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ENVIRONMENTAL CONTROLS ON GROUNDWATER CHEMISTRY IN NEW MEXICO

I. THE EFFECT OF PHREATOPHYTES

Technical Completion Report

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TECHNICAL COMPLETION REPORT
Project No. A-030-NMEX

New Mexico Water Resources Research Institute
in cooperation with
New Mexico Institute of Mining and Technology
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ABSTRACT

The relationship between phreatophyte-induced evapotranspiration, water level fluctuations, and changes in groundwater quality were investigated with arrays of nested piezometers installed at two sites of the Rio Grande flood plain. Only data from one site (Hope Farms), spanning 490 days, were found suitable for analysis and interpretation.

Consumptive use was computed from continuous water level records. The best correlation was found between consumptive use and averaged maximum daily temperature, while a lack of direct recharge from precipitation at the site was indicated.

The absence of a dominant salinity stratification in either space or time was the salient feature of the specific-conductance data. A strong seasonal cyclic variation was observed in the difference between horizontally averaged conductivities from piezometers set at 10 ft and 20 ft below the land surface. This cyclic variation showed a strong inverse correlation with water table fluctuations caused by evapotranspiration. This is in agreement with a salinity mechanism of temporary "deposition" of salts in and above the capillary fringe during the growing season, ascribed to the transpiring phreatophytes, and "dissolution" of these salts in the fall and early winter as the phreatic surface rises. The averaged horizontal water table gradient also showed a high inverse correlation with the specific conductance difference.

The chemical characteristics of the groundwater in this area appear to be determined by mixing of waters of different chemical composition. In general, the groundwater of this area has a calcium sulfate character.

It is postulated that evapotranspiration causes fluctuations of the vertical hydraulic gradient which are responsible for the mixing and a weak diurnal cycle of specific groundwater conductance.

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History of this Work

The work described in the present report was carried out under the direction of Dr. Frank Titus spanning the years 1971, 1972, and part of 1973. Dr. Titus resigned his position with New Mexico Institute of Mining and Technology in the summer of 1973.

Starting in early spring, 1974, Messrs. Richard Naff and Adel Bakr, research graduate assistants in the hydrology program, with the direction and coordination of Prof. Gerardo Wolfgang Gross, undertook the analysis of the data provided by Dr. Titus and wrote the present report.

Acknowledgement

Dr. Jerome Westphal, Center for Water Resources Research, Desert Research Institute, Las Vegas, Nevada kindly supplied the stepwise multiple regression/correlation program used in this work. Prof. Lynn Gelhar critically read the manuscript and suggested improvements. Miss Petra Apodaca typed two versions of the manuscript.

INTRODUCTION

Objectives

Phreatophytes are those plants that meet their water needs by consuming ground water within reach of their root systems. W. N. White (1932) described the heavy consumptive use of water by these plants in the Escalante Valley, Utah. Later investigators (for instance, Gatewood et al., 1950; Mower et al., 1964) confirmed his findings elsewhere. Johnson (1960) and Urie (1971) among others indicated that removal of phreatophytes produces a significant reduction in evapotranspiration as evidenced by increased base flow and groundwater yield from cleared areas. However, the nature and distribution of salt concentrations in groundwater caused by phreatophytes immediately beneath the water table has yet to be thoroughly investigated. Investigations of this type would, in addition to increasing our academic knowledge of phreatophyte systems, allow for such practical gains as more realistic cost/benefit calculations of phreatophyte eradication projects. Clearly, there is a need not only to improve our ability to quantify evapotranspiration from phreatophyte areas, but also to characterize and, if possible, quantify salt-phreatophyte relationships.

In the spring and summer of 1971, apparatus and instrumentation to collect climatologic, groundwater potential, and groundwater chemistry data were installed at two sites on the Rio Grande flood plain. The first is a salt cedar (tamarix gallica) stand in the southern part of the Bosque del Apache Wildlife Refuge and the other a mature cottonwood (Populus weslizeni(?)) grove on private land (Hope Farms) about four miles south of Socorro. As indicated later in this report, only the data from the Hope Farms site were considered to be of such quality that further analysis was warranted. This report is, therefore, mainly devoted to the Hope Farms site.

The objectives of these installations were outlined as follows in the original research proposal:

1) To determine the distribution and concentration of soluble salts in groundwater beneath a shallow water table under conditions of consumptive use by phreatophytes.

2) To investigate the hypothesis of seasonal variation in this concentration.

3) To investigate the relative influence of dispersion/diffusion versus lateral groundwater flow in removing water containing a higher salt load from the water table zone.

4) To determine whether monitoring of water levels and water chemistry in a single piezometer nest, or a group of nests, will allow calculation of transpiration.

Not all of these objectives could be realized. The data support a rather detailed treatment of the first and fourth objectives and a brief discussion of the second objective. Only a few statements will be made regarding the third objective.

Previous work on consumptive use by phreatophytes

Since the opening of this century it has been realized that a large class of plant life, loosely termed phreatophytes, utilize groundwater as a source of sustenance in arid regions. Numerous investigators have looked into the peculiarities of their existence in the Southwest of the U.S. Robinson (1958) listed many phreatophytes and described qualitatively their relationship to groundwater reservoirs. Several studies, including projects in the Safford Valley, Arizona (Gatewood et al., 1950), on the Pecos River, New Mexico (Mower et al., 1964), and near Yuma, Arizona (McDonald and Hughes, 1968) have described quantitatively the heavy consumptive use of water by these plants. Phreatophytes are known to consume large quantities of shallow groundwater from river valleys in the southwestern United States and in other arid zones. Nearly 25 million acre-feet of water may be consumed yearly by more than 16 million acres of phreatophytes growing on river flood plains in the Western States (Robinson, 1952). Water consumed by phreatophytes is considered to be wasted relative to its high economic value when used for agriculture and domestic purposes. This may explain why salvage of water by eradicating these plants in certain areas has such appeal. Measures to control the growth of certain phreatophytes have been carried out in several areas. Urie (1971) estimated groundwater recharge balances under 40-acre blocks of a jack pine plantation in northwestern Michigan during the 4 years following removal of 50% of the trees in clear-cut strips. Approximately three inches per year of additional groundwater was produced as a result of strip cutting. Base flow increases following a reduction in forest cover have also been reported by Johnson (1960).

