Hydraulic properties of the Gerber soil
by James Buckley Sisson

A thesis submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of
MASTER OF SCIENCE in Soils
Montana State University
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Abstract:
During 1971 two plots, instrumented with neutron access tubing and tensiometers, were flooded, covered and allowed to drain. Total water above a depth x was described by an empirical equation in the form of W = axct-b, where W is total water in cm, a, b, c are parameters, t is time in days. The physical significance of the parameter b is presented. The regression equations for estimating total water above a depth are 1.012t-0.014 W = o.326x and 1.022-0.021 W = 0.319x t for plot 1 and plot 2, respectively.

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ABSTRACT

During 1971 two plots, instrumented with neutron access tubing and tensiometers, were flooded, covered and allowed to drain. Total water above a depth x was described by an empirical equation in the form of $W = ax^{c}t^{-b}$, where W is total water in cm, a, b, c are parameters, t is time in days. The physical significance of the parameter b is presented. The regression equations for estimating total water above a depth are

$$W = o.326x^{1.012}t^{-0.014}$$

and

$$W = 0.319x^{1.022}t^{-0.021}$$

for plot 1 and plot 2, respectively.

INTRODUCTION

Alarm of saline seeps encroaching onto valuable crop land in Montana was first sounded by Warden (1954) in a popular article titled "Why that North Slope Alkali?", in which he presented observations on the nature and occurrence of saline seeps on the Highwood Bench in Chouteau County.

Warden reported that the depth to shale under the seeped areas was usually only 12-15 feet (4-5 m) and that test holes filled with water. Problem spots generally occurred on 3-5% slopes with lengths of 100-200 rods (500-1000 m) on areas which had been under cultivation for 30-40 years. He used 1937, 1941 and 1951 aerial photos and interviews with agriculture operators in the area to point out that saline seeps were increasing in size and number. Warden stated that the problem was becoming evident at other locations in Central Montana and in the Province of Saskatchewan and speculated the problem was caused by precipitation exceeding evapotranspiration under a summerfallow-crop rotation system.

Warden's observations have been substantiated by research conducted on the area since the fall of 1969. That research established that the soils on the Highwood Bench are of glacial origin and are underlain by several hundred feet of Colorado Shale (Appendix I). Also, the region is isolated from possible ground water sources by the Big Sag on the south, Highwood Creek on the west, the Shonkin Creek channel on the east and the present Missouri River channel on the north. Thus, excessive ground water originates on the Highwood Bench itself and

Warden's original hypothesis that precipitation in excess of evapotranspiration causes the overabundance of shallow ground water in the area is substantiated. This condition leads to the formation of alkali seeps.

A saline seep can be divided into three essential parts. Obvious is the discharge area, where the actual seep exists. This region is characterized by a salt crust and lack of vegetation. A second part is the subsurface aquifer or that portion of till resting on shale which conducts water into the seep. The third part is the recharge area, where water enters the aquifer, that usually consists of clean summerfallow or a good stand of small grain.

A simple definition of a recharge area is an area where precipitation percolates through the rooting zone, enters the aquifer and eventually appears at the seep. With this definition the amount of water that enters the aquifer is simply that quantity of water which moves beyond the rooting depth of the vegetation established on the recharge area.

The motion of water in soils is generally described mathematically as:

$$\frac{\partial \theta}{\partial t} = \nabla \cdot K \nabla H \qquad (1)$$

where θ is the volumetric water content, (cm^3/cm^3), t is time, K is the hydraulic conductivity and H is the total fluid potential.

Although this expression is valid and general, solutions are available for only a few simple boundary conditions. The problem of finding solutions is greatly confounded by the fact that K, θ, and H are all interrelated in a complicated fashion that is not fully understood.

Much of the theoretical work during the past 20 years in soil physics has centered around solving (1) subject to different boundary and initial conditions. These works have been invaluable in leading to a greater understanding of soil-water relationships. The methods that have evolved from these studies work satisfactorily for simple initial and boundary conditions. But vast amounts of laboratory data and adequate empirical relations between K, θ, and H are needed to facilitate solutions. These requirements greatly limit the applicability of this technique. In order to describe soil-water behavior in extensive recharge areas, a less intensive model must be employed to study soil-water dynamics.

Of the less intensive methodologies currently available, no single model describes the motion of soil water from early stages of infiltration through late stages of drainage. These processes are studied independently with the intermediate stage usually ignored.

The most extensively used relationship to relate infiltration with time is that of Phillip (1954)

$$Q = St^{\frac{1}{2}} + At; \qquad (2)$$

Q is the total amount infiltrated, S and A are constants and t is time in seconds. Phillip stated that his equation failed at large values of t. Miller and Gardner (1962), working with uniform and stratified soil columns, demonstrated that equations of the form

$$Q = At^b \qquad (3) \qquad \text{or} \qquad Q = at^b + ct \qquad (4)$$

failed to describe the entire infiltration process and were inadeqaute for a time period of a few seconds up to 3 hours. Miller and Gardner also encountered discontinuities in the infiltration rate as the wetting front reached sand lenses. These phenomena were encountered previously by Colman and Bodman (1944). But equations of the form of (2) and (3) are finding continued use since their form is easy to handle and they are reasonable approximations.

An empirical expression relating drainage and surface evaporation with time was proposed by Richards, Gardner and Ogata (1956) in the form

$$W = W_L t^{-b} \qquad (5)$$

where W is the total quantity of water above the depth L, i.e., $W = \int_0^L \theta dx$, t is the time in days following the irrigation and W_L is the total quantity of water above depth L on day 1. The exponent b is a constant, and under conditions of evaporation, will be different for each depth.

Ogata and Richards (1957) further verified this equation form on a sandy loam soil covered with a sheet of polyethylene and straw. Soil water was monitored gravimetrically at periodic intervals for 50 days.

The relation between soil water, depth and time was

$$W = (0.52 + 0.209x + 0.00053x^2)\ t^{-0.128} \qquad (6)$$

The authors noted that the simplified equation

$W = 0.256\ xt^{-0.128}$ described the data almost as well. These results were consistent with laboratory data and previous experiments conducted on the site.

Wilcox (1959), in attempting to determine the rate of drainage following irrigations, examined the Richards equation in detail. Using the data of Blaney, Taylor and Young (1933), he concluded that the equation was valid on a sandy loam for the duration of that test (435 days). Wilcox conducted a series of experiments on a wide range of soil types. The research was carried out under the following conditions:

1. Field trials only
2. Uniform soil texture to the depth studied
3. Free drainage into the subsoil
4. No water table within 100 feet of the soil surface
5. Subsoil moisture was present
6. Trials followed heavy irrigations

The results of these tests, for the upper 6 feet, were "W_L" values ranging from 6.30 to 40.16 inches and "b" values ranging from .1404 to .0288 for sandy loams and clay loams, respectively.

The experiments ran from 15 to 64 days and to depths of 6 or 7 feet. Wilcox reported that the data points did not lie close to the predicted values until 1 day after irrigation for a sandy loam and that

2 to 3 days were required for the data of a heavy loam to approach the predicted curve. In general, the equation overpredicted drainage during the early part of the experiments, except in the upper 1-2 feet where drainage was underestimated. The author concluded that (5) with the above exceptions, accurately predicted deep percolation.

Davidson et al. (1969) reported a similar equation to describe drainage from both uniform and non-uniform profiles. Assuming a relationship between θ and K, they derived the equation

$$q_L = K_L/(1 + aK_L t/L) \qquad (7)$$

to predict percolation from covered plots. q_L is soil-water flux at depth L, K_L is the average saturated hydraulic conductivity to depth L, a is a constant and t is time.

Richards et al. (1956) predicted flux at depth L with

$$q_L = \left.\frac{\partial W}{\partial t}\right|_L = -b(W_L)\, t^{-b-1} = \left.\frac{-b}{t} W\right|_L \qquad (8)$$

where W_L is the initial water above depth L. Equation (7) and (8) are similar in that the rate of drainage is inversely proportional to time.

Gardner (1970) proposed that if the hydraulic gradient approximated unity (ie. $\frac{\partial H}{\partial x} = -1$) then,

$$q_L = \int_o^L \left(\frac{\partial \theta}{\partial t}\right) dx = -K_L \qquad (9)$$

where K_L is the hydraulic conductivity at depth L.

But equation (9) is merely a special form of equation (8) in that $\left.\frac{\partial W}{\partial t}\right|_L = \int_o^L \frac{\partial \theta}{\partial t} dx$. Combining equations (8) and (9), the result is

$$\left.\frac{\partial W}{\partial t}\right|_L = -b(W_L)\, t^{-b-1} = K_L \left|\frac{\partial H}{\partial x}\right|_L \qquad (10)$$

If on day 1 a unit gradient exists, (10) becomes

$$-bW_L = -K_L \qquad (11)$$

which implies that $b = K_L/W_L$. Thus, the physical significance of b is established as the ratio of the hydraulic conductivity at depth L to the total water held above that depth.

The most important variable in the study of saline seep problems requires an estimate of the quantity of water moving through the soil profile in the recharge areas. The purpose of this investigation was to establish the applicability of a model for predicting flux and total water lost by drainage from the rooting zone of Gerber silty clay loam. The model employed was first proposed by Richards et al. (1956) and requires only the flux at a depth and total soil water above that depth be known at the time of arrival of the wetting front.

MATERIALS AND METHODS

In 1970 a site was chosen on a Gerber silty clay loam (Appendix II), where the water table was known to be at a depth greater than 13.8 m (46 ft.). Plots were established and steel neutron access tubing (OD = 4.4 cm) were installed to allow an overwinter stabilization period. Of the original plots, two were selected for study in 1971.

Since equation (10) required both soil water potentials and volumetric water contents, these variables were monitored simultaneously throughout the experiment. Although a knowledge of soil water potentials are not required for the model under test, these data were collected in order to obtain a better understanding of the soil water system.

Soil water potential was determined with tensiometers installed at various depths. The tensiometers consisted of rigid plastic tubing bonded to porous cups. Small diameter nylon tubing joined the tensiometer to a liquid mercury reservoir forming the necessary manometer. The height of mercury standing in the manometer was multiplied by 13.546 to give total soil water potential in cm of water.

On both plots the volumetric water content was determined at 15 cm depth increments by a neutron meter equipped with an 80-mc Am-Be high energy neutron source (sheid counting rate = 5.4×10^4 cpm). Volumetric water content was interpolated from the factory calibration curve.

Water for flooding the plots was obtained at the Highwood Municipal Water Works and trucked to the site. A ponding depth of 10 cm was achieved within 10 minutes on both plots, after which inflow rate was

monitored occasionally with a 355 cm^3 (12 oz.) aluminum can and by interrupting the inflow and observing the rate of fall of the water surface. The inflow was constant throughout the flooding period on both plots at approximately 1 cm per hour.

The major differences between plot 1 and plot 2 were: 1) Plot 1 was 3 x 3 m in area where plot 2 was 6 x 6 m, 2) Plot 1 was covered with polyethylene whereas plot 2 was covered with a heavy straw mulch. 3) Tensiometers were installed at the 15, 30, 60,....., 240 cm depths on plot 1, whereas 15 cm depth increments were employed to a depth of 270 cm on plot 2. 4) water was ponded at 10 cm for 4 hours on plot 1 and plot 2 received the full ponding depth for approximately 24 hours. On both plots the water level receded within approximately 10 hrs.

All data were processed on an XDS 7 computer at Montana State University. Regression analysis was carried out on Multiple Regression Program by R. E. Lund. Plotting was executed on an IBM 1627 plotter.

RESULTS AND DISCUSSION

In order to fit regressions to (5) the equation was written in the logarithmic form of

$$W = ax^c t^b \qquad (12)$$

(i.e., LnW = Lna + cLnx + bLnt, where Ln denotes the natural logarithm). Linear regressions were developed and the results are presented in Table 1.

The regression coefficients are b and c, the intercept is the Lna. The r^2 values imply that over 99.9% of the experimental variation is accounted for by the regression equations.

The partial correlation coefficients are a crude measure of association between the independent variable and the dependent variable. The correlation coefficients (Table 1) for Lnx are considerably higher than for Lnt. This would be expected since W varied by a factor of 20 in depth but only 0.05 in time.

In order to more closely estimate the effect of time, (12) was written as $W/x^c = at^{-b}+d$, where a and d arise from regression and the exponents were taken from Table 1. This form of the equation helps to estimate the effect of time by incorporating the effects of x^c into a new dependent variable W/x^c. Another objective is also accomplished, in a not too obvious fashion, in that (12) is being tested for asymptotes, i.e., as time becomes arbitrarily large, will there still be water in the profile? The results are presented in Table 2.

Table 1. Regression parameters for equations of the form Ln(W) = Ln(a) + cLn(x) + bLn(t). Where W is total water above x at time t.

Plot No. 1

Source of Variation	Mean	Partial Correlations	Regression Coefficients	Std. Error of Coefficient	Computed t
Ln of t in days	3.502	-0.5626	-0.01405	±0.001301	-10.80
Ln of x in cm	4.679	0.9995	1.012	±0.002048	494.1
Ln of total water above x	3.565				

r^2 = 0.9990 intercept = -1.0120 Std. error Sy·x = 0.02525

Plot No. 2

Source of Variation	Mean	Partial Correlations	Regression Coefficients	Std. Error of Coefficient	Computed t
Ln of t in days	2.103	-0.7742	-0.02078	0.001118	-18.59
Ln of x in cm	4.730	.9997	1.022	0.001549	660.0
Ln of total water (cm) above x	3.648				

r^2 = 0.9994 intercept = -1.144 Std. error Sy·x = 0.005601

Table 2. Analysis of variance for the regression equation in the form of $W/x^{c} = at^{-b}$. The exponents are coefficients from Table 1 and W is total water above x at time t.

