1.94	SW
28	18.9	3.9	4.3	61	35	567	2.94	W
29	22.8	-1.1	-1.3	75	15	592	1.60	W
30	25.6	1.7	-0.9	66	14	589	1.58	W
31	22.2	1.7	0.9	78	24	577	1.60	W
AVERAGES	24.5	4.7	4.8	74.2	29.1	555	1.66	

CLIMATIC DATA (BICKETT STATION) SEP 1975

DAY	TMAX C	TMIN C	0800 TDPT C	0800 RH %	TMAX RH %	RSOL LY	-WIND- SPEED M/S	DIR
1	19.4	2.2	2.6	88	30	372	2.37	W
2	19.4	-2.2	-2.6	76	23	576	1.32	SW
3	23.9	1.1	-1.3	66	13	572	1.34	W
4	24.4	0.0	-1.3	75	18	509	1.30	SW
5	26.1	2.2	0.0	48	16	552	1.15	E
6	28.9	6.1	0.9	57	13	542	1.32	W
7	30.6	4.4	-1.3	47	12	530	1.58	W
8	28.9	4.4	0.9	55	14	524	1.42	W
9	28.9	3.9	0.9	57	14	519	1.14	NW
10	22.2	3.9	-0.9	50	30	300	1.19	W
11	25.0	6.7	5.2	69	29	471	1.47	SE
12	26.1	6.1	2.6	67	19	512	1.58	SE
13	25.0	5.6	2.2	68	27	493	1.21	E
14	26.1	5.6	3.1	69	25	406	1.47	SW
15	27.2	5.6	3.1	81	22	422	1.38	W
16	25.0	7.8	5.2	75	21	407	2.16	W
17	19.4	2.8	0.9	43	22	477	4.64	W
18	17.2	-2.2	-4.4	72	22	510	1.53	SW
19	17.2	-1.7	-5.3	70	22	505	1.29	E
20	18.9	-1.1	-4.8	62	19	493	1.06	SW
21	21.7	-2.8	-6.2	58	13	500	1.23	SE
22	23.9	0.0	-7.1	45	13	488	1.43	SE
23	25.0	0.6	-6.2	50	12	484	1.30	SE
24	25.0	2.8	-7.1	43	13	471	1.06	SW
25	26.7	3.3	-4.8	40	13	431	1.99	W
26	21.1	0.6	-4.8	67	15	470	1.47	SW
27	21.7	0.6	-6.6	54	17	473	1.15	S
28	24.4	2.2	-4.4	59	16	456	2.33	W
29	18.9	-1.7	-3.9	57	28	455	1.42	NW
30	19.4	0.6	-3.1	74	25	454	1.32	E
AVERAGES	23.6	2.2	-1.6	60.2	18.4	479	1.55	

NOTES:

a. Sept. 5–26: Solar data calculated from Kimberly data

CLIMATIC DATA (BICKETT STATION) OCT 1975

DAY	TMAX	TMIN	0800 TDPT	0800 RH	TMAX RH	RSOL	-WIND- SPEED	DIR
	C	C	C	%	%	LY	M/S	
1	23.3	1.7	-2.2	65	16	451	1.02	SW
2	25.0	2.2	-5.3	46	13	448	1.23	SW
3	23.3	1.7	-4.8	51	20	340	1.55	W
4	20.6	3.3	1.3	51	29	381	4.62	W
5	23.9	0.6	-5.3	49	16	433	1.40	W
6	23.3	3.9	-2.2	60	19	386	1.66	S
7	10.0	1.7	3.1	94	62	103	5.12	W
8	9.4	-2.2	-4.8	76	50	404	2.79	W
9	12.8	-1.1	-2.2	76	39	308	3.78	-
10	15.0	4.4	0.5	70	47	277	2.27	-
11	5.6	2.8	3.5	93	95	68	2.74	-
12	8.9	0.0	-1.3	91	65	315	1.42	-
13	10.6	-0.6	-1.3	91	53	301	1.27	-
14	12.2	-2.2	-3.5	80	50	392	1.73	-
15	14.4	-2.2	-3.5	87	64	356	3.05	-
16	15.0	-2.8	-4.4	78	43	379	2.20	-
17	18.3	0.0	-1.7	81	32	381	3.74	-
18	17.8	0.0	-2.2	82	40	351	2.27	W
19	17.8	-2.2	-5.3	76	32	370	2.46	W
20	17.2	-0.6	-1.3	84	45	341	3.11	W
21	17.8	0.6	-0.4	86	44	328	3.45	W
22	6.7	-2.8	-0.9	94	53	333	4.51	N
23	3.3	-8.9	-10.6	80	55	238	1.58	NW
24	1.7	-10.6	-12.3	83	56	306	1.75	S
25	-0.6	-7.2	-7.9	73	86	70	0.95	E
26	3.9	-1.1	0.0	96	91	208	2.92	SW
27	2.8	-8.9	-9.7	70	85	269	1.97	NW
28	2.8	-10.6	-8.4	88	65	310	0.93	N
29	10.6	-3.3	-4.4	78	47	240	1.94	N
30	10.6	-2.2	-2.2	73	67	197	2.79	W
31	3.3	-3.9	-3.9	92	81	173	1.06	E
AVERAGES	12.5	-1.6	-3.3	75.7	44.1	308	2.36	