Measuring water use by salt cedar (Tamarix sp.) in evapotranspirometers (lysimeters), Van Hylckama (1970) found that thinned out stands use nearly as much water as control tanks with the vegetation unthinned, if the water is of good quality. Hence, he argued that thinning and cutting are ineffective methods of saving water and cautioned against exaggerated claims as to the quantity of water potentially saved by phreatophyte removal.

Cunningham et al., (1973) developed and utilized a method for estimating transpiration-water use by riparian plant communities. It requires estimation of the leaf area of each species on a stand and calculation of an average transpiration rate for each species. The method was used to compare rates of consumptive water use by several southern New Mexico phreatophyte species. Though this method allows comparison of different species on both a leaf area and total stand basis, it needs further evaluation in relation to other similar techniques.

Study area

The Hope Farms site was selected for its rather dense growth of mature cottonwoods (*Populus weslizeni* (?)). It was located on the western edge of the Rio Grande flood plain, south of the Socorro Grant boundary and east of the New Mexico Principal Meridian (Figure 1). The site was surrounded on three sides by drainage and irrigation ditches; but one of these was later obliterated by land-clearing operations while the present work was still in progress. Within the site, the water-table gradient was almost due south. The phreatic surface generally was located at depths greater than 7 ft.

Sample logs taken during piezometer emplacement operations indicate that the alluvial aquifer consisted dominantly of relatively clean fine to coarse-grained sand (Appendix A). A silty or clayey layer ranging from 5 to 14 ft. in thickness covered the principal sand aquifer. Any confining effect from this upper layer was apparently negligible. This was aptly demonstrated by the apparent lack of effect on continuous water level recordings of railroad trains passing daily in the vicinity of the piezometers. The railroad line was about 100 yards from the investigation site, and the recording device was capable of registering fluctuations of 0.01 ft.

Throughout the data collection period active farming operations occurred in the area immediately north of nest A (Figure 1). This activity included extensive periods of flood irrigation during the summer months. In addition, land clearing operations were initiated in the area surrounding the site in the winter of 1971. These operations reduced the size of the grove from its original 80 acres at the beginning of the investigation to approximately 15 acres by April, 1972 (Figure 2). The remainder of the grove was not removed until termination of the experiment, in December, 1972.

Since data from the Bosque del Apache site were not utilized for this report, it will not be discussed.

Instrumentation and data collection

Figures 1 and 2 show the location and the relative position of the

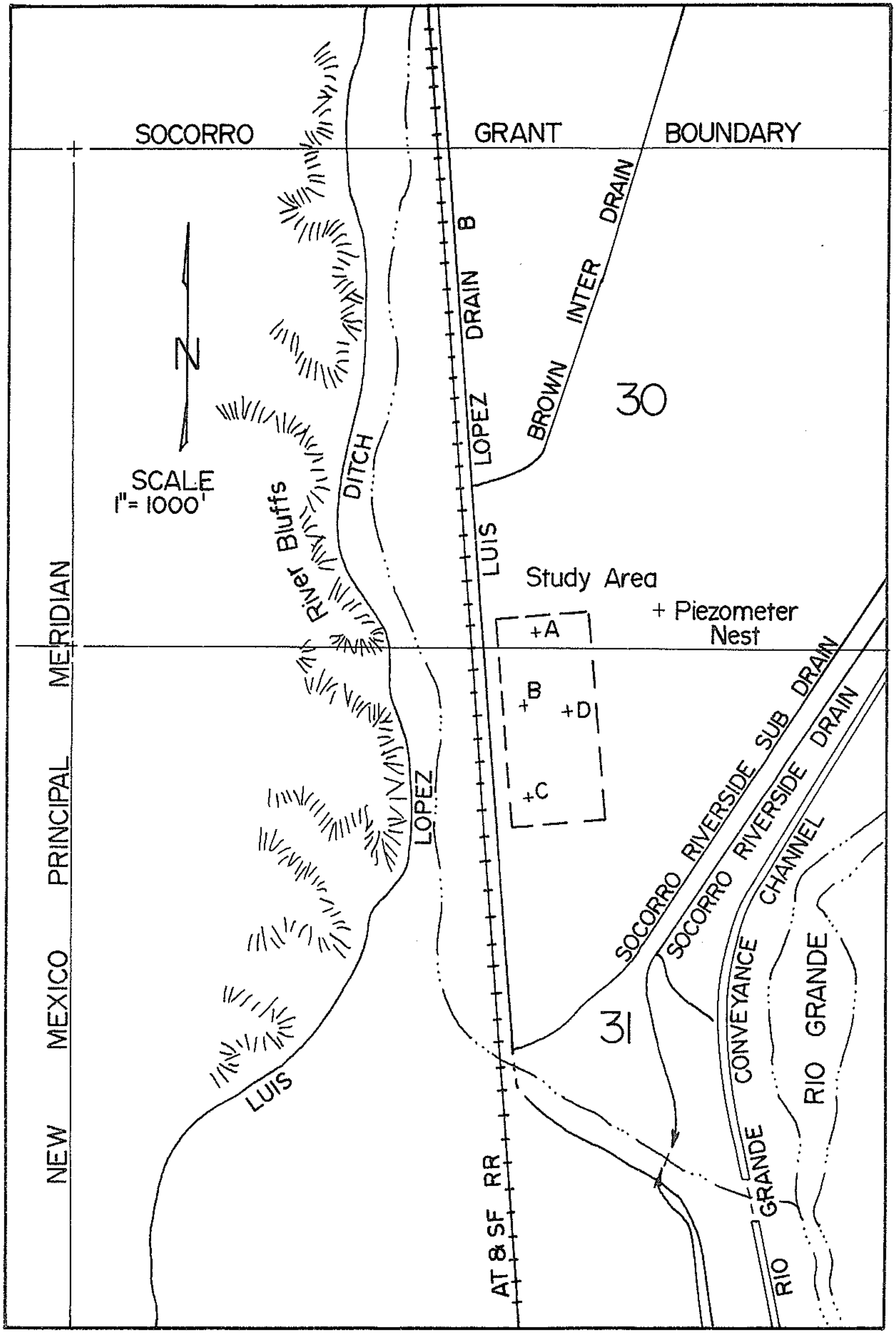


Figure 1 — Hope Farms site; T3S, R1W, Socorro County.