Plot No. 1

Source of Variation	d.f.	M.S.	F
Due to Regression	1	24.5825	408386
Residual	254	6.01941×10^{-5}	
Total	255		

$r^2 = 0.9994$ Intercept = 0.0000 Std. error $Sy \cdot x = 0.007758$
Regression coefficient a = 0.3260

Plot No. 2

Source of Variation	d.f.	M.S.	F
Due to Regression	1	21.8393	696207
Residual	233	3.13689×10^{-5}	
Total	234		

$r^2 = 0.9997$ Intercept = 0.0000 Std. error $Sy \cdot x = 0.005601$
Regression Coefficient a = 0.3190

Note in Table 2 that the new variable W/x^c is strongly dependent on time. And, since d = 0.0, all the water in a soil profile, covered and free to drain, is in theory subject to loss by drainage. These results imply that a recharge area is continually adding water to the underlying aquifer.

From Tables 1 and 2 the final equations for estimating cm of water above a depth x are

$$W = 0.326x^{1.012}t^{-0.014} \qquad (13)$$

and

$$W = 0.319x^{1.022}t^{-0.021} \qquad (14)$$

for plot 1 and plot 2 respectively, where water in the profile on day 1 is given by ax^c. The differences between (13) and (14) have been attributed to natural variation between the sites and to differences in the quantity of water added.

These curves together with scatter diagrams of the data, are presented in Figures 1 and 2, respectively. The curve for plot 1 has been extrapolated backwards in time to approximately 1 day after infiltration had ceased, in order to show that the equation also predicted part of the redistribution phase. Extrapolation was not done for plot 2.

Drainage fluxes from the profiles are obtained by differentiating (13) and (14) with respect to time. The resulting flux equations are

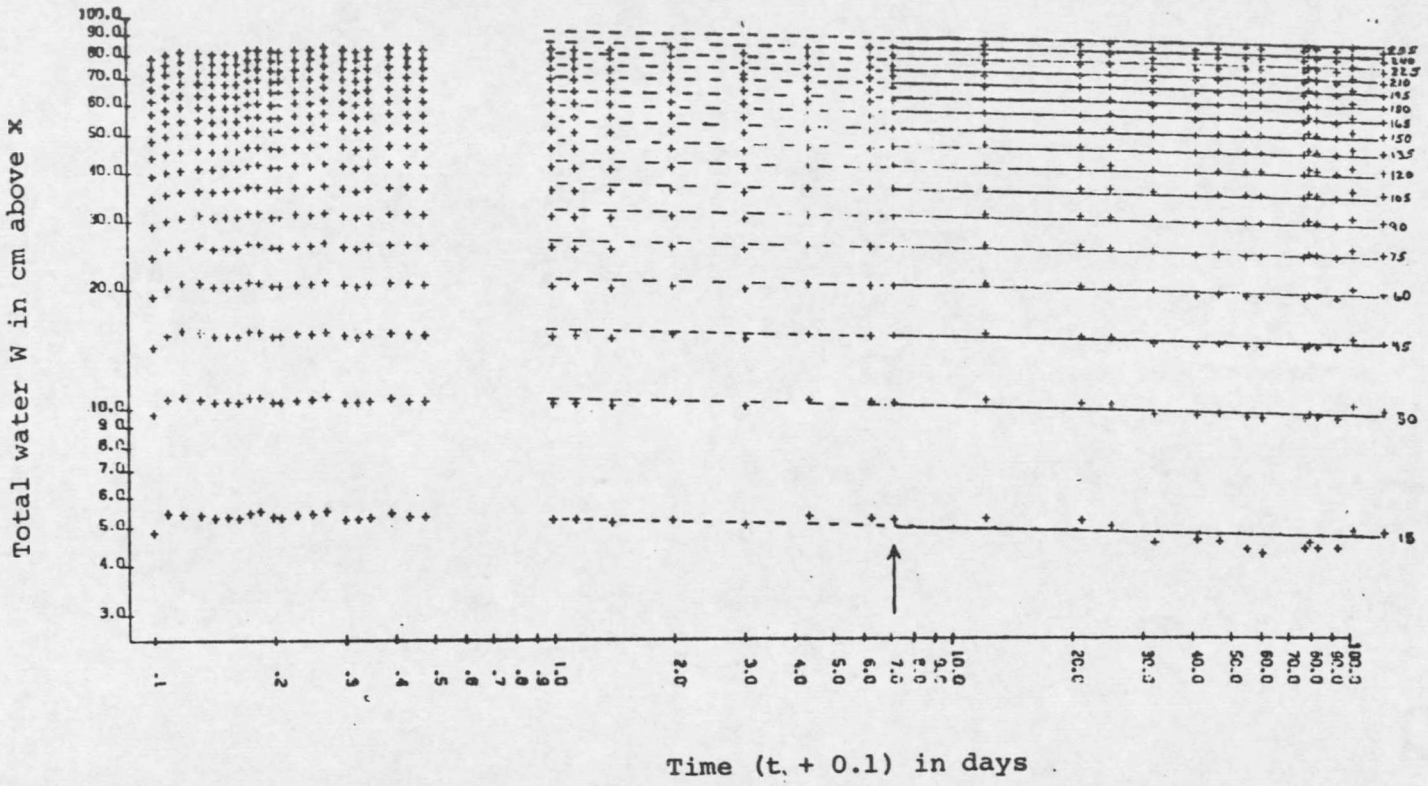


Figure 1. Total water above x vs. time in days in plot 1. Time is actually t + 0.1 to allow plotting of data from initiation of flooding through the drainage phase. The parameter is depth in cm. The vertical arrow denotes "day 1" of the drainage phase and the dashed lines are extrapolations of the solid regression lines.

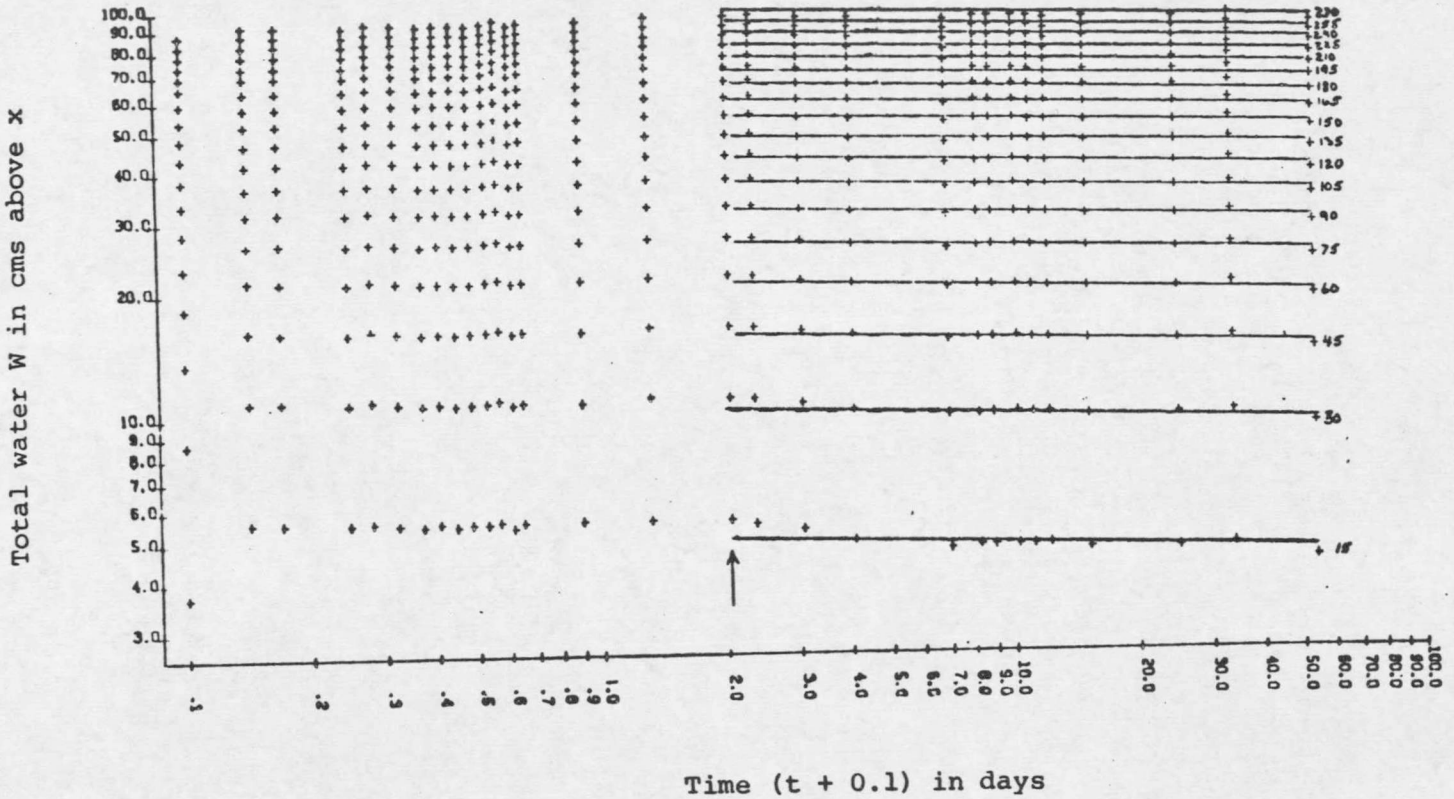


Figure 2. Total water above x vs. time in days for plot 2. Time is actually t + 0.1 to allow plotting of data from initiation of flooding through the drainage phase. The parameter is depth in cms. The vertical arrow denotes "day 1" of the drainage phase and the solid lines are regression lines.

$$q = 0.00456x^{1.012}t^{-1.014} \quad (15)$$

and

$$q = 0.00670x^{1.022}t^{-1.021} \quad (16)$$

for plot 1 and plot 2, respectively.

Utilizing hydraulic gradients estimated from tensiometer data together with the flux equations (15) and (16), the hydraulic conductivities were computed by

$$K_L = \left.\frac{-q}{\frac{\Delta H}{\Delta x}}\right|_L \quad (17)$$

K_L is the hydraulic conductivity at depth L; q and $\frac{\Delta H}{\Delta x}$ are the flux and total hydraulic gradient respectively at depth L. The gradient is actually an average gradient over the interval Δx; thus, L is interpreted to be the midpoint of the interval.

Since the soil water potential data were erratic, perhaps because of wide fluctuations in ambient temperature and a continual problem with air bubbles developing in the tensiometers, no attempt was made to correlate these data with time or depth. Instead, the data were smoothed with a 3-point moving average in time and the gradients were computed between depths that reacted parallel in time.

Fluxes, volumetric water contents, hydraulic conductivities and matrix potential (matrix potential (h) = total potential (H) - depth) for several depths, are presented in Table 3. These data show that soil water flux and the hydraulic conductivity decrease rapidly with time, whereas θ

Table 3. Hydraulic properties at various depths during drainage. Fluxes were obtained with equation 15.

PLOT 1

Dats into Drainage	60 cm depth Gradient from 30-90 avgd. 1.66 during the drainage phase q[1/]	K[2/]	θ[3/]	h[4/]	75 cm depth Gradient from 30-120 avgd. 1.046 during drainage q	K	θ	h
1.00	0.29	.17	34.2	20	0.36	.34	35.5	20
5.00	0.047	.028	34.5	35	0.059	.056	35.1	30
14.00	0.018	.011	34.8	44	0.023	.022	34.9	36
18.00	0.015	.0090	34.1	74	0.018	.017	34.8	61
25.00	0.011	.0066	35.0	90	0.013	.012	34.3	78
34.00	0.0078	.0047	32.6	100	0.0098	.0094	34.5	89
40.00	0.0068	.0041	33.2	104	0.0084	.0080	34.4	95
48.00	0.0067	.0040	32.6	104	0.0070	.0067	34.5	104
53.00	0.0056	.0034	32.9	108	0.0063	.0060	34.8	97
69.87	0.0051	.0031	32.2	116	0.0048	.0046	34.2	82
72.10	0.0038	.0023	32.8	110	0.0047	.0045	35.0	65
74.17	0.0037	.0022	32.9	110	0.0044	.0042	35.2	74
86.02	0.0035	.0021	32.3	90	0.0039	.0037	34.5	74
95.00	0.0031	.0019	33.3	72	0.0035	.0033	34.8	66

Days into Drainage	105 cm depth Gradient from 90-120 Avgd. 0.632 during the drainage phase q	K	θ	h	180 cm depth Gradient from 120-240 Avgd. 1.66 during drainage q	K	θ	h
1.00	0.51	.81	35.6	34	.87	1.25	32.1	6.9
5.00	0.083	.13	34.9	40	.14	.20	32.1	13.3
14.00	0.033	.052	35.5	42	.056	.080	32.1	19.0
18.00	0.026	.041	36.4	64	.044	.063	30.6	36.0
25.00	0.019	.030	34.9	80	.032	.045	32.0	53.0
34.00	0.014	.022	34.8	98	.024	.034	31.8	68.0
40.00	0.012	.019	34.9	109	.020	.028	31.5	79.0
48.00	0.0098	.016	34.5	126	.017	.024	31.8	90.5
53.00	0.0089	.014	34.8	118	.015	.021	31.4	83.5
69.87	0.0068	.011	34.3	121	.012	.017	32.2	72.0
72.10	0.0065	.010	35.1	100	.011	.016	31.4	55.0
74.17	0.062	.0098	34.5	101	.011	.016	31.4	55.5
86.02	0.0055	.0097	34.5	90	.0094	.013	31.1	57.5
95.00	0.0050	.0079	34.8	84	.0086	.012	31.4	62.0

Table 3. (Cont.)