NOTES:

a. Oct. 14-23: Solar data calculated from Kimberly data

b. Oct 9-17: Wind data from Stevenson site

c. Oct 29: Humidity data estimated

CLIMATIC DATA (BICKETT STATION)   NOV 1975

DAY	TMAX C	TMIN C	0800 TDPT C	0800 RH %	TMAX RH %	RSOL LY	-WIND- SPEED M/S	DIR
1	8.3	-5.0	-1.7	95	61	313	0.65	E
2	11.7	-1.7	-3.1	80	83	280	1.84	W
3	13.9	0.0	-2.6	82	47	294	0.95	W
4	15.0	-0.6	-3.1	74	37	306	1.73	E
5	16.1	-0.6	-4.8	70	31	286	1.66	E
6	11.7	-1.1	-3.1	65	54	283	3.56	W
7	7.8	-3.3	1.8	89	91	148	5.16	W
8	3.3	-6.7	-6.2	84	69	315	4.28	W
9	1.7	-8.9	-12.3	73	47	283	2.40	W
10	2.2	-7.8	-3.9	78	78	166	6.39	W
11	0.0	-13.3	-16.4	71	50	291	2.50	W
12	2.2	-11.7	-15.2	68	47	303	1.84	N
13	6.7	-7.2	-11.4	61	37	284	1.79	E
14	7.8	-6.7	-9.7	67	39	191	1.14	NW
15	7.8	-2.8	-3.9	78	60	100	1.27	NW
16	3.3	-0.6	0.0	92	92	66	2.12	W
17	1.7	-5.0	-7.5	79	73	261	3.54	W
18	-0.6	-7.2	-11.4	63	47	166	1.99	-
19	0.0	-9.4	-14.8	62	48	242	1.32	N
20	-2.2	-8.3	-10.6	65	63	62	1.70	E
21	-3.3	-10.6	-12.7	74	68	229	1.49	E
22	-0.6	-11.1	-13.6	75	61	210	1.90	N
23	5.0	-6.1	-8.8	75	62	231	1.45	E
24	6.1	-5.0	-6.6	88	76	153	4.41	W
25	0.0	-7.8	-14.0	58	29	234	2.40	-
26	-3.9	-13.3	-9.3	82	84	128	1.15	NW
27	-2.8	-11.7	-10.6	80	86	115	1.61	SE
28	-3.3	-12.8	-11.4	82	75	158	4.17	W
29	-8.3	-21.1	-20.6	75	59	237	3.82	W
30	-5.6	-22.2	-23.4	58	86	141	1.25	W
AVERAGES	3.4	-7.6	-9.0	74.4	58.5	216	2.36	

CLIMATIC DATA (BICKETT STATION) DEC 1975

DAY	TMAX	TMIN	0800 TDPT	0800 RH	TMAX RH	RSOL	-WIND- SPEED	DIR
	C	C	C	%	%	LY	M/S	
1	6.7	-5.6	0.9	87	90	122	6.22	W
2	6.1	-5.6	-7.9	83	67	223	2.87	W
3	4.4	-4.4	-6.6	72	68	232	0.99	-
4	5.6	-6.7	-8.4	80	59	158	1.36	W
5	1.7	-2.8	-3.9	88	71	147	2.48	W
6	3.9	-3.3	-0.9	94	86	135	1.55	W
7	6.1	-1.7	-2.6	89	99	143	3.22	W
8	7.2	-2.2	-4.4	82	73	186	1.01	-
9	8.3	-3.3	-4.8	86	69	211	0.86	-
10	6.7	-3.9	-4.8	82	69	190	1.58	-
11	0.0	-5.6	-7.9	77	75	56	0.89	E
12	1.1	-8.9	-0.9	90	90	137	3.35	-
13	-5.0	-13.3	-11.0	78	75	154	2.61	-
14	-8.9	-20.6	-22.4	74	74	256	0.86	-
15	-1.1	-16.1	-18.4	72	78	137	1.90	-
16	0.0	-13.3	-15.6	76	75	233	3.20	-
17	-3.9	-16.7	-19.5	78	66	240	0.82	-
18	-2.2	-16.1	-15.6	76	65	236	0.99	-
19	-0.6	-13.9	-13.1	81	66	235	1.01	-
20	2.8	-8.9	-13.6	63	52	239	1.38	-
21	0.6	-11.7	-11.9	66	63	167	0.99	NW
22	1.7	-10.6	-10.6	71	62	152	1.29	NW
23	-5.0	-13.3	-14.8	81	85	186	0.76	NW
24	-1.7	-8.3	-10.6	80	79	102	1.10	NW
25	-2.8	-5.6	-6.6	88	89	100	1.04	N
26	0.0	-6.1	-5.7	87	82	90	1.34	SW
27	0.6	-13.9	-12.7	59	67	194	5.98	W
28	-5.6	-18.3	-18.8	73	57	198	1.01	NW
29	-2.2	-20.0	-18.8	76	63	188	1.77	E
30	-0.6	-9.4	-9.7	73	75	200	6.82	W
31	-6.1	-14.4	-15.6	76	62	219	1.49	N
AVERAGES								
	0.6	-9.8	-10.2	78.4	71.9	176	2.02	