Figure 2 - Oblique aerial photograph of Hope Farms site, 4/1/72.

four piezometer nests completed at the Hope Farms site. The horizontal distances between these nests were roughly determined using areal photographs of the site, while the vertical elevation of each of the nests was obtained by leveling. The accuracy of the horizontal distances was estimated at ± 5 ft. while that of vertical elevations was believed to be on the order of ± 0.01 ft.

Each piezometer nest consisted of 4 pieces of 1¼ inch-ID steel tubing with a well point on the bottom. In each nest the shallowest piezometer was set just below the water table, and the other three were screened at approximately 10 foot intervals below the water table. For convenience, the piezometers will be referred to throughout the report by a combination of two capital letters followed by a two-digit number. The first letter abbreviates the name of the site while the second designates the nest and the number approximates the depth of the piezometer below the land surface. For instance, HB-10 refers to a piezometer 10 ft. below land surface in nest B at the Hope Farms site.

Piezometer installation, begun in May 1971, was mostly completed by mid-July. A total of 31 piezometers was installed at both sites. To install each piezometer, a 4-in. hole was drilled with a truck-mounted auger to a depth at least 5 ft. greater than the depth at which the piezometer was eventually set. After installation each piezometer was developed by pumping vigorously with a hand-operated cylinder pump until sufficient fine sand had been drawn through the screen for the formation to stabilize. Water samples were collected and the initial water levels were measured as each nest was completed.

A water level recorder was installed on a single piezometer at both sites. Water level measurements were made with a steel tape and water samples were collected on a regular schedule from all piezometers for determination of the specific electrical conductance. Sampling and water level measurements during the spring and summer months were made one to three times a week, but only once a week or less frequently during fall and winter. Following heavy rain storms and at the end of the snowmelt season collection of data was not feasible due to bad road conditions.

Sets of water samples were periodically submitted to the State Bureau of Mines and Mineral Resources for complete analysis. Upon returning from the field, supplementary analyses on the same samples were run for a few constituents, such as pH and the carbonate and bicarbonate ions. Changes in specific conductance were measured every 2 hours over a 24-hour period on water samples from the HC nest of piezometers while water levels in a piezometer of nest HB were simultaneously measured.

Climatological data were collected at the cottonwood grove for the purpose of calculating evapotranspiration rates. The data recorded include wind run and direction, temperature, humidity, barometric pressure, incident solar radiation, and precipitation. However, due to frequent malfunctioning of some of the instruments leading to several gaps in the records, climatological data published by the Weather Bureau for the weather station at Socorro were used in this report.

Data for quality and quantity of irrigation water applied to fields next to the groves were not available since neither water samples nor flow measurements were collected from nearby ditches. No pumping tests were performed on any of the piezometers in either site. No attempt was made to determine the specific yield of the aquifer materials. However from an inspection of well logs for most of the piezometers at Hope Farms site, a specific yield of 0.1 was considered reasonable upon comparison with similar data available in the literature.

Three factors were involved in the decision to delete the Bosque site from this report. The foremost of these was the lack of leveling data, resulting from the removal of all piezometers before leveling could be initiated. Second, the area immediately north of the site was subject to ponding to several feet depth as part of the maintenance program of the Bosque del Apache Wildlife Refuge. It is safe to assume that ponding caused an extraneous influence on the site, obscuring the effects of evapotranspiration. Finally, much of the data was in obvious duplication with that gathered at the Hope Farms site. Given these factors plus the rather mediocre results obtained from the considerable work done with the Hope Farms data, deletion of the Bosque site was considered proper. However, most of the raw data collected from that site, including chemical analyses and specific conductance of water samples, are available in the appendices of this report. Water level data are available upon request from New Mexico Institute of Mining and Technology.

CONSUMPTIVE WATER USE

Plant and hydraulic considerations

Most likely, evapotranspiration at the Hope Farms site is largely the result of transpiration rather than of evaporation. White (1932) has pointed out that, especially in coarser sediments, similar to those present at Hope Farms, evaporation is minimal when the water table is found more than 5 ft. below the land surface. Thus, evapotranspirative losses, as referred to in this report, are understood to be mainly transpirative in nature.

Transpiration occurs through stomatal openings of the leaves, after liquid phase uptake in the root system and longitudinal transport through the vascular elements of the stem. The root system is the primary element of the plant which is in direct contact with soil water. In particular, it has been shown that the zone of most rapid water absorption lies immediately behind the formative plant tissue of the root tip itself, and ahead of the region where suberization (formation of corky tissue) develops (Slatyer, 1967). Two working hypotheses explain the observations of earlier workers in this field, as well as the observations resulting from the present investigation.

The first of these hypotheses concerns the ability of the endodermis to act as an osmotic membrane with respect to the ionic constituents of the soil water. That is, given that an osmotic potential exists to induce flow from the rooting medium across the endodermis into the central vascular system of the plant root, the endodermis excludes ions from entering the zylem (Scholander et al., 1965). In many plants the endodermis is known to be an important barrier to the free diffusion of ions and the main source of resistance to water entry in young roots but this may not be true for all plants, specifically not for certain mesophytes (Slatyer, 1967).

The second hypothesis concerns the location of maximum concentration of phreatophyte roots with regard to the phreatic surface, and the effects of inundation upon a root's ability to absorb water. In general, it is found that the greatest root concentration is located in the zone directly above the phreatic surface (for instance, see Gary, 1963, p. 312; White, 1932, p. 60; and McDonald and Hughes, 1968, p. F14), although some roots may extend below the phreatic surface. This observation is also assumed to be true of cottonwood roots at the Hope Farms site, and in addition it is assumed that those roots which penetrate into the saturated zone absorb little or no water. This second assumption is supported by some experimental data (Slatyer, 1967) where it has been demonstrated that root permeability is extremely sensitive to metabolic inhibitors. Poor aeration, as a byproduct of inundation by a rising water table, may indeed be expected to inhibit absorption of water by roots.

In light of the little evidence available, the above working hypotheses are not unreasonable. However, it should be mentioned that, while Scholander et al., (1965) have measured the (negative) sap pressures in cottonwoods, their ability to exclude ions has not been studied.