1/ q is flux in cm/day

2/ K is hydraulic conductivity in cm/day

3/ θ is volumetric water content expressed as percent

4/ h is matrix potential expressed in cm of water.

and, to a lesser degree, matrix potential (h) appears to remain nearly constant in time. These results are consistent with the fact that the hydraulic conductivity is characteristically a violent function of θ, changing 2 to 3 orders of magnitude with small changes in θ. Thus, even small errors in estimating θ obscure any relationship that may exist between K and θ. The data for plot 2 are similar to plot 1 and are not presented in this paper.

Assuming a 180 cm rooting depth, (15) and (16) become

$$q = 0.87t^{-1.014} \tag{18}$$

$$q = 1.35t^{-1.021} \tag{19}$$

Also, (13) and (14) become

$$W = 62.45t^{-.014} \tag{20}$$

$$W = 64.37t^{-.021} \tag{21}$$

and noting that total water lost to drainage is $W_L - W$, Table 4 was constructed.

Table 4 shows that flux and total drainage from plot 2 are greater than from plot 1. As emphasized in the introduction, the "b" parameter is directly proportional to flux and was 50% greater for plot 2 than for plot 1. Differences in drainage characteristics are to be expected since natural variation in hydraulic properties is known to occur over any area.

The data in Tables 3 and 4 demonstrate that when the soils in these

plots reach a water content higher than about 33%, drainage will take place at a rate exceeding that of crop water use for the first few days.

Summerfallow operations are directed specifically at producing a profile with the maximum water content possible, by reducing evaporation from the soil surface and plant water extraction to a minimum. This practice usually produces a wet profile and thus, loses the maximum water to drainage.

Assuming a recharge area to discharge area ratio of 10 to 1 and that the data in Table 4 represent the recharge area, 39 to 59 cm of water per unit area of discharge would be available over a 100-day period. These estimates explain in part why seeps in the area are growing at a rapid rate.

Table 4. Rate of drainage and total water drained on various days for the 180 cm depth.

Days into Drainage	Rate of drainage (cm/day)		Total water lost(cm)	
	Plot 1	Plot 2	Plot 1	Plot 2
1	.87	1.33	----	----
5	.14	.26	1.39	2.12
10	.083	.13	1.95	3.01
20	.041	.062	2.55	3.89
30	.027	.041	2.90	4.37
40	.020	.031	3.14	4.75
50	.016	.025	3.33	5.03
100	.0081	.012	3.90	5.87

Results from the tensiometers (see Appendix III) are similar to those of Davidson, Stone, Nielsen and LaRue (1969) and Black, Gardner and Thurtell (1969) in that the hydraulic gradients remain nearly constant for

extended periods of time during drainage. However, negative matrix potentials were encountered at considerable depths in the profiles. Most notably these anomalies occurred at 60, 150 and 210 cm depths on both plots. One explanation of these phenomena is that large continuous pores (e.g., root channels, vertical joints, etc.) hydraulically connected the soil surface to the depth horizons. The physical implications are that water can enter subsurface horizons with large pores such as sand and gravel, while most of the profile is in an unsaturated condition.

Tensiometers provide an estimate of total water potential gradients and also marked the time of the wetting front arrival at a given depth. This event is actually day 1 for equation (5) and is signified by an abrupt decrease in soil water potential at that depth. (See Appendix III).

An estimate of the wetting front position with time may also be obtained from soil water content-depth data during infiltration. Figures 3 and 4 show typical data from plots 1 and 2, respectively. Although these figures describe θ as being determined at points in space, θ is actually an average water content over a depth interval. The exact size of the interval is not known. The factory manual for the neutron probe states that the zone of measurement will vary with water content between 10 cm (4 in) and 30 cm (11.6 in) in height. For this reason the $\int_o^L \theta dx$ was estimated as $\Sigma\ \theta_j \Delta xj$. to the depth under consideration. Therefore, Figures 3 and 4 describe an average volumetric content of soil water ov over the interval Δxj. Figures 3 and 4 show a diffuse wetting frong and a relatively small increase in water content in the transmitting zone

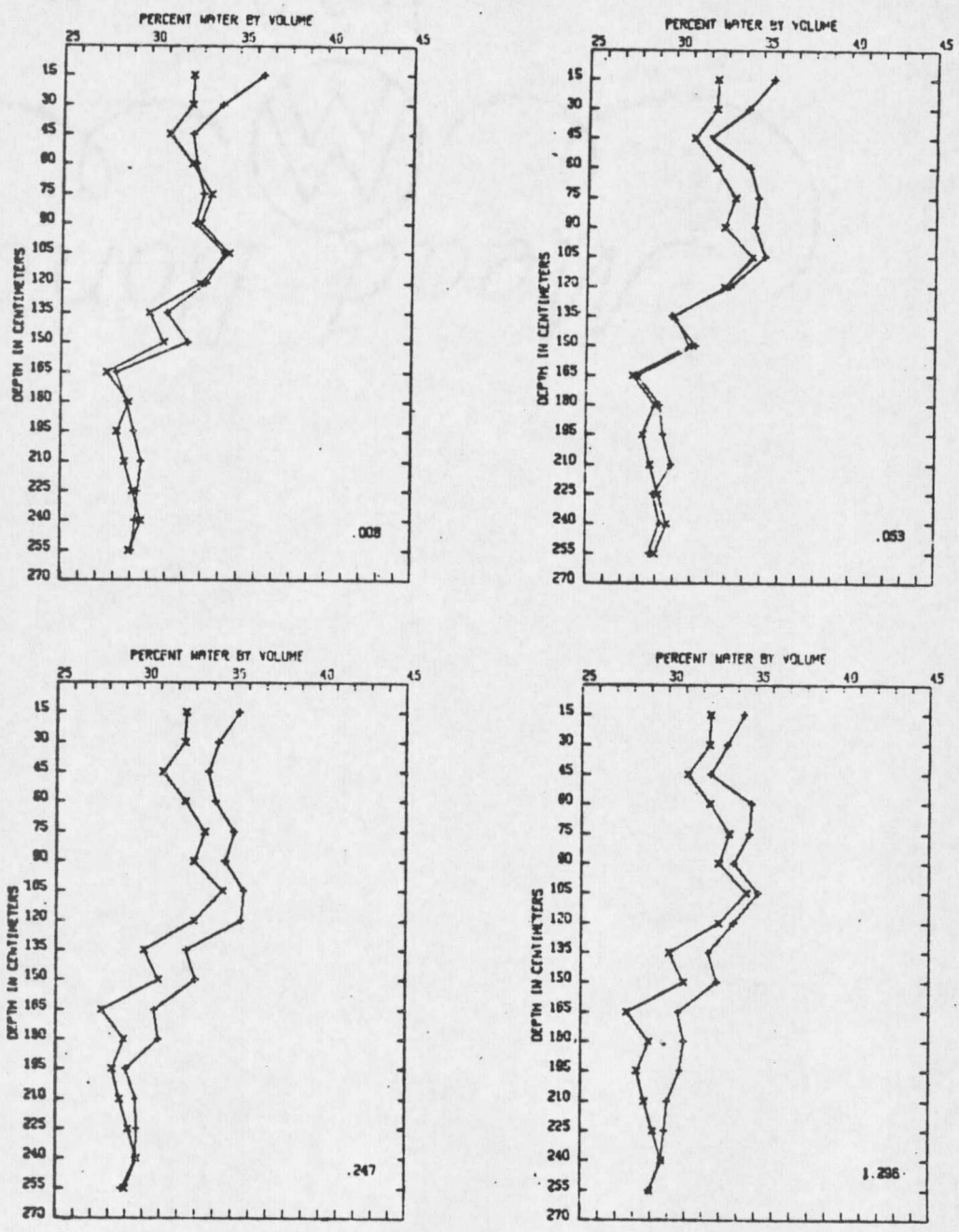


Figure 3. Volumetric water content vs. depth at various times during infiltration for plot 1. Parameter is time in days. The curves designated by the crosses (X) are time 0.0; those designated by pluses (+) are for times shown.

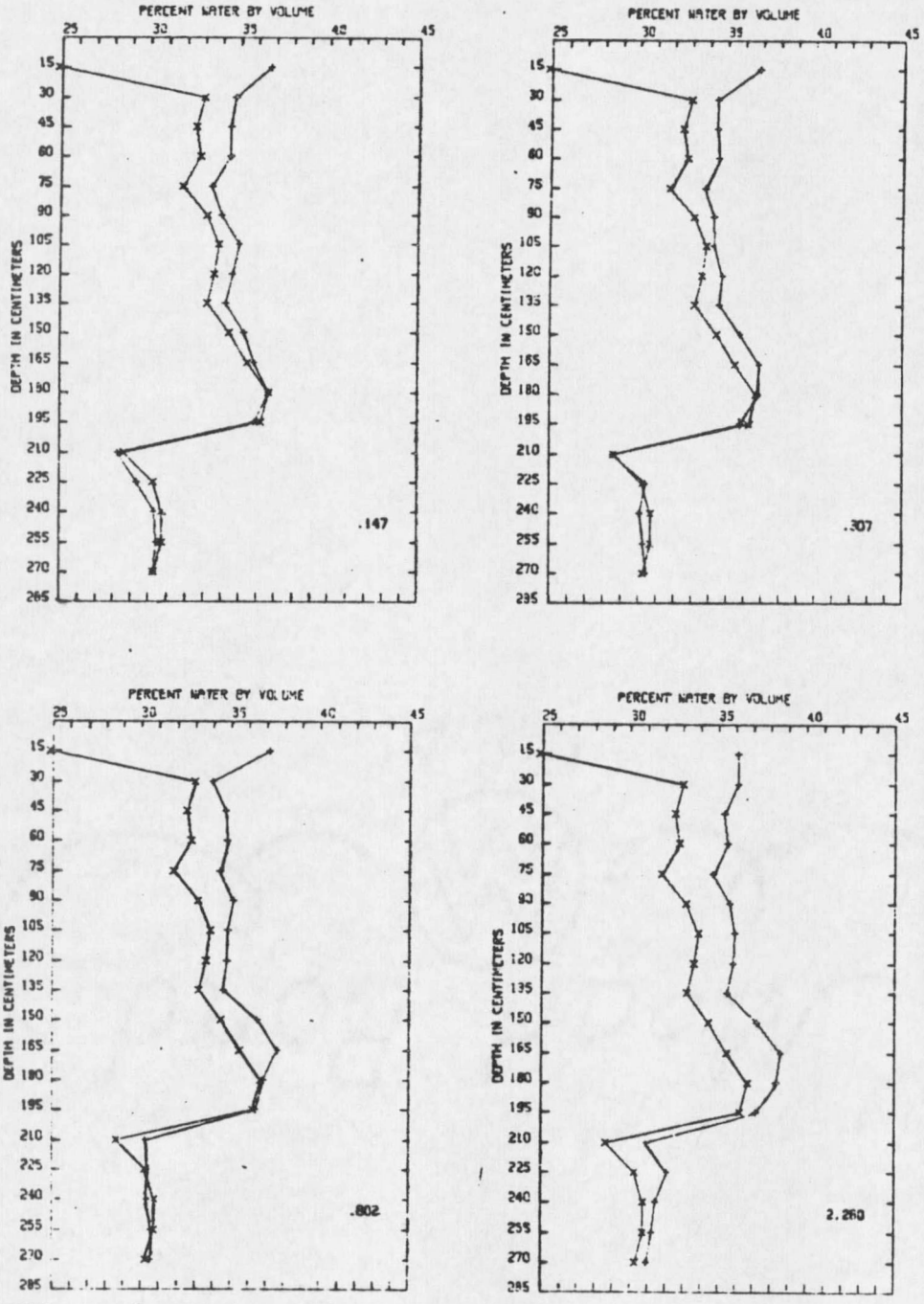


Figure 4. Volumetric water content vs. depth at various times during infiltration for plot 2. Parameter is time in days. The curves designated by the crosses (X) are time 0.0; those designated by pluses (+) are for times shown.

above the wetting front. This is to be expected when water is added to an already wet soil (Hillel and Gardner, 1970 and Miller and Richards, 1952). By comparison, when infiltration takes place into initially dry media, the transmitting zone is characterized by large increases in water content and the wetting front remains abrupt. Also, the wetting front moves at a slower rate through an initially dry media.

Figures 3, 4 and data presented in Appendix III provide an estimate of the movement of the wetting front with time. This is important since (5) requires a knowledge of when the wetting front arrives at the depth where drainage is being considered. Until the wetting front arrives at this depth, drainage at that depth will occur as if no water had been added to the soil profile.

Considerably more water was added to each plot than could be accounted for by the increase in soil water content measured with the neutron probe. It is possible that ponding the water on the plots resulted in water being conducted completely through the profile by large vertical pores. Certainly Figures 3 and 4 indicate a rapid movement of water into the two plots, at least to the 180 cm depth. However, it is more likely that lateral seepage from the plots during the ponding period accounted for most of the water loss. The objective of this study was to establish the validity of a simple model that can be used to predict drainage losses from a covered profile. The model, once established can be extended to a wider variety of initial and boundary

conditions and ultimately provide estimates of the quantity of water entering an aquifer. Water was added to obtain the initial conditions required by the model, not as a part of a water budget study.