White (1932) ascribed the driving force for water table fluctuations caused by transpiring phreatophytes to a slight artesian head at some depth below the root zone of the plants. Thus, when transpiration occurred at a rate greater than that at which the artesian head could replenish water to the root zone, a net decline in the water table would result. For more homogeneous sediments, as those found at the Hope Farms site, an explanation similar to that given by Troxell (1936) is preferable. With reference to the Hope Farms site, Figure 3 is a schematic representation of the probable flow system. During the non-transpirative winter period, the phreatic surface acts as a no-flow boundary, and drainage ditches in the farm area to the north control its elevation. During the period of high transpiration losses, in the summer, root absorption of soil water causes a net flow from the phreatic surface through the unsaturated zone to the active root zone. The resulting depression of the phreatic surface causes an increase in the water table gradient and creates a flow component perpendicular to the phreatic surface. This perpendicular component of flow, which probably exists only in the immediate vicinity of the phreatic surface, would by necessity have a hydraulic gradient along its streamlines in the approximate direction of flow. This hydraulic gradient, then, would be the driving force for diurnal fluctuations of the water table, and diurnal fluctuations in turn should be proportional to the water table gradient. In addition, irrigation immediately north of the site may also have affected the water table gradient by moving the hinge line over which the gradient rotates further to the south.

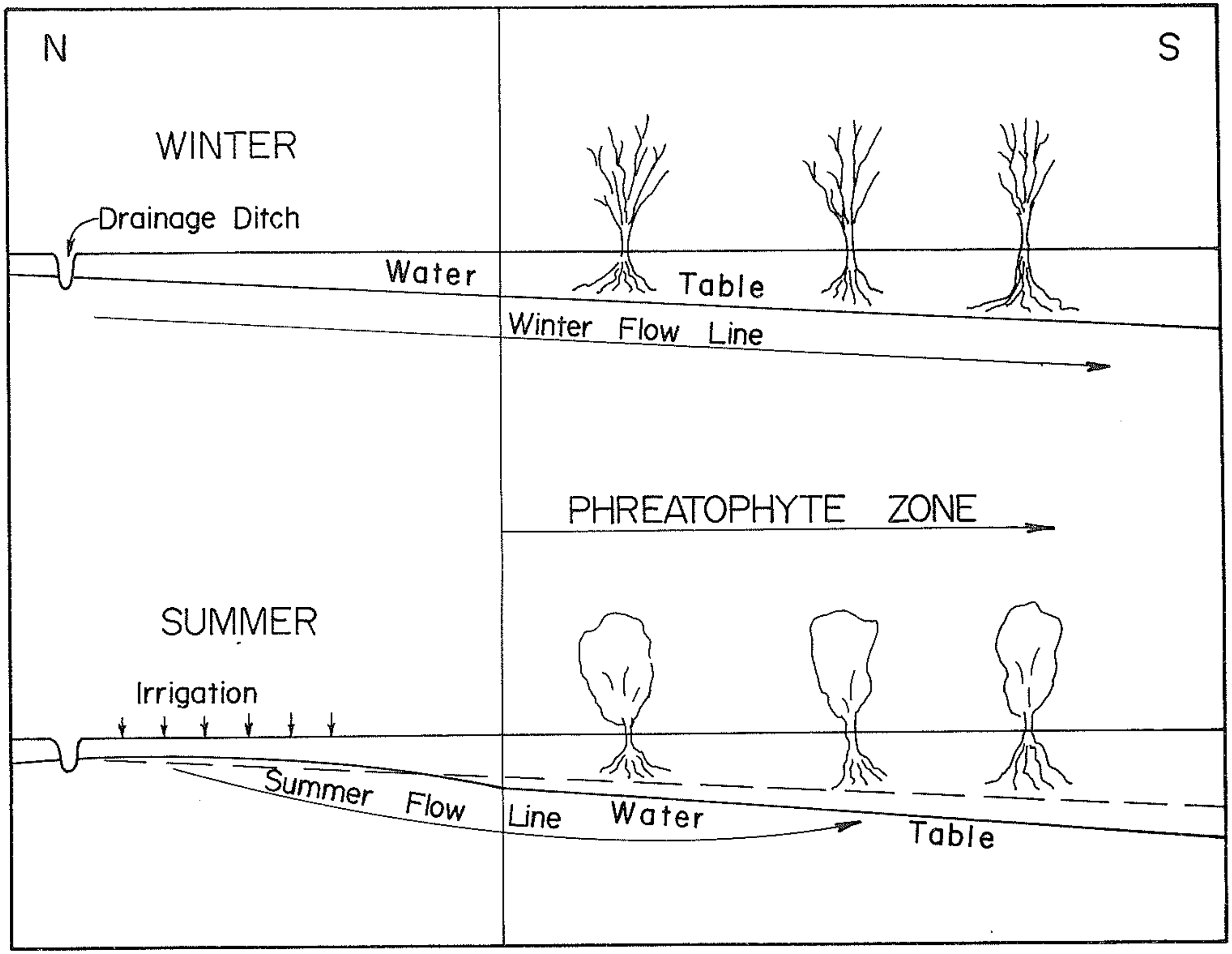


Figure 3 — Schematic of flow system of Hope Farms site.

Estimation of consumptive use

As originally conceived by White (1932), water level fluctuations in phreatic aquifers can be used to estimate consumptive use. Figure 4 illustrates a portion of the fluctuations from piezometer HB-10 at the Hope Farms site. The clear diurnal fluctuation was the result of transient response to transpirative losses at the phreatic surface, as described in the previous section. This diurnal cycle approximately represents a cumulative curve of the rate of inflow less the rate of transpiration. Because of the cumulative nature of the record, direct calculation of evapotranspiration is possible.

The graphical water budget method developed by White (1932) was applied to the continuous water level records from piezometer HB-10 at the Hope Farms site. The transpired water was determined utilizing daily water level fluctuations to obtain values for r and s in the equation

$$q = y\,(24\,r \pm s)$$

in which q = depth of water withdrawn by evapotranspiration, in inches,

y = specific yield of the aquifer material in which daily fluctuations of phreatic surface take place,

r = hourly rate of water table change from midnight to 4 a.m., in inches, and

s = net fall or rise of the water table during the 24-hour period, in inches.

Results of these calculations are exhibited in Figure 5. According

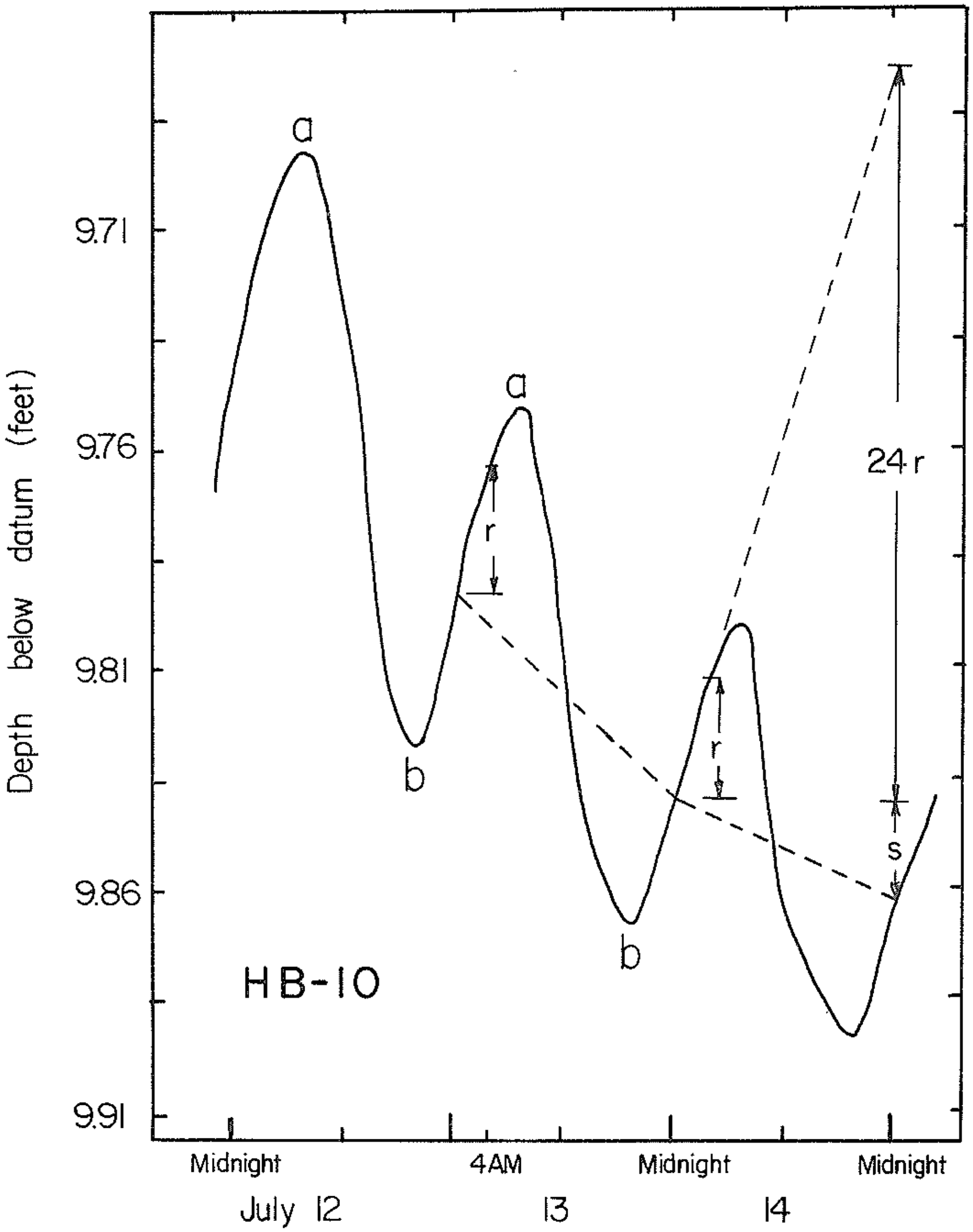


Figure 4 – Portion of the record of water-table fluctuation used in graphical analysis, July 12-14, 1971.

to White (1932), if transpiration is assumed to be practically zero during the early morning hours (viz. between 2 to 4 a.m.), then r during this period would be the upward flux of groundwater. If this rate were to continue throughout the 24 hour period and there were no transpirative or other losses, the phreatic surface would rise an amount approximately equivalent to the distance marked 24 r. However, as shown in Figure 4, transpiration occurred and, instead of rising, the phreatic surface dropped a distance s during the day. Thus, the net phreatic surface elevation is a composite of the rate of recharge and the amount of water withdrawn by transpiration, and would be deeper or shallower depending upon which of the above variables was the greater.

As recharge progresses, the head in a given piezometer will gradually approach a limiting value. Therefore, the recharge rate is only approximately constant within any one 24 hour period (Troxell, 1936). This approximation, however, may be negligible in comparison to the assumption of a constant specific yield if the total range of water level fluctuations is large compared to the water table depth below land surface (Urie, 1971). At the Hope Farms site this range was relatively small, allowing for use of an approximately constant specific yield. The constant recharge rate assumption cannot easily be improved upon without considering regional groundwater circulation in the model. In light of the type of data gathered, this was impossible.