Figures 5 and 6 show examples of the drainage pattern from plots 1 and 2, respectively. These figures (and Figures 3 and 4) indicate a considerable degree of heterogeneity within both profiles. The drainage pattern was much more consistant in plot 2 than plot 1. However, the scatter diagrams for soil water above a specified depth as a function of time (Figures 1 and 2) and the r^2 values (Table 1) indicate significant drainage from both profiles. Equation 5 and 12 describe soil water behavior in these moderately heterogenious profiles satisfactorily. For cases of extreme heterogeneity a more elaborate function of W_L may be needed, or a separate "b" term may be utilized for each depth. The 15 cm depth lost more water than average, but equations (13) and (14) predicted this as can be seen from Figures 1 and 2.

In order to predict flux from profiles on which vegetation is transpiring soil water, Wilcox (1959) combined (5) with its derivative in time as follows:

$$W = W_L t^{-b} \qquad (5)$$

$$\frac{\partial W}{\partial t} = -bW_L t^{-b-1}$$

taking logarithms of both equations and eliminating time (t) to

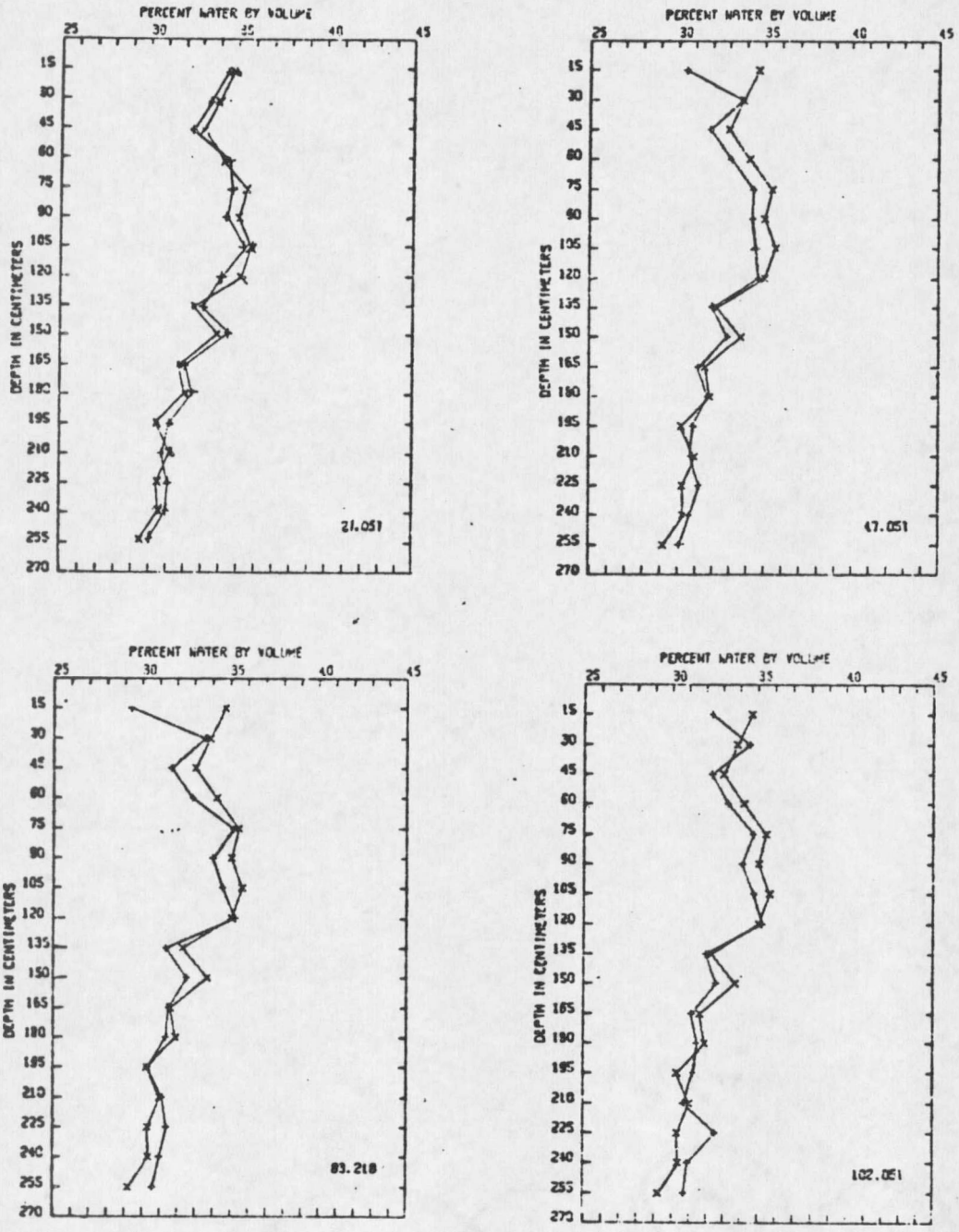


Figure 5. Volumetric water content vs. depth at various times during drainage for plot 1. Parameter is times in days. The crosses (X) designate "day 1"; pluses (+) are for time shown.

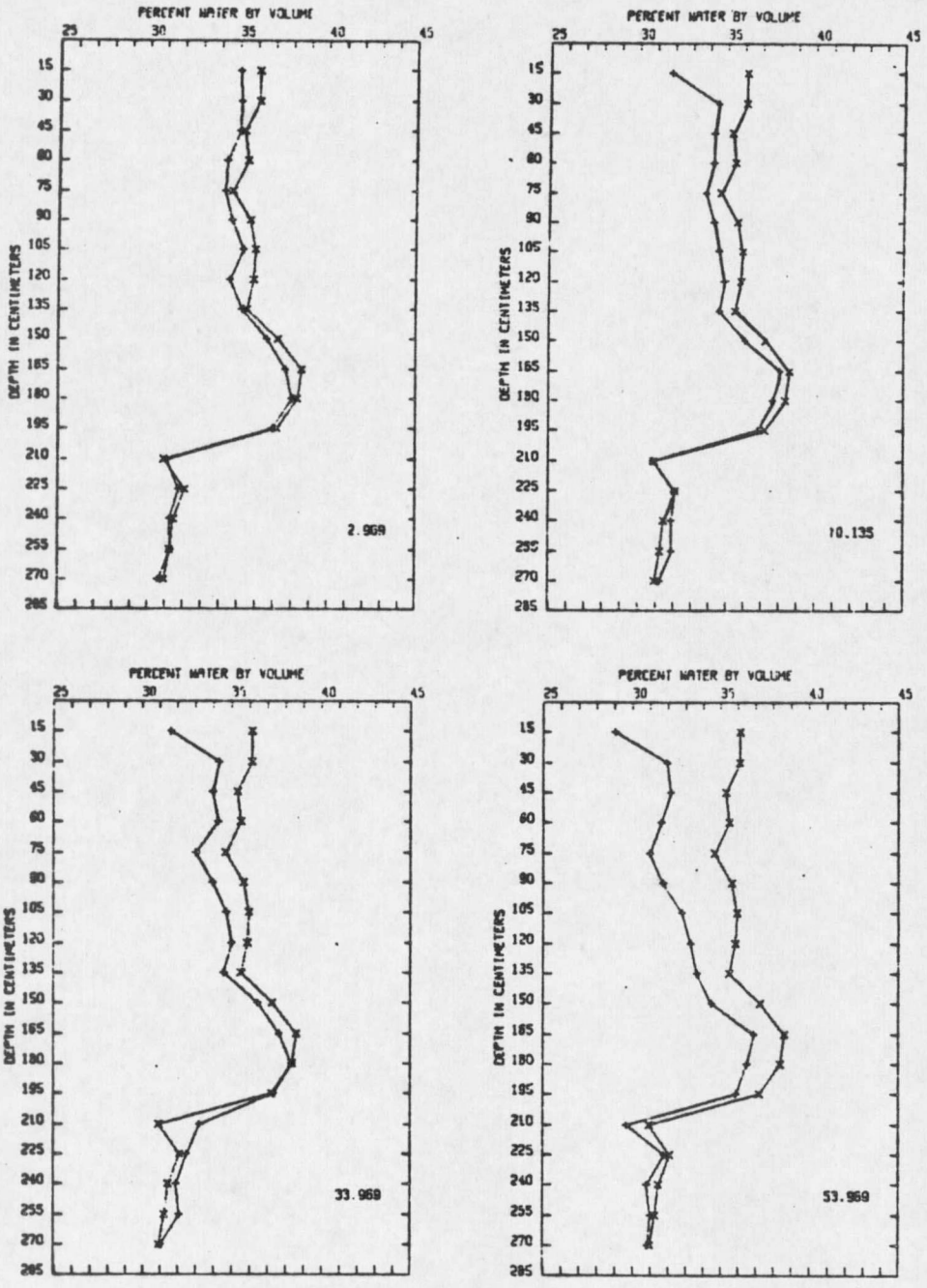


Figure 6. Volumetric water content vs. depth at various times during drainage for plot 2. Parameter is time in days. The crosses (X) designate "day 1"; pluses (+) are for time shown.

give

$$\frac{\partial W}{\partial t} = -bW_L\left(\frac{W}{W_L}\right)^{\frac{b+1}{b}} \qquad (22)$$

In terms of the development carried out in the introduction, (22) can be written as

$$q = q_L\left(\frac{W}{W_L}\right)\frac{q_L + W_L}{q_L} \qquad (23)$$

Wilcox utilized (22) to estimate drainage from cropped profiles by proceeding as follows:

1) assume the rate of drainage is independent of crop water use.
2) sample the soil at periodic intervals and determine W.
3) use graphical interpolation to establish the average rate of drainage between the dates (i.e. the average W).
4) use the average rate of drainage times the number of days between the sampling dates as being the total water lost by drainage.

Although Wilcox was never able to establish the accuracy of this procedure, he stated the method yielded reasonable estimates of deep percolation losses from beneath growing crops.

More recently Miller and Aastard (1972) verified (22) for predicting drainage losses from laboratory columns on which alfalfa (Medicago sativa, Var. Vernal) was established. The results obtained were in agreement with the predictive equation, provided adequate time was

allowed for drainage to start.

A condition prevalent on recharge areas where the validity of (5) is yet to be established is the presence of a water table. A possible modification to allow extension of (5) would be to introduce a function of x to account for the presence of the water table.

Further study of saline seeps should be directed at applying this model to estimate deep percolation into aquifers of large areas. When reliable estimates become available of soil water drainage and aquifer gains, sound judgement can be made on what changes are necessary to control the saline seep problem.

SUMMARY AND CONCLUSIONS

The most important variable in the study of saline seeps is drainage loss from soil profiles. The model

$$W = ax^{c}t^{-b},$$

proposed by Richards et al. (1956), for describing soil water behavior was varified in the field for a Gerber silty clay loam. Examination of the model indicated that the parameter "b" had the physical significance of being the ratio of drainage flux at depth L to the total water held above that depth at the moment of the arrival of the wetting front.

The model's parameters were estimated by least squares regression. The resulting equations for predicting total water above a depth x at time t are

$$W = 0.326x^{1.012}t^{-0.014}$$

and

$$W = 0.319x^{1.022}t^{-0.021}$$

for two adjacent covered plots. In both cases r^2 values in excess of 0.999 were obtained, indicating that the model accurately described soil water data for the Gerber soil.

Differentiation of these equations with respect to time t yields the flux equations

$$q = 0.00456x^{1.012}t^{-1.014}$$

and

$$q = 0.00670x^{1.022}t^{-1.021}$$

for the two plots respectively. These equations describe the rate of

soil water loss at depth x and time t.

The model predicts drainage losses of 3.9 and 5.9 cm of water from profiles wet to a depth of 180 cm over a 100 day time period. Assuming a recharge to discharge area ratio of 10 to 1, 39 to 59 cm of water per unit area of discharge would be supplied to the seep. Further assuming a porosity of 50% for the soils in the discharge area, the water table could rise to 78 to 118 cm.

It is concluded that the model does predict soil water behavior at the study site and should be applicable to large recharge areas. Also the model may be applicable to more hetrogenous profiles.

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APPENDIX I

GEOLOGY OF THE HIGHWOOD AREA[1/]

The geological history of the Highwood Bench area, as well as the rest of northern Montana, includes long periods of sedimentation, emplacement of volcanic and plutonic igneous rocks, regional uplift, erosion, and glaciation. Throughout most of the Paleozoic (225 to 600 million years ago) and Mesozoic (70 to 225 million years ago) time, thousands of feet of predominantly marine sediments were deposited in this region. At the end of the Mesozoic Era (Late Cretaceous time) and extending into Early Tertiary time (50 to 70 million years ago), the entire area was uplifted, faulted, and folded, producing the Rocky Mountains to the west and south, tilting the sedimentary rocks under lying Chouteau County gently to the northeast (1/2 to 3 degrees), and subjecting the area to erosion. The emplacement of volcanic and plutonic rocks forming the Highwood and Bearpaw Mountains also occurred during this time. Continued erosion during the Tertiary Period stripped away the uppermost Cretaceous sediments, exposing the black shale of the Colorado Group in the Highwood Bench area. This same area was dissected and drained by the ancestral Missouri River, which flowed in a northeasterly direction to Hudson Bay.

During the Pleistocene Epoch (20,000 to 1 million years ago), the entire region north of the Highwood Mountains were covered two or more times by glacial ice, leaving a mantle of unconsolidated, poorly sorted deposits called glacial till or drift, which filled most of

have been observed lying beneath, within, and on top of the glacial till. No salt accumulation has been observed in areas where the gravel lies at the till-shale contact, but large saline areas are noticeable adjacent to the gravel beds that are within or on top of the till. These gravel zones probably act as recharge areas capable of transmitting large quantities of water to nearby low areas. In exposures of till along the Missouri River, extensive vertical joints have been noticed, which could greatly enhance the vertical movement of water. These joints are filled with salt crystals.