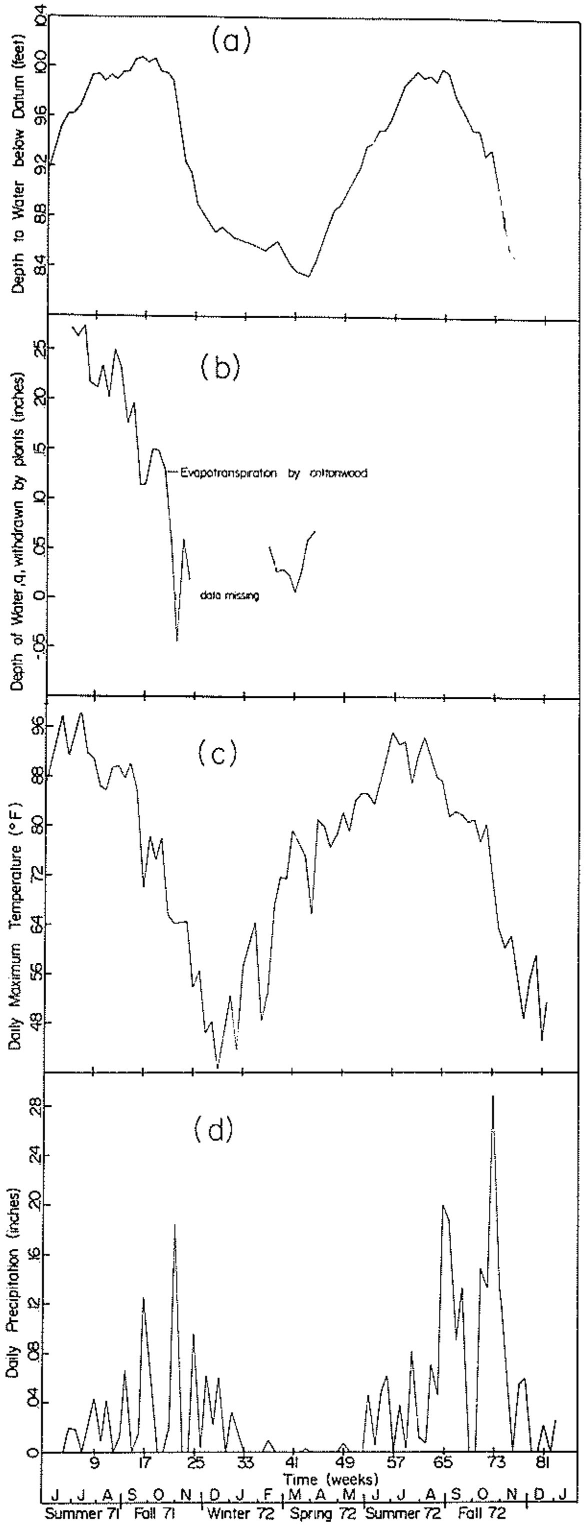


Fig. 5. Daily depth to water (a), evapotranspiration by cottonwood (b) maximum temperature (c), and precipitation (d) at piezometer HB-10, June 1971 through December 1972. All data are daily averages on a weekly basis.

Early in the growing season the elevation of the phreatic surface and of the mean head of the system are nearly the same since evapotranspiration is essentially zero. As the growing season progresses, the increase in evapotranspirative extraction from the saturated zone depresses the phreatic surface in the vicinity of the root zone. As the phreatic surface drops, the difference in elevation between the mean head and the phreatic surface increases leading to an increase in the rate of recharge $\underline{r}$. Thus, during the middle of the growing season, the increased water table gradient would cause the rate of recharge to be a maximum. This maximum recharge rate is clearly discernible on Figure 6, where the largest amplitudes were recorded during the month of August. In addition, this figure indicates three distinct constant trends in the phreatic regime, which underline the diurnal cycles. From August 3-7, the recharge rate is less than transpirative losses; from October 7-11, they are approximately equal; and from October 20-25, recharge is greater than evaporative loss.

Water table fluctuations

Values of the hourly rate of water table change $\underline{r}$ and the net fall or rise, $\underline{s}$, of the water table during 24 hour periods were estimated from continuous water level records in piezometer HB-10. These values were used in the water budget equation to evaluate $\underline{q}$, the depth of water withdrawn by evapotranspiration. The available data were averaged for each weekly interval to obtain a daily value characterizing that week. Similarly, daily maximum temperatures and daily precipitation