X-ray analysis of the clay minerals in the glacial till indicates 80 percent montmorillonite (highly plastic sodium-rich expanding clay), 15 percent illite, and 5 percent kaolinite or chlorite. The high montmorillonite content may severely hinder the chances of effectively draining the saline areas.

Beneath the glacial till and underlying the entire Highwood Bench is 950 to 1,850 feet of black bentonitic marine shale of the Colorado Group. Owing to erosion and the gentle dip to the northeast, the shale thins to a southwest toward the Little Belt Mountains and thickens to the northeast. Lithologic information obtained from more than 120 test holes indicates that a weathered zone at the till-shale contact is 1 to 2 feet thick. This zone is commonly saturated with water and is somewhat more premeable (able to transmit water) than the overlying glacial till. The underlying unweathered shale

the pre-existing valleys and coulees, leaving a relatively flat glacial plain. The ice blocked the drainage of the Missouri River and its tributaries, forcing the streams to change course numerous times and in some places to cut new channels. The Shonkin Sag, along the flanks of the Highwood Mountains, is a classic example of one of these glacial channels. During the last 20,000 years (Recent Epoch), the area was again subjected to erosion, establishing the present-day drainage pattern in the Highwood Bench area, which may or may not correspond to the preglacial drainage network.

Geological units of considerable importance in the investigation area are the glacial till and the underlying black shale of the Colorado Group. Available drill-hole information and exposures along the Missouri River indicate that the thickness of the glacial till ranges from a few feet to 60 feet. Two distinct tills, representing two separate ice advances, are normally present--the upper till (youngest) is normally the thickest and is buff to tan, whereas the lower till (oldest) is generally only a few feet thick (locally absent) and is light to dark gray. A pebble or boulder zone is frequently encountered between the two tills. Except for the upper 2 or 3 feet, the entire till profile is loaded with salt crystals--an inexhaustible supply. The till consists of unsorted clay and silt and contains well-rounded pebbles scattered throughout. A few sandy lenses were encountered in some of the test holes, and several gravel beds (representing temporary glacial channels of the ancestral Missouri River)

is completely dry, indicating that it is virtually impermeable; consequently, there is no upward or downward movement of water in the unweathered shale of the Colorado Group.

1/ Marvin R. Miller, "Hydrology of Saline-Seep Spots in Dryland Farm Areas - A Preliminary Evaluation," Saline Seep-Fallow Workshop, February 22-23, 1971, Sponsored by the Highwood Alkali Control Association, Highwood, Montana. The above was used with the author's permission.

APPENDIX II

Area: Chouteau County Date: Sept. 21, 1970
Location: Section 3, T22N, R8E, Fred Booth test plots
Soil Type: Gerber silty clay loam
Classification: Vertic Agriborolls - fine montmorillonitic family
Parent Materials: Deep alluvium over till
Physiography and Relief: Nearly level terrace
Elevation: 3200 feet
Slope: less than 1% Aspect: Level
Drainage: Well drained. Water table more than 46 feet (test well)
Permeability: Moderately slow throughout most of profile
Native Vegetation: Barley, small grain
Root distribution: Plentiful to 37 inches, few to 78 inches
Sample No. 70-COC-1 (1 to 8) Described by C. O. Clark

Soil Profile: Gerber silty clay loam, nearly level.

Ap 0-8" Grayish brown (10 yR5/2) silty clay loam, very dark grayish brown (10yR3/a) moist; strong fine granular and subangular blocky structure; hard, friable, sticky and plastic; abrupt wavy boundary.

B2t 8-14" Brown (10yR5/3) silty clay, brown (10yR4/3) with dark brown (10yR3/3) coatings on peds; strong medium prismatic and strong fine subangular blocky structure separating to strong very fine subangular blocks; very hard, friable sticky and very plastic; continuous thin clay films on faces of peds; common very fine and fine roots; many very fine and micro pores; clear wavy boundary.

B31 14-21" Light brownish gray (2.5y6/2) with graying brown (10yR5/2) coating on peds silty clay loam, dark grayish brown (10yR4/2) moist; moderate medium and coarse prismatic and moderate fine and medium subangular blocky structure separating to moderate very fine subangular blocks; very hard, friable, sticky and plastic; strongly effervescents; common thin clay films and stains along prisms; common very fine and fine roots; many very fine and micro pores, common fine pores; gradual wavy boundary.

B32ca 21-29" Light brownish gray (2.5y6/2) silty clay loam dark grayish brown (2.5y4/2) moist; weak medium and coarse prismatic structure separating to moderate very fine, fine and medium separating to moderate very fine, fine and medium subangular blocks; very hard, very friable, sticky and plastic; common fine and very fine roots; many very fine and micro pores, common fine pores; strongly effervescent with common fine distinct lime masses and threads, fewer pebbles lime coated; gradual wavy boundary.

C1ca 29-37" Light brownish gray (2.5y6/2) silty clay loam, dark grayish brown (2.5y4/2) moist; weak medium and fine subangular blocky structure; very hard, very friable sticky and plastic; common very fine and fine roots; many very fine and micro pores, common fine pores; few weathered shale fragments; strongly effervescent with common fine distinct lime masses and threads, few pebbles lime coated, gradual wavy boundary.

C2Ca 37-48" Light brownish gray (2.5y6/2) in upper 4' grayish brown (2.5y5/1) lower 5" light clay loam, dark grayish brown (2.5y4/2) in upper 4" dark grayish brown (2.5y4/1) moist in lower 5", weak medium and coarse subangular blocky structure separates to moderate fine and very fine subangular blocks in weathered shale chips; very hard, friable, sticky and plastic; few fine and very fine roots; many very fine and micro pores, common fine pores; few lignite chips and limonite specks; strong effervescent with common fine distinct lime masses and threads, few pebbles lime coated, diffuse wavy boundary.

C3cs 48-78" Pale brown (2.5y6/3) with light brownish gray and light yellowish brown (2.5y6/2 & 6/4) clay loam, dark grayish brown (2.5y4/2) with very dark grayish brown (2.5y3/2) coatings on peds moist; moderate medium and coarse subangular blocky structure; very hard, firm, sticky and plastic; few fine and very fine roots, many very fine and micro pores, common fine pores; few lignite chips and limonite specks, few and common gypsum streaks and coating on blocks masses; diffuse wavy boundary.

C4 78-96" Light brownish gray (2.5y6/2) light yellowish brown mottlings (2.5y6/4) clay loam, dark graying brown (2.5y4/2) with mottles of dark yellowish brown (10yR4/4) and dark gray (5y4/2) moist; massive and ploty; very hard, firm, sticky and plastic; very few roots; few pores; few lignite chips and limonite specks; few threads and masses of gypsum; slight effervescent.

APPENDIX III

PLOT NO. 1

DATE 5/27
DAYS INTO EXPERIMENT .000

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	32.38	4.86	157.
30	32.36	9.71	147.
45	31.10	14.38	0.
60	32.39	19.23	142.
75	33.48	24.26	0.
90	32.91	29.19	297.
105	34.52	34.37	0.
120	32.91	39.31	429.
135	30.04	43.81	0.
150	30.91	48.45	142.
165	27.58	52.59	0.
180	28.89	56.92	186.
195	28.20	61.15	0.
210	28.66	65.45	566.
225	29.17	69.82	0.
240	29.65	74.27	613.
255	28.94	78.61	0.

DATE 5/27
DAYS INTO EXPERIMENT .008

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	36.35	5.45	146.
30	34.05	10.56	142.
45	32.39	15.42	0.
60	32.66	20.32	173.
75	33.05	25.27	0.
90	32.60	30.16	291.
105	34.27	35.30	0.
120	33.24	40.29	402.
135	31.03	44.94	0.
150	32.24	49.78	146.
165	28.13	54.00	0.
180	28.82	58.32	213.
195	29.21	62.70	0.
210	29.64	67.15	324.
225	29.45	71.57	0.
240	29.28	75.96	402.
255	29.08	80.32	0.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

PLOT NO. 1

DATE 5/27
DAYS INTO EXPERIMENT .018

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTENTIAL ******
15	36.27	5.44	-6.
30	35.26	10.73	136.
45	33.91	15.82	0.
60	33.33	20.82	185.
75	33.23	25.80	0.
90	32.94	30.74	304.
105	34.09	35.85	0.
120	32.93	40.79	415.
135	30.84	45.42	0.
150	32.26	50.26	150.
165	28.25	54.50	0.
180	30.10	59.01	239.
195	30.18	63.54	0.
210	30.22	68.07	348.
225	29.84	72.55	0.
240	30.21	77.08	423.
255	29.21	81.46	0.

DATE 5/27
DAYS INTO EXPERIMENT .031

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTENTIAL ******
15	36.02	5.40	-5.
30	34.59	10.59	-3.
45	33.63	15.64	0.
60	35.20	20.92	167.
75	35.06	26.18	0.
90	33.12	31.14	304.
105	33.34	36.14	0.
120	33.55	41.18	415.
135	30.66	45.78	0.
150	31.29	50.47	150.
165	28.56	54.75	0.
180	28.82	59.08	245.
195	29.42	63.49	0.
210	30.14	68.01	360.
225	29.70	72.47	0.
240	29.56	76.90	441.
255	28.96	81.24	0.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

PLOT NO. 1

DATE 5/27

DAYS INTO EXPERIMENT .042

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	35.39	5.31	-5.
30	33.82	10.38	-6.
45	32.76	15.29	0.
60	33.96	20.39	136.
75	34.71	25.59	0.
90	34.25	30.73	304.
105	34.61	35.92	0.
120	32.96	40.87	415.
135	29.50	45.29	0.
150	31.54	50.02	150.
165	27.77	54.19	0.
180	29.39	58.60	249.
195	29.15	62.97	0.
210	29.99	67.47	368.
225	29.37	71.87	0.
240	29.61	76.31	444.
255	28.25	80.55	0.

DATE 5/27

DAYS INTO EXPERIMENT .053

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	35.62	5.34	-2.
30	34.13	10.46	-5.
45	31.98	15.26	0.
60	34.32	20.41	102.
75	34.79	25.63	0.
90	34.61	30.82	300.
105	35.22	36.10	0.
120	33.24	41.09	415.
135	29.86	45.57	0.
150	31.28	50.26	150.
165	27.91	54.45	0.
180	29.20	58.82	247.
195	29.38	63.23	0.
210	29.91	67.72	375.
225	28.83	72.04	0.
240	29.25	76.43	465.
255	28.67	80.73	0.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

PLOT NO. 1

DATE 5/27
DAYS INTO EXPERIMENT .063

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	35.36	5.30	6.
30	33.98	10.40	2.
45	32.41	15.26	0.
60	34.59	20.45	81.
75	34.20	25.58	0.
90	35.03	30.84	291.
105	35.59	36.18	0.
120	33.16	41.15	422.
135	30.13	45.67	0.
150	31.58	50.40	152.
165	27.91	54.59	0.
180	28.38	58.85	246.
195	29.02	63.20	0.
210	29.22	67.58	384.
225	28.73	71.89	0.
240	29.27	76.28	471.
255	27.88	80.47	0.

DATE 5/27
DAYS INTO EXPERIMENT .074

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	36.49	5.47	9.
30	34.95	10.72	5.
45	33.61	15.76	0.
60	34.64	20.95	71.
75	35.32	26.25	0.
90	35.27	31.54	274.
105	35.85	36.92	0.
120	33.78	41.99	422.
135	30.89	46.62	0.
150	32.01	51.42	152.
165	28.76	55.74	0.
180	29.63	60.18	242.
195	29.78	64.65	0.
210	29.76	69.11	387.
225	30.27	73.65	0.
240	30.20	78.18	473.
255	28.83	82.51	0.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

PLOT NO. 1

DATE 5/27

DAYS INTO EXPERIMENT .084

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	36.91	5.54	13.
30	34.53	10.72	10.
45	33.15	15.69	0.
60	34.86	20.92	58.
75	35.42	26.23	0.
90	35.25	31.52	273.
105	36.32	36.97	0.
120	34.37	42.12	422.
135	31.37	46.83	0.
150	32.28	51.67	154.
165	28.29	55.91	0.
180	30.08	60.42	236.
195	29.98	64.92	0.
210	29.73	69.38	398.
225	29.83	73.86	0.
240	30.44	78.42	492.
255	29.42	82.84	0.

DATE 5/27

DAYS INTO EXPERIMENT .098

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	35.55	5.33	13.
30	33.83	10.41	10.
45	32.45	15.27	0.
60	34.68	20.48	44.
75	34.62	25.67	0.
90	35.00	30.92	266.
105	35.94	36.31	0.
120	34.67	41.51	410.
135	32.15	46.33	0.
150	32.17	51.16	152.
165	28.58	55.45	0.
180	29.56	59.88	231.
195	29.96	64.37	0.
210	29.73	68.83	406.
225	28.93	73.17	0.
240	29.30	77.57	506.
255	29.37	81.97	0.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

PLOT NO. 1

DATE 5/27
DAYS INTO EXPERIMENT .108

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTENTIAL ******
15	35.46	5.32	13.
30	33.70	10.37	10.
45	33.06	15.33	0.
60	34.55	20.51	40.
75	34.76	25.73	0.
90	34.86	30.96	262.
105	35.05	36.22	0.
120	34.37	41.37	318.
135	32.85	46.30	0.
150	32.70	51.20	136.
165	28.85	55.53	0.
180	29.54	59.96	224.
195	29.56	64.40	0.
210	29.56	68.83	410.
225	28.86	73.16	0.
240	28.78	77.48	515.
255	28.80	81.80	0.