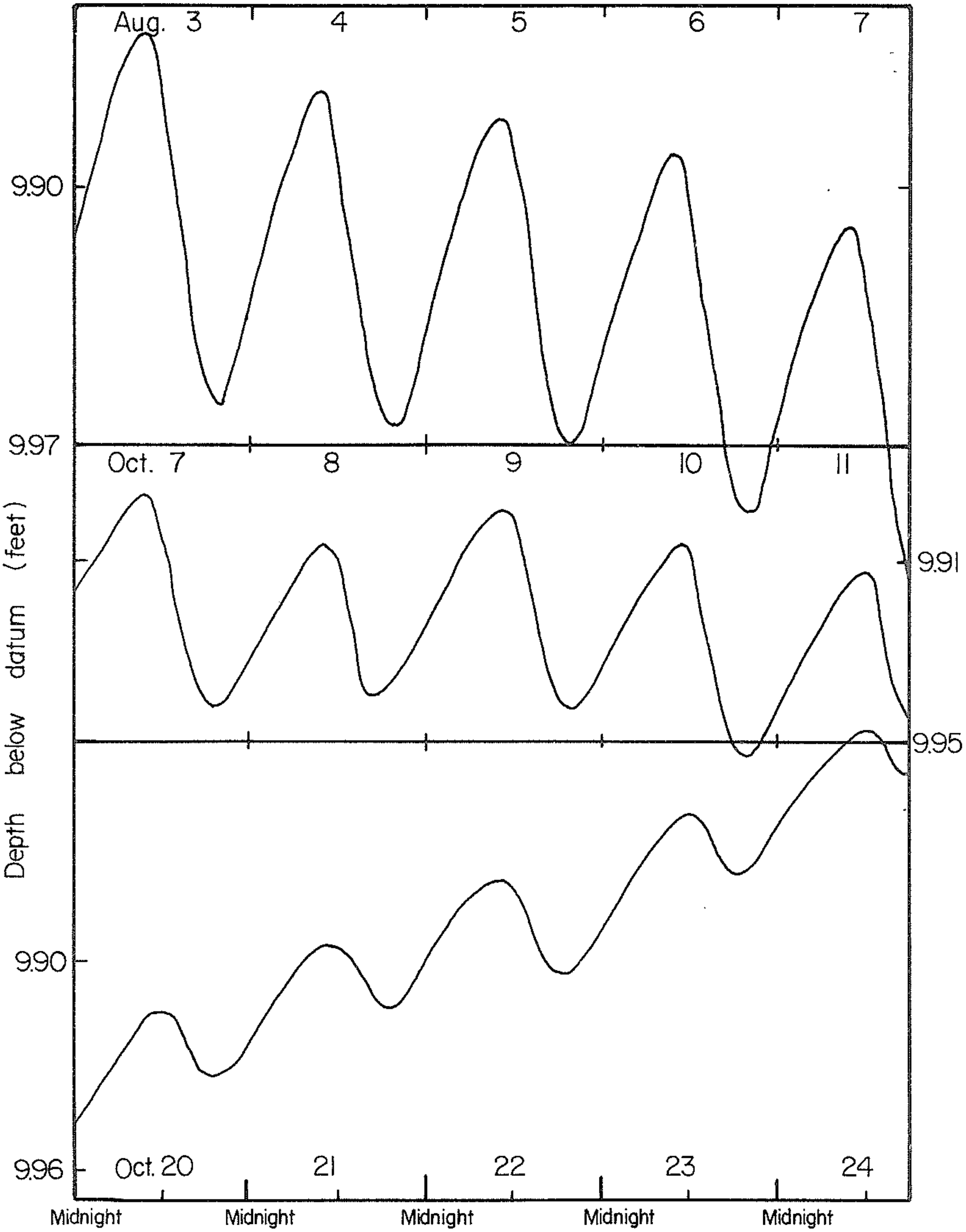


Figure 6 — Typical record of water table fluctuations in piezometer HB-10 during the year 1971.

values from U.S. Weather Bureau reports were also converted to such daily averages on a weekly basis. This conversion to averages on a weekly basis was necessary because small gaps in the continuous water level records were present. Thus, the daily evapotranspiration calculated from our water level measurements could be correlated with the temperature and precipitation data. The same method was used for water level data and, as noted later in this report, for specific-conductance data, both of which also had gaps. In addition, for these latter data it was also necessary to fill in a very few daily averages on a weekly basis by linear interpolation.

To facilitate correlation between the various parameters and estimated consumptive use, a starting date (June 1, 1971) common to all data was selected and daily averages were plotted against the week in which they occurred. Graphs of depth to water (see appendices for water level data) and evapotranspiration computed from water level fluctuations in piezometer HB-10 were plotted on the same time scale as were graphs of maximum daily temperature and precipitation in order to facilitate comparison of these parameters. A stepwise multiple regression/correlation program was used to derive correlation coefficients between various parameters.

From Figure 5, it is apparent that the best correlation of estimated consumptive use occurs, not unexpectedly, with averaged maximum daily temperature. This correlation (correlation coefficient = 0.82) tends to confirm the validity of using water table fluctuations as a means of estimating consumptive use, since transpirative losses are closely related to net solar radiation and therefore to temperature .

Precipitation, on the other hand, correlates poorly with estimated consumptive use. The small inverse correlation (-0.19) which was found is probably the result of the inhibiting effect of precipitation on evapotranspiration. That is, precipitation acts to reduce or increase these variables (temperature, solar radiation, relative humidity) which control evapotranspiration. If precipitation were to affect the phreatic surface directly (i.e. recharge), this would also cause a response by the phreatic surface equivalent to reducing evapotranspiration. However, the multiple correlation coefficient of evapotranspiration with temperature and precipitation is essentially the same as the partial correlation coefficient of evapotranspiration with temperature alone. Therefore any direct effect of precipitation upon the phreatic surface must have been negligible, the effect being largely restricted to inhibiting evapotranspiration. That precipitation indirectly affects water levels is clearly demonstrated by irregularities in the graphs of Figures 5a and 5b, which frequently coincide with rainfall events.

Finally the clear direct correlation of depth to water and consumptive use is also discernible in Figure 5. This result was anticipated because water level fluctuation data are the source of consumptive use estimates. As previously noted, the water level fluctuations should be proportional to the changes in water table gradients induced by transpiration.

In order to achieve a better understanding of the effect of precipitation on the phreatic surface, an attempt was made to eleminate the temperature-precipitation interaction from the consumptive use estimate. It was assumed that a smooth computed evapotranspiration curve would have resulted if precipitation had not reduced temperature and net solar radiation. By fitting a third degree polynomial to the calculated consumptive use, the effect of net solar radiation without precipitation was estimated. The residuals between the polynomial fit and the consumptive use estimate were assumed to approximate the effect of precipitation upon evapotranspiration.

Figure 7 is a plot of these residuals and precipitation (missing data have been ignored on the plot). The distinctive feature of this figure are the precipitation events which coincide with low consumptive use residuals. A correlation coefficient of -0.57 was obtained for this plot, probably indicating, in part, the crudeness of the method and, in part, that while precipitation does account for some of the irregularities in Figures 5a and 5b, it cannot in itself be causative of all the irregularities observed.

A visual inspection of Figure 7 shows that the correlation is better for the earlier period of the plot, and deteriorates considerably toward the end of the plot. This latter part of the plot was obtained from winter water level fluctuations when evapotranspirative losses should have been essentially nonexistent. Thus, residuals in this part of the plot cannot be ascribed to either evapotranspiration or precipitation and are probably the result of some extraneous influence on the

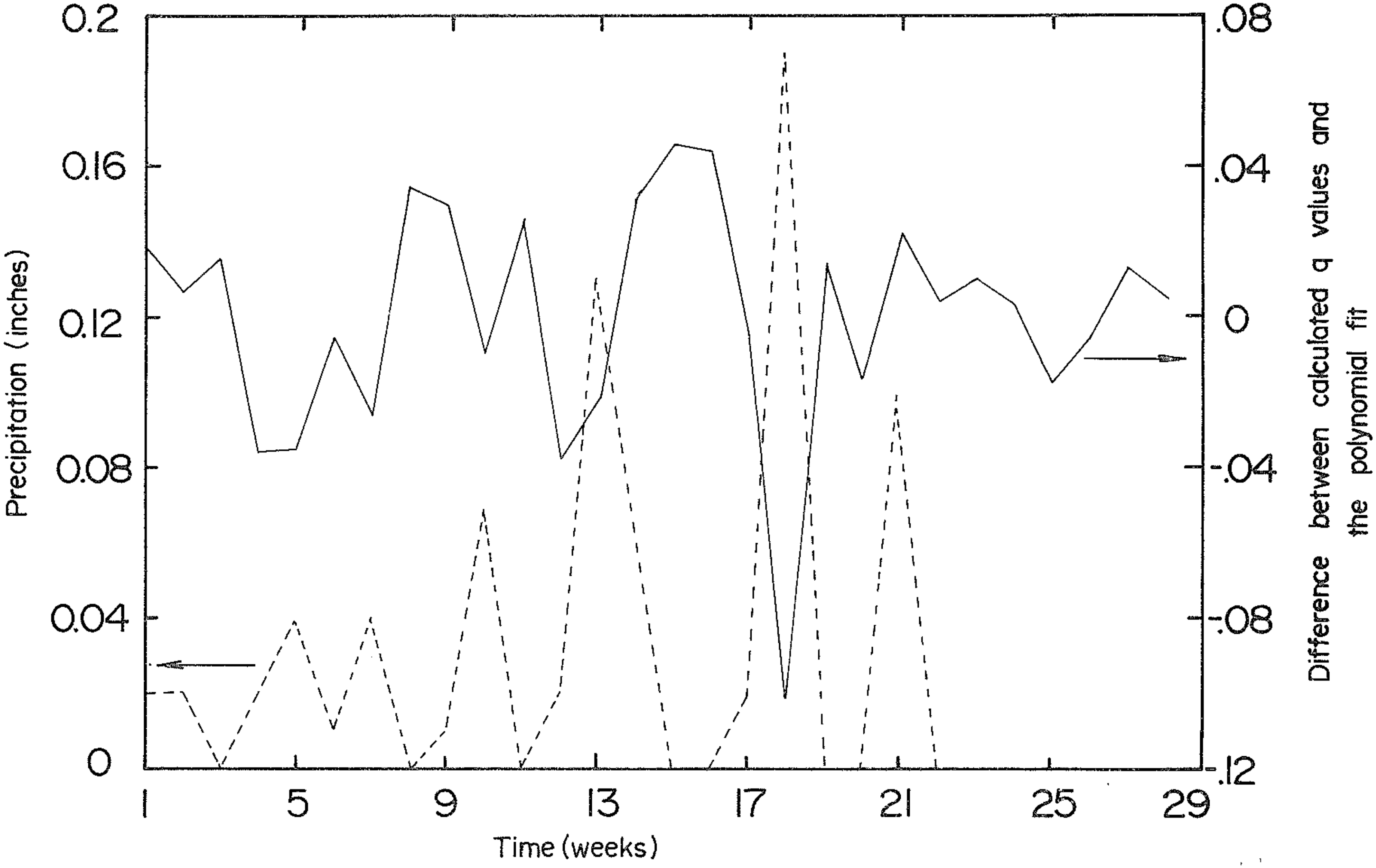


Figure 7 — Comparison of averaged precipitation to polynomial fit evapotranspiration residual.

phreatic surface. However, the lack of correlation with precipitation during this period, and in particular with the rainfall event of the 21st week, does again show that precipitation is not causing significant recharge to the groundwater system at the Hope Farms site.

EVAPOTRANSPIRATION AND SALINITY VARIATIONS

Proposed mechanism of salinity variations

Probably one of the more important phenomena which affects the seasonal groundwater salinity is a deposition-dissolution process which is believed to occur in the general area of the capillary fringe. As transpiration proceeds in the general area of the capillary fringe during the growing season, the roots of phreatophytes will extract water from the vadose zone and, in agreement with the hypotheses outlined above (see Plant and hydraulic considerations) cause salts to accumulate in their general vicinity. The phreatic surface should respond to this transpirative loss by declining, thus activating roots previously submerged, and leaving behind a zone of saline soil water. Near the top of this saline zone some precipitation of salts may take place but it is considered probable by the writers that the bulk of the salts would be held in a concentrated form in the soil water. This temporary storage of salts in and above the capillary fringe is referred to in this report as "deposition".

"Dissolution" of these salts should occur in the fall and early winter as the phreatic surface rises, thus returning them to the flow system. The dissolution process should first occur in the upper reaches of the capillary fringe and, as the water table continues to rise, dissolved salts would be transferred from the capillary fringe to the saturated zone below the phreatic surface.

A hydrodynamic imbalance may occur because of the density contrast between this newly entrained water and older water in the zone of saturation. If this density contrast is indeed present, and instability does occur, it is probable that the newly entrained water is quickly mixed with the older water in the upper few feet of the saturated zone below the phreatic surface. In any event, as noted later in this report, the shallowest piezometer in the winter season frequently contained a water of higher salt concentration than that found in this piezometer during the summer season or other deeper piezometers during all seasons.

In addition to the above deposition-dissolution phenomenon, convection, dispersion and diffusion were probably acting to transport newly dissolved salts throughout the flow system. Convection, or simple transport by the aqueous medium, would be the prime dispersing agent of dissolved salts throughout the system. At the Hope Farms site, rather low water table gradients (on the order of 10^{-3}) plus sample logs suggestive of relatively well sorted aquifer materials would indicate that a fairly high hydraulic conductivity, possibly on the order of 10^3 gpd/ft^2, existed in the phreatic aquifer. Assuming a specific yield of 10^{-1} (see above), rather simple calculations indicate that, at the nest spacing present at the Hope Farms site (~600 ft), it would have required nearly the entire data collection period (490 days for all piezometers) in order for transient chemical effects observed at one piezometer up-gradient to appear at a piezometer down-gradient. Thus, it is probable that, unless unusually high permeabilities were present at the Hope Farms site, transient chemical effects between piezometers could not have been observed.

Dispersion, caused by tortuosity of flow path, is probably the major dispersing agent of dissolved salts perpendicular to any flow line. By definition, however, it must be of a secondary nature in relationship to convection in the direction of flow. Diffusion is probably of minor concern in comparison to dispersion and convective transport. Diffusion of newly dissolved salts near the phreatic surface may have allowed for some additional vertical downward transport of these salts with time.

Diurnal variation of specific electrical conductance

For a 24 hour period beginning at 8:00 a.m., 9/21/71, and ending at 8:00 a.m., 9/22/71, water samples for specific-conductance determinations were taken once every two hours from all piezometers in nest C. Figure 8 exhibits the results of these determinations together with water level fluctuations in piezometer HB-10 (levels in the C nest having been disturbed by sampling). A weak cyclic trend in conductivity, apparent in all 4 piezometers, parallels the water level fluctuations. In addition, a salinity stratification is indicated by the figure but waters at the 30 foot and 40 foot depths are less saline than those at the 20 foot depth. This stratification is consistent with long term conductivity data for this nest. The amplitudes of the conductivity fluctuations are on the order of 10% of the average specific conductance of water occurring at a particular depth.

Because the record is so short, the existence of a cyclic trend