DATE 5/27
DAYS INTO EXPERIMENT .128

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTENTIAL ******
15	36.01	5.40	20.
30	34.13	10.52	16.
45	33.49	15.54	0.
60	34.31	20.69	40.
75	35.35	25.99	0.
90	35.65	31.34	259.
105	35.70	36.70	0.
120	35.15	41.97	217.
135	32.38	46.83	0.
150	33.33	51.82	152.
165	28.28	56.07	0.
180	29.10	60.43	226.
195	29.46	64.85	0.
210	29.86	69.33	414.
225	29.38	73.74	0.
240	29.09	78.10	526.
255	28.82	82.42	0.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

PLOT NO. 1

DATE 5/27
DAYS INTO EXPERIMENT .148

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	36.19	5.43	20.
30	34.18	10.55	16.
45	32.74	15.46	0.
60	35.15	20.74	39.
75	34.68	25.94	0.
90	35.23	31.22	235.
105	35.30	36.52	0.
120	34.92	41.76	188.
135	33.28	46.75	0.
150	34.03	51.85	152.
165	29.22	56.24	0.
180	29.58	60.67	234.
195	29.15	65.04	0.
210	29.86	69.52	437.
225	28.96	73.87	0.
240	29.71	78.32	537.
255	28.08	82.54	0.

DATE 5/27
DAYS INTO EXPERIMENT .169

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	36.89	5.53	21.
30	34.77	10.75	17.
45	32.90	15.69	0.
60	35.24	20.97	39.
75	36.15	26.39	0.
90	35.08	31.66	224.
105	35.95	37.05	0.
120	35.98	42.45	166.
135	33.48	47.47	0.
150	34.67	52.67	135.
165	30.47	57.24	0.
180	30.02	61.74	236.
195	30.19	66.27	0.
210	30.43	70.83	452.
225	29.80	75.30	0.
240	29.82	79.78	295.
255	27.98	83.97	0.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

PLOT NO. 1

DATE 5/27

DAYS INTO EXPERIMENT .200

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	34.98	5.25	21.
30	34.22	10.38	16.
45	33.12	15.35	0.
60	35.44	20.66	37.
75	34.75	25.88	0.
90	35.07	31.14	197.
105	35.54	36.47	0.
120	34.80	41.69	161.
135	33.34	46.69	0.
150	34.04	51.79	135.
165	30.81	56.42	0.
180	29.88	60.90	236.
195	29.11	65.27	0.
210	29.43	69.68	464.
225	29.98	74.18	0.
240	29.43	78.59	238.
255	28.03	82.80	0.

DATE 5/27

DAYS INTO EXPERIMENT .223

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	35.20	5.28	21.
30	34.19	10.41	16.
45	32.19	15.24	0.
60	34.32	20.39	35.
75	34.76	25.60	0.
90	34.04	30.70	188.
105	34.81	35.93	0.
120	34.52	41.11	143.
135	31.96	45.90	0.
150	32.70	50.80	136.
165	30.94	55.44	0.
180	30.16	59.97	231.
195	29.39	64.38	0.
210	29.67	68.83	472.
225	28.50	73.10	0.
240	29.74	77.56	226.
255	28.29	81.81	0.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

PLOT NO. 1

DATE 5/27

DAYS INTO EXPERIMENT .247

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	35.39	5.31	22.
30	34.25	10.45	17.
45	33.70	15.50	0.
60	34.10	20.62	35.
75	35.15	25.89	0.
90	34.63	31.08	186.
105	35.69	36.44	0.
120	35.55	41.77	143.
135	32.45	46.64	0.
150	32.98	51.58	133.
165	30.63	56.18	0.
180	30.92	60.82	223.
195	28.99	65.17	0.
210	29.59	69.60	480.
225	29.66	74.05	0.
240	29.59	78.49	224.
255	28.76	82.80	0.

DATE 5/27

DAYS INTO EXPERIMENT .292

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	36.45	5.47	22.
30	34.41	10.63	20.
45	32.95	15.57	0.
60	35.16	20.84	35.
75	35.42	26.16	0.
90	34.90	31.39	177.
105	35.74	36.75	0.
120	35.56	42.09	143.
135	32.87	47.02	0.
150	33.33	52.02	132.
165	31.41	56.73	0.
180	30.72	61.34	238.
195	29.50	65.76	0.
210	30.10	70.28	510.
225	29.57	74.71	0.
240	29.78	79.18	593.
255	28.52	83.46	0.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

PLOT NO. 1

DATE 5/27

DAYS INTO EXPERIMENT .334

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	35.54	5.33	24.
30	34.18	10.46	20.
45	33.26	15.45	0.
60	35.01	20.70	35.
75	35.85	26.08	0.
90	35.87	31.46	163.
105	35.85	36.83	0.
120	35.03	42.09	143.
135	33.11	47.06	0.
150	33.29	52.05	128.
165	30.79	56.67	0.
180	31.22	61.35	239.
195	29.65	65.80	0.
210	29.93	70.29	528.
225	29.54	74.72	0.
240	28.96	79.06	223.
255	28.57	83.35	0.

DATE 5/27

DAYS INTO EXPERIMENT .375

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	35.65	5.35	24.
30	33.97	10.44	20.
45	33.14	15.41	0.
60	35.10	20.68	35.
75	35.16	25.95	0.
90	35.00	31.20	158.
105	35.23	36.49	0.
120	35.47	41.81	143.
135	32.35	46.66	0.
150	33.02	51.61	125.
165	31.49	56.34	0.
180	30.16	60.86	245.
195	30.21	65.39	0.
210	29.22	69.78	548.
225	28.43	74.04	0.
240	28.57	78.33	222.
255	28.39	82.58	0.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

PLOT NO. 1

DATE 5/28

DAYS INTO EXPERIMENT .894

DEPTH	PERCENT WATER BY VOLUME	TOTAL WATER ABOVE DEPTH	TOTAL WATER POTENTIAL
*****	********	*****	******
15	34.99	5.25	28.
30	33.46	10.27	20.
45	33.19	15.25	0.
60	34.36	20.40	41.
75	34.89	25.63	0.
90	34.70	30.84	115.
105	35.26	36.13	0.
120	35.30	41.42	144.
135	32.51	46.30	0.
150	33.09	51.26	123.
165	30.55	55.85	0.
180	31.13	60.52	293.
195	30.37	65.07	0.
210	29.93	69.56	147.
225	28.54	73.84	0.
240	29.53	78.27	222.
255	27.49	82.40	0.

DATE 5/28

DAYS INTO EXPERIMENT 1.035

DEPTH	PERCENT WATER BY VOLUME	TOTAL WATER ABOVE DEPTH	TOTAL WATER POTENTIAL
*****	********	*****	******
15	34.93	5.24	28.
30	33.80	10.31	21.
45	32.97	15.26	0.
60	33.97	20.35	47.
75	34.03	25.46	0.
90	34.49	30.63	121.
105	34.93	35.87	0.
120	34.00	40.97	148.
135	32.43	45.83	0.
150	32.92	50.77	29.
165	31.26	55.46	0.
180	31.18	60.14	296.
195	29.96	64.63	0.
210	30.05	69.14	157.
225	29.97	73.63	0.
240	29.56	78.07	220.
255	28.38	82.33	0.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

PLOT NO. 1

DATE 5/28
DAYS INTO EXPERIMENT 1.296

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	34.28	5.14	36.
30	33.37	10.15	29.
45	32.42	15.01	0.
60	34.73	20.22	58.
75	34.63	25.41	0.
90	33.73	30.47	133.
105	35.15	35.75	0.
120	33.74	40.81	139.
135	32.31	45.65	0.
150	32.79	50.57	32.
165	30.53	55.15	0.
180	30.91	59.79	254.
195	30.65	64.38	0.
210	29.93	68.87	165.
225	29.80	73.34	0.
240	29.58	77.78	219.
255	28.89	82.11	0.

DATE 5/29
DAYS INTO EXPERIMENT 1.885

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	34.85	5.23	47.
30	34.52	10.41	43.
45	33.12	15.37	0.
60	33.84	20.45	50.
75	35.26	25.74	0.
90	34.60	30.93	121.
105	34.41	36.09	0.
120	34.18	41.22	143.
135	31.95	46.01	0.
150	33.80	51.08	14.
165	31.63	55.83	0.
180	32.20	60.65	292.
195	31.19	65.33	0.
210	30.43	69.90	181.
225	30.00	74.40	0.
240	30.59	78.99	215.
255	29.61	83.43	0.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

PLOT NO. 1

DATE 5/30
DAYS INTO EXPERIMENT 2.916

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	33.84	5.08	48.
30	33.43	10.09	55.
45	32.25	14.93	0.
60	34.17	20.05	54.
75	34.26	25.19	0.
90	33.91	30.28	129.
105	34.54	35.46	0.
120	34.54	40.64	155.
135	32.14	45.46	0.
150	33.05	50.42	142.
165	31.30	55.11	0.
180	31.52	59.84	314.
195	30.54	64.42	0.
210	30.54	69.00	199.
225	15.21	71.29	0.
240	30.03	75.79	203.
255	29.17	80.17	0.

DATE 5/31
DAYS INTO EXPERIMENT 4.260

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	35.66	5.35	33.
30	34.06	10.46	28.
45	32.85	15.39	0.
60	34.65	20.58	100.
75	34.77	25.80	0.
90	34.51	30.98	135.
105	35.32	36.27	0.
120	34.53	41.45	158.
135	32.14	46.28	0.
150	33.34	51.28	136.
165	31.10	55.94	0.
180	31.28	60.63	349.
195	30.34	65.18	0.
210	30.22	69.72	213.
225	30.44	74.28	0.
240	30.33	78.83	205.
255	29.65	83.28	0.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

PLOT NO. 1

DATE 6/ 2
DAYS INTO EXPERIMENT 6.176

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN- TIAL ******
15	34.99	5.25	28.
30	33.89	10.33	24.
45	32.67	15.23	0.
60	34.22	20.37	98.
75	35.04	25.62	0.
90	34.04	30.73	132.
105	35.00	35.98	0.
120	34.64	41.17	152.
135	31.80	45.94	0.
150	33.25	50.93	40.
165	31.72	55.69	0.
180	31.54	60.42	254.
195	30.54	65.00	0.
210	30.02	69.50	220.
225	29.83	73.98	0.
240	30.51	78.55	216.
255	29.00	82.90	0.

DATE 6/ 3
DAYS INTO EXPERIMENT 7.051

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN- TIAL ******
15	34.67	5.20	41.
30	33.78	10.27	50.
45	33.01	15.22	0.
60	34.21	20.35	104.
75	35.46	25.67	0.
90	35.06	30.93	136.
105	35.66	36.28	0.
120	35.06	41.54	170.
135	32.29	46.38	0.
150	33.70	51.43	173.
165	31.62	56.18	0.
180	31.91	60.97	255.
195	30.23	65.50	0.
210	30.98	70.15	223.
225	30.31	74.69	0.
240	30.37	79.25	217.
255	29.21	83.63	0.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

PLOT NO. 1

DATE 6/ 8
DAYS INTO EXPERIMENT 12.051

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	35.05	5.26	28.
30	34.57	10.44	36.
45	33.09	15.41	0.
60	34.48	20.58	86.
75	35.13	25.85	0.
90	35.21	31.13	108.
105	34.93	36.37	0.
120	35.16	41.64	136.
135	33.24	46.63	0.
150	33.28	51.62	174.
165	32.02	56.43	0.
180	32.08	61.24	284.
195	30.58	65.83	0.
210	30.99	70.47	219.
225	31.12	75.14	0.
240	30.37	79.70	230.
255	30.13	84.22	0.

DATE 6/17
DAYS INTO EXPERIMENT 21.051

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	34.54	5.18	64.
30	33.68	10.23	82.
45	32.59	15.12	0.
60	34.77	20.34	242.
75	34.86	25.57	0.
90	34.62	30.76	157.
105	35.50	36.08	0.
120	34.11	41.20	161.
135	32.71	46.11	0.
150	34.42	51.27	199.
165	31.58	56.01	0.
180	32.11	60.82	261.
195	31.42	65.53	0.
210	30.63	70.13	230.
225	30.95	74.77	0.
240	30.69	79.38	247.
255	30.26	83.91	0.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

PLOT NO. 1

DATE 6/21
DAYS INTO EXPERIMENT 25.051

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	33.31	5.00	77.
30	34.39	10.16	87.
45	32.57	15.04	0.
60	34.09	20.15	0.
75	34.84	25.38	0.
90	34.71	30.59	159.
105	36.41	36.05	0.
120	35.09	41.31	162.
135	32.62	46.21	0.
150	34.41	51.37	203.
165	31.73	56.13	0.
180	32.08	60.94	226.
195	31.42	65.65	0.
210	31.93	70.44	236.
225	31.38	75.15	0.
240	30.97	79.79	258.
255	31.17	84.47	0.

DATE 6/28
DAYS INTO EXPERIMENT 32.051

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	30.35	4.55	147.
30	33.70	9.61	133.
45	32.77	14.52	0.
60	34.97	19.77	161.
75	34.31	24.91	0.
90	35.12	30.18	188.
105	34.89	35.42	0.
120	32.02	40.22	192.
135	32.66	45.12	0.
150	30.93	49.76	224.
165	31.40	54.47	0.
180	30.61	59.06	213.
195	30.80	63.68	0.
210	30.67	68.28	273.
225	30.29	72.82	0.
240	30.46	77.39	278.
255	30.97	82.04	0.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

PLOT NO. 1

DATE 7/ 7
DAYS INTO EXPERIMENT 41.051

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTENTIAL ******
15	30.81	4.62	184.
30	32.97	9.57	138.
45	31.39	14.28	0.
60	32.58	19.16	0.
75	34.46	24.33	0.
90	33.80	29.40	200.
105	34.77	34.62	0.
120	34.88	39.85	211.
135	31.63	44.59	0.
150	32.49	49.47	228.
165	31.08	54.13	0.
180	32.02	58.93	177.
195	30.62	63.53	0.
210	30.85	68.15	276.
225	30.41	72.71	0.
240	30.87	77.34	297.
255	30.00	81.84	0.

DATE 7/13
DAYS INTO EXPERIMENT 47.051

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTENTIAL ******
15	30.52	4.58	158.
30	33.79	9.65	96.
45	31.89	14.43	0.
60	33.16	19.40	133.
75	34.43	24.57	0.
90	34.34	29.72	207.
105	34.56	34.90	0.
120	34.69	40.11	217.
135	32.05	44.91	0.
150	32.94	49.85	213.
165	31.19	54.53	0.
180	31.75	59.29	154.
195	30.84	63.92	0.
210	30.82	68.54	266.
225	31.27	73.23	0.
240	30.70	77.84	293.
255	30.10	82.35	0.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

PLOT NO. 1

DATE 7/21
DAYS INTO EXPERIMENT 55.051

DEPTH	PERCENT WATER BY VOLUME	TOTAL WATER ABOVE DEPTH	TOTAL WATER POTEN-TIAL
*****	********	*****	******
15	29.02	4.35	62.
30	33.91	9.44	125.
45	32.06	14.25	0.
60	32.61	19.14	0.
75	34.47	24.31	0.
90	34.62	29.50	216.
105	35.46	34.82	0.
120	35.30	40.12	235.
135	31.92	44.91	0.
150	32.79	49.82	209.
165	31.23	54.51	0.
180	31.48	59.23	101.
195	31.22	63.91	0.
210	30.82	68.54	273.
225	31.13	73.21	0.
240	30.96	77.85	301.
255	30.87	82.48	0.

DATE 7/26
DAYS INTO EXPERIMENT 60.051

DEPTH	PERCENT WATER BY VOLUME	TOTAL WATER ABOVE DEPTH	TOTAL WATER POTEN-TIAL
*****	********	*****	******
15	28.49	4.27	70.
30	33.93	9.36	116.
45	31.97	14.16	0.
60	32.87	19.09	0.
75	34.82	24.31	0.
90	34.03	29.42	227.
105	35.50	34.74	0.
120	34.89	39.97	282.
135	31.57	44.71	0.
150	32.55	49.59	253.
165	31.19	54.27	0.
180	31.78	59.04	119.
195	30.91	63.68	0.
210	30.85	68.30	270.
225	30.42	72.87	0.
240	30.81	77.49	293.
255	30.10	82.00	0.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

PLOT NO. 1

DATE 8/12
DAYS INTO EXPERIMENT 76.926

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	29.25	4.39	-24.
30	33.15	9.36	108.
45	31.56	14.09	0.
60	32.24	18.93	37.
75	34.20	24.06	0.
90	33.42	29.07	213.
105	34.30	34.22	0.
120	34.45	39.39	167.
135	31.13	44.06	0.
150	31.85	48.83	215.
165	31.06	53.49	0.
180	31.39	58.20	39.
195	30.25	62.74	0.
210	31.04	67.39	253.
225	30.43	71.96	0.
240	30.32	76.51	304.
255	29.95	81.00	0.

DATE 8/14
DAYS INTO EXPERIMENT 79.156

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	30.30	4.55	35.
30	33.85	9.62	97.
45	31.78	14.39	0.
60	32.85	19.32	0.
75	35.02	24.57	0.
90	34.83	29.79	194.
105	35.59	35.13	0.
120	35.44	40.45	173.
135	31.84	45.23	0.
150	32.64	50.12	239.
165	31.49	54.85	0.
180	32.15	59.67	29.
195	31.55	64.40	0.
210	31.06	69.06	264.
225	31.63	73.80	0.
240	31.30	78.50	293.
255	31.03	83.15	0.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

PLOT NO. 1

DATE 8/18
DAYS INTO EXPERIMENT 83.218

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	29.33	4.40	35.
30	33.57	9.43	140.
45	31.66	14.18	0.
60	32.87	19.11	192.
75	35.15	24.39	0.
90	34.02	29.49	197.
105	34.57	34.67	0.
120	35.28	39.97	185.
135	31.34	44.67	0.
150	32.53	49.55	241.
165	31.48	54.27	0.
180	31.35	58.97	173.
195	30.30	63.52	0.
210	31.13	68.19	247.
225	31.39	72.89	0.
240	30.98	77.54	287.
255	30.59	82.13	0.

DATE 8/28
DAYS INTO EXPERIMENT 93.072

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	29.32	4.40	0.
30	32.75	9.31	128.
45	31.23	14.00	0.
60	32.26	18.83	0.
75	33.84	23.91	0.
90	33.59	28.95	193.
105	34.49	34.12	0.
120	34.47	39.29	197.
135	31.48	44.02	0.
150	31.84	48.79	223.
165	30.58	53.38	0.
180	31.12	58.05	213.
195	30.77	62.66	0.
210	30.85	67.29	246.
225	31.78	72.06	0.
240	30.21	76.59	278.
255	29.69	81.04	0.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

PLOT NO. 1

DATE 9/ 6
DAYS INTO EXPERIMENT 102.051

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	32.35	4.85	52.
30	34.57	10.04	75.
45	32.31	14.89	0.
60	33.29	19.88	0.
75	34.76	25.09	0.
90	34.10	30.21	200.
105	34.77	35.43	0.
120	35.27	40.72	200.
135	31.96	45.51	0.
150	32.58	50.40	247.
165	31.11	55.06	0.
180	31.43	59.78	280.
195	31.21	64.46	0.
210	30.66	69.06	292.
225	32.55	73.94	0.
240	30.90	78.58	277.
255	30.71	83.18	0.

DATE 9/26
DAYS INTO EXPERIMENT 122.051

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	32.00	4.80	18.
30	32.84	9.73	45.
45	31.56	14.46	0.
60	32.51	19.34	0.
75	33.55	24.37	0.
90	33.69	29.42	151.
105	34.45	34.59	0.
120	34.27	39.73	197.
135	30.52	44.31	0.
150	32.56	49.19	217.
165	29.50	53.62	0.
180	30.36	58.17	352.
195	29.63	62.61	0.
210	29.98	67.11	311.
225	30.01	71.61	0.
240	29.91	76.10	303.
255	29.17	80.47	0.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

PLOT NO. 2

DATE 8/ 3
DAYS INTO EXPERIMENT .000

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	24.78	3.72	192.
30	32.97	8.66	226.
45	32.49	13.54	143.
60	32.74	18.45	143.
75	31.76	23.21	81.
90	33.17	28.19	102.
105	33.84	33.26	205.
120	33.61	38.30	310.
135	33.18	43.28	528.
150	34.47	48.45	571.
165	35.52	53.78	282.
180	36.69	59.28	0.
195	36.25	64.72	184.
210	28.61	69.01	610.
225	30.27	73.55	238.
240	30.75	78.16	426.
255	30.76	82.78	486.
270	30.31	87.33	673.

DATE 8/ 3
DAYS INTO EXPERIMENT .042

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	37.16	5.57	284.
30	35.45	10.89	262.
45	35.25	16.18	157.
60	35.02	21.43	266.
75	32.73	26.34	64.
90	33.69	31.39	60.
105	34.30	36.54	6.
120	34.03	41.64	0.
135	33.90	46.73	572.
150	35.60	52.07	625.
165	36.49	57.54	358.
180	37.09	63.11	507.
195	36.56	68.59	216.
210	29.07	72.95	450.
225	30.35	77.50	303.
240	31.24	82.19	469.
255	30.72	86.80	518.
270	30.88	91.43	690.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

PLOT NO. 2

DATE 8/ 3
DAYS INTO EXPERIMENT .070

DEPTH	PERCENT WATER BY VOLUME	TOTAL WATER ABOVE DEPTH	TOTAL WATER POTENTIAL
*****	********	*****	******
15	37.13	5.57	266.
30	35.36	10.87	250.
45	34.46	16.04	157.
60	34.48	21.21	254.
75	34.37	26.37	2.
90	34.56	31.55	35.
105	34.75	36.77	6.
120	34.04	41.87	0.
135	33.40	46.88	575.
150	35.38	52.19	633.
165	36.25	57.63	368.
180	36.69	63.13	547.
195	36.25	68.57	220.
210	28.80	72.89	488.
225	29.88	77.37	314.
240	30.75	81.98	471.
255	30.72	86.59	522.
270	30.87	91.22	712.

DATE 8/ 3
DAYS INTO EXPERIMENT .147

DEPTH	PERCENT WATER BY VOLUME	TOTAL WATER ABOVE DEPTH	TOTAL WATER POTENTIAL
*****	********	*****	******
15	36.72	5.51	140.
30	34.69	10.71	63.
45	34.45	15.88	155.
60	34.47	21.05	182.
75	33.40	26.06	0.
90	34.00	31.16	-18.
105	35.01	36.41	10.
120	34.67	41.61	0.
135	34.23	46.75	575.
150	35.32	52.04	662.
165	35.90	57.43	415.
180	36.71	62.94	610.
195	35.89	68.32	265.
210	28.27	72.56	614.
225	29.36	76.96	366.
240	30.33	81.51	468.
255	30.47	86.08	549.
270	30.31	90.63	746.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

PLOT NO. 2

DATE 8/ 3
DAYS INTO EXPERIMENT .180

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	37.11	5.57	86.
30	35.34	10.87	54.
45	34.88	16.10	136.
60	34.74	21.31	135.
75	33.94	26.40	-18.
90	34.43	31.57	0.
105	35.06	36.82	10.
120	34.69	42.03	0.
135	34.60	47.22	501.
150	36.70	52.72	629.
165	36.49	58.20	392.
180	37.39	63.81	486.
195	36.51	69.28	257.
210	29.22	73.67	636.
225	29.83	78.14	358.
240	30.41	82.70	457.
255	31.04	87.36	526.
270	30.95	92.00	736.

DATE 8/ 3
DAYS INTO EXPERIMENT .223

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	36.57	5.49	73.
30	34.83	10.71	0.
45	34.64	15.91	117.
60	34.40	21.07	123.
75	33.94	26.16	0.
90	34.41	31.32	0.
105	35.21	36.60	12.
120	35.12	41.87	0.
135	34.82	47.09	21.
150	36.47	52.56	433.
165	37.60	58.20	391.
180	36.65	63.70	204.
195	36.24	69.14	289.
210	28.66	73.43	658.
225	29.74	77.90	375.
240	30.09	82.41	361.
255	30.33	86.96	547.
270	30.16	91.48	743.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

PLOT NO. 2

DATE 8/ 3

DAYS INTO EXPERIMENT .271

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTENTIAL ******
15	36.29	5.44	66.
30	34.21	10.57	55.
45	34.18	15.70	-11.
60	34.10	20.82	108.
75	33.62	25.86	0.
90	34.37	31.02	0.
105	34.46	36.18	13.
120	34.38	41.34	0.
135	34.40	46.50	13.
150	35.88	51.88	297.
165	36.50	57.36	383.
180	36.65	62.86	162.
195	35.74	68.22	295.
210	28.95	72.56	664.
225	29.17	76.93	387.
240	30.16	81.46	228.
255	30.21	85.99	547.
270	30.13	90.51	744.

DATE 8/ 3

DAYS INTO EXPERIMENT .307

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTENTIAL ******
15	36.87	5.53	63.
30	34.38	10.69	54.
45	34.42	15.85	0.
60	34.50	21.03	71.
75	33.76	26.09	0.
90	34.27	31.23	0.
105	34.28	36.37	13.
120	34.75	41.58	0.
135	34.58	46.77	-9.
150	35.80	52.14	201.
165	36.89	57.67	373.
180	36.81	63.19	144.
195	35.89	68.58	282.
210	28.59	72.87	656.
225	30.46	77.44	398.
240	30.11	81.95	136.
255	30.32	86.50	548.
270	30.52	91.08	746.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

PLOT NO. 2

DATE 8/ 3
DAYS INTO EXPERIMENT .346

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTENTIAL ******
15	36.24	5.44	60.
30	34.30	10.58	55.
45	34.58	15.77	0.
60	34.03	20.87	51.
75	33.75	25.93	0.
90	34.40	31.09	0.
105	34.73	36.30	13.
120	34.64	41.50	0.
135	34.35	46.65	-9.
150	36.09	52.07	151.
165	37.44	57.68	366.
180	37.55	63.31	136.
195	36.09	68.73	285.
210	29.13	73.10	73.
225	30.11	77.61	411.
240	29.99	82.11	119.
255	30.44	86.68	548.
270	30.12	91.20	751.

DATE 8/ 4
DAYS INTO EXPERIMENT .387

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTENTIAL ******
15	36.66	5.50	56.
30	34.49	10.67	55.
45	34.29	15.82	0.
60	33.87	20.90	41.
75	33.92	25.98	0.
90	34.21	31.12	0.
105	34.76	36.33	13.
120	34.42	41.49	0.
135	34.18	46.62	-18.
150	35.38	51.93	131.
165	37.06	57.49	360.
180	36.31	62.93	132.
195	36.10	68.35	288.
210	29.19	72.73	66.
225	29.89	77.21	422.
240	30.14	81.73	112.
255	29.96	86.23	548.
270	29.89	90.71	753.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

DATE 8/ 4
DAYS INTO EXPERIMENT .431

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	36.60	5.49	55.
30	34.73	10.70	55.
45	34.68	15.90	0.
60	34.88	21.14	32.
75	34.31	26.28	0.
90	34.42	31.44	0.
105	35.06	36.70	16.
120	34.47	41.87	0.
135	35.04	47.13	-18.
150	35.82	52.50	117.
165	37.62	58.14	343.
180	37.69	63.80	129.
195	36.49	69.27	300.
210	29.25	73.66	66.
225	29.80	78.13	427.
240	29.87	82.61	104.
255	30.69	87.21	545.
270	30.31	91.76	753.

PLOT NO. 2
DATE 8/ 4
DAYS INTO EXPERIMENT .470

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	36.96	5.54	54.
30	35.63	10.89	55.
45	35.07	16.15	20.
60	34.97	21.40	0.
75	34.38	26.55	0.
90	34.79	31.77	0.
105	36.00	37.17	13.
120	35.14	42.44	0.
135	35.47	47.76	-18.
150	36.81	53.28	109.
165	37.69	58.94	329.
180	38.22	64.67	125.
195	37.05	70.23	297.
210	29.65	74.68	70.
225	30.81	79.30	433.
240	30.68	83.90	98.
255	31.23	88.58	548.
270	30.78	93.20	755.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

PLOT NO. 2

DATE 8/ 4

DAYS INTO EXPERIMENT .512

DEPTH	PERCENT WATER BY VOLUME	TOTAL WATER ABOVE DEPTH	TOTAL WATER POTENTIAL
*****	********	*****	******
15	35.78	5.37	54.
30	34.69	10.57	55.
45	34.20	15.70	0.
60	34.16	20.83	10.
75	34.07	25.94	0.
90	33.78	31.00	0.
105	34.61	36.19	13.
120	34.01	41.30	0.
135	33.91	46.38	0.
150	35.70	51.74	105.
165	36.52	57.21	315.
180	36.65	62.71	123.
195	35.93	68.10	296.
210	28.88	72.43	73.
225	30.04	76.94	438.
240	30.38	81.50	85.
255	30.51	86.07	539.
270	30.34	90.63	755.

DATE 8/ 4

DAYS INTO EXPERIMENT .549

DEPTH	PERCENT WATER BY VOLUME	TOTAL WATER ABOVE DEPTH	TOTAL WATER POTENTIAL
*****	********	*****	******
15	36.76	5.51	54.
30	34.45	10.68	55.
45	34.74	15.89	0.
60	34.23	21.03	5.
75	33.54	26.06	0.
90	34.64	31.25	0.
105	35.01	36.51	16.
120	35.00	41.76	0.
135	34.95	47.00	0.
150	36.28	52.44	105.
165	37.12	58.01	306.
180	36.73	63.52	123.
195	36.46	68.99	293.
210	29.94	73.48	75.
225	30.01	77.98	444.
240	30.44	82.55	94.
255	30.84	87.17	534.
270	30.17	91.70	755.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

PLOT NO. 2

DATE 8/ 4
DAYS INTO EXPERIMENT .802

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTENTIAL ******
15	37.13	5.57	47.
30	33.95	10.66	54.
45	34.71	15.87	0.
60	34.82	21.09	0.
75	34.38	26.25	0.
90	35.16	31.52	0.
105	34.87	36.76	17.
120	34.79	41.97	0.
135	34.59	47.16	0.
150	36.51	52.64	93.
165	37.67	58.29	194.
180	36.83	63.81	112.
195	36.42	69.28	223.
210	30.25	73.81	82.
225	30.37	78.37	417.
240	30.36	82.92	78.
255	30.59	87.51	430.
270	30.61	92.10	706.

DATE 8/ 4
DAYS INTO EXPERIMENT 1.219

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTENTIAL ******
15	37.08	5.56	40.
30	35.79	10.93	43.
45	35.06	16.19	0.
60	34.76	21.40	0.
75	34.80	26.62	0.
90	35.17	31.90	0.
105	35.68	37.25	16.
120	35.43	42.56	0.
135	35.23	47.85	0.
150	37.25	53.43	94.
165	37.74	59.10	146.
180	37.72	64.75	105.
195	37.16	70.33	182.
210	31.17	75.00	91.
225	30.79	79.62	369.
240	30.61	84.21	70.
255	31.09	88.88	289.
270	31.20	93.56	706.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

PLOT NO. 2

DATE 8/ 5
DAYS INTO EXPERIMENT 1.948

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	36.96	5.54	36.
30	35.77	10.91	39.
45	35.58	16.25	0.
60	35.38	21.55	0.
75	34.70	26.76	0.
90	35.02	32.01	0.
105	35.66	37.36	16.
120	35.00	42.61	0.
135	35.16	47.89	-9.
150	36.79	53.40	68.
165	37.59	59.04	64.
180	38.36	64.80	83.
195	37.31	70.39	128.
210	30.81	75.01	96.
225	31.73	79.77	284.
240	31.01	84.42	68.
255	30.75	89.04	219.
270	30.51	93.61	709.

DATE 8/ 5
DAYS INTO EXPERIMENT 2.260

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	36.10	5.41	47.
30	36.10	10.83	50.
45	35.32	16.13	-1.
60	35.50	21.45	35.
75	34.67	26.65	-2.
90	35.64	32.00	0.
105	35.95	37.39	33.
120	35.83	42.77	0.
135	35.50	48.09	21.
150	37.27	53.68	96.
165	38.60	59.47	136.
180	38.34	65.22	102.
195	37.20	70.80	184.
210	30.89	75.44	124.
225	32.11	80.25	234.
240	31.45	84.97	123.
255	31.25	89.66	289.
270	30.94	94.30	730.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

PLOT NO. 2

DATE 8/ 6
DAYS INTO EXPERIMENT 2.969

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTENTIAL ******
15	35.05	5.26	70.
30	35.11	10.52	75.
45	35.05	15.78	21.
60	34.33	20.93	37.
75	34.25	26.07	9.
90	34.65	31.27	2.
105	35.28	36.56	48.
120	34.54	41.74	8.
135	35.23	47.02	51.
150	36.63	52.52	110.
165	37.71	58.17	83.
180	38.05	63.88	119.
195	36.95	69.43	101.
210	31.09	74.09	151.
225	31.75	78.85	123.
240	31.27	83.54	112.
255	31.29	88.23	259.
270	30.62	92.83	689.

DATE 8/ 7
DAYS INTO EXPERIMENT 4.000

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTENTIAL ******
15	32.89	4.93	89.
30	34.62	10.13	79.
45	35.06	15.39	39.
60	34.50	20.56	56.
75	33.33	25.56	18.
90	34.37	30.72	21.
105	35.08	35.98	60.
120	35.25	41.27	43.
135	35.03	46.52	83.
150	36.43	51.98	125.
165	37.88	57.67	106.
180	37.80	63.34	136.
195	37.14	68.91	131.
210	30.51	73.48	166.
225	31.26	78.17	151.
240	31.18	82.85	143.
255	31.89	87.63	300.
270	30.89	92.27	686.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

PLOT NO. 2

DATE 8/10
DAYS INTO EXPERIMENT 6.906

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	31.13	4.67	104.
30	34.30	9.81	32.
45	33.81	14.89	48.
60	33.56	19.92	77.
75	32.87	24.85	71.
90	33.86	29.93	109.
105	33.93	35.02	70.
120	34.52	40.20	104.
135	33.82	45.27	119.
150	35.90	50.66	146.
165	36.83	56.18	140.
180	37.47	61.80	170.
195	36.69	67.30	154.
210	30.60	71.89	190.
225	31.42	76.61	143.
240	30.92	81.24	182.
255	31.08	85.91	297.
270	30.55	90.49	671.

DATE 8/11
DAYS INTO EXPERIMENT 8.156

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	31.78	4.77	110.
30	33.78	9.83	98.
45	34.34	14.99	87.
60	34.25	20.12	123.
75	33.62	25.17	73.
90	34.37	30.32	41.
105	34.83	35.55	83.
120	35.08	40.81	119.
135	34.89	46.04	119.
150	36.78	51.56	146.
165	38.53	57.34	140.
180	38.07	63.05	170.
195	37.03	68.60	154.
210	30.68	73.20	213.
225	32.17	78.03	143.
240	31.66	82.78	182.
255	31.59	87.52	297.
270	31.35	92.22	341.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

DATE 8/12
DAYS INTO EXPERIMENT 8.865

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	31.66	4.75	112.
30	34.24	9.89	105.
45	34.40	15.04	78.
60	34.04	20.15	75.
75	33.56	25.18	48.
90	34.52	30.36	33.
105	34.64	35.56	85.
120	34.91	40.80	100.
135	34.58	45.98	150.
150	36.25	51.42	158.
165	38.00	57.12	119.
180	38.13	62.84	181.
195	36.70	68.35	142.
210	30.81	72.97	200.
225	31.61	77.71	127.
240	31.82	82.48	190.
255	31.96	87.28	258.
270	31.56	92.01	292.

PLOT NO. 2
DATE 8/13
DAYS INTO EXPERIMENT 10.135

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	31.78	4.77	125.
30	34.51	9.94	109.
45	34.25	15.08	89.
60	34.26	20.22	115.
75	33.80	25.29	78.
90	34.30	30.43	36.
105	34.60	35.62	86.
120	34.89	40.86	143.
135	34.59	46.05	170.
150	36.09	51.46	190.
165	38.05	57.17	151.
180	37.64	62.81	200.
195	36.79	68.33	162.
210	30.84	72.96	217.
225	32.07	77.77	143.
240	31.91	82.55	212.
255	31.91	87.34	265.
270	31.27	92.03	303.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

PLOT NO. 2

DATE 8/14
DAYS INTO EXPERIMENT 11.062

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	31.73	4.76	119.
30	34.09	9.87	106.
45	33.76	14.94	86.
60	33.78	20.00	93.
75	33.56	25.04	60.
90	33.93	30.13	28.
105	34.77	35.34	90.
120	34.44	40.51	138.
135	34.14	45.63	165.
150	35.83	51.00	174.
165	37.71	56.66	151.
180	37.36	62.27	194.
195	36.69	67.77	185.
210	31.11	72.43	215.
225	31.90	77.22	170.
240	31.57	81.95	200.
255	32.71	86.86	255.
270	31.40	91.57	291.

DATE 8/15
DAYS INTO EXPERIMENT 12.125

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	31.90	4.79	120.
30	33.86	9.86	113.
45	34.09	14.98	104.
60	33.34	19.98	133.
75	33.28	24.97	90.
90	34.32	30.12	32.
105	34.32	35.27	93.
120	34.77	40.48	151.
135	34.44	45.65	186.
150	36.01	51.05	207.
165	37.75	56.71	189.
180	37.06	62.27	216.
195	30.63	66.87	230.
210	30.42	71.43	231.
225	32.01	76.23	189.
240	31.40	80.94	226.
255	32.13	85.76	269.
270	30.99	90.41	333.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

PLOT NO. 2

DATE 8/18

DAYS INTO EXPERIMENT 15.094

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	30.92	4.64	146.
30	33.91	9.73	115.
45	33.68	14.78	94.
60	33.73	19.84	223.
75	32.95	24.78	68.
90	33.70	29.83	32.
105	34.54	35.01	100.
120	34.17	40.14	102.
135	33.68	45.19	178.
150	35.57	50.53	193.
165	37.65	56.17	166.
180	37.86	61.85	211.
195	36.93	67.39	197.
210	30.84	72.02	231.
225	32.18	76.84	155.
240	31.70	81.60	230.
255	31.54	86.33	269.
270	31.31	91.03	303.

DATE 8/28

DAYS INTO EXPERIMENT 24.990

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	31.04	4.66	136.
30	33.88	9.74	135.
45	33.22	14.72	6.
60	33.35	19.72	102.
75	32.14	24.54	32.
90	33.77	29.61	-5.
105	34.52	34.79	117.
120	34.42	39.95	150.
135	34.01	45.05	189.
150	35.77	50.42	213.
165	37.28	56.01	186.
180	37.75	61.67	230.
195	36.68	67.17	207.
210	30.63	71.77	243.
225	31.98	76.57	247.
240	31.44	81.28	259.
255	31.74	86.04	264.
270	31.32	90.74	314.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

PLOT NO. 2

DATE 9/ 6
DAYS INTO EXPERIMENT 33.969

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	31.59	4.74	150.
30	34.28	9.88	139.
45	33.97	14.98	139.
60	34.27	20.12	161.
75	33.00	25.07	41.
90	33.94	30.16	43.
105	34.70	35.36	131.
120	35.02	40.62	232.
135	34.53	45.80	85.
150	36.44	51.26	94.
165	37.65	56.91	112.
180	38.33	62.66	116.
195	37.31	68.26	136.
210	33.18	73.23	124.
225	32.49	78.11	161.
240	31.92	82.89	125.
255	32.09	87.71	147.
270	31.01	92.36	209.

DATE 9/26
DAYS INTO EXPERIMENT 53.969

DEPTH *****	PERCENT WATER BY VOLUME ********	TOTAL WATER ABOVE DEPTH *****	TOTAL WATER POTEN-TIAL ******
15	29.00	4.35	166.
30	31.94	9.14	158.
45	32.15	13.96	105.
60	31.60	18.70	158.
75	30.96	23.35	0.
90	31.68	28.10	52.
105	32.82	33.02	182.
120	33.28	38.02	273.
135	33.64	43.06	243.
150	34.51	48.24	258.
165	36.89	53.77	268.
180	36.51	59.25	303.
195	35.91	64.64	282.
210	29.65	69.08	273.
225	31.79	73.85	312.
240	30.80	78.47	301.
255	31.02	83.12	320.
270	30.84	87.75	361.

NOTE ZERO VALUES OF TOTAL WATER POTENTIAL DENOTE EQUIPMENT FAILURE OR MANOMETER READINGS BELOW THE MERCURY RESERVOIR.

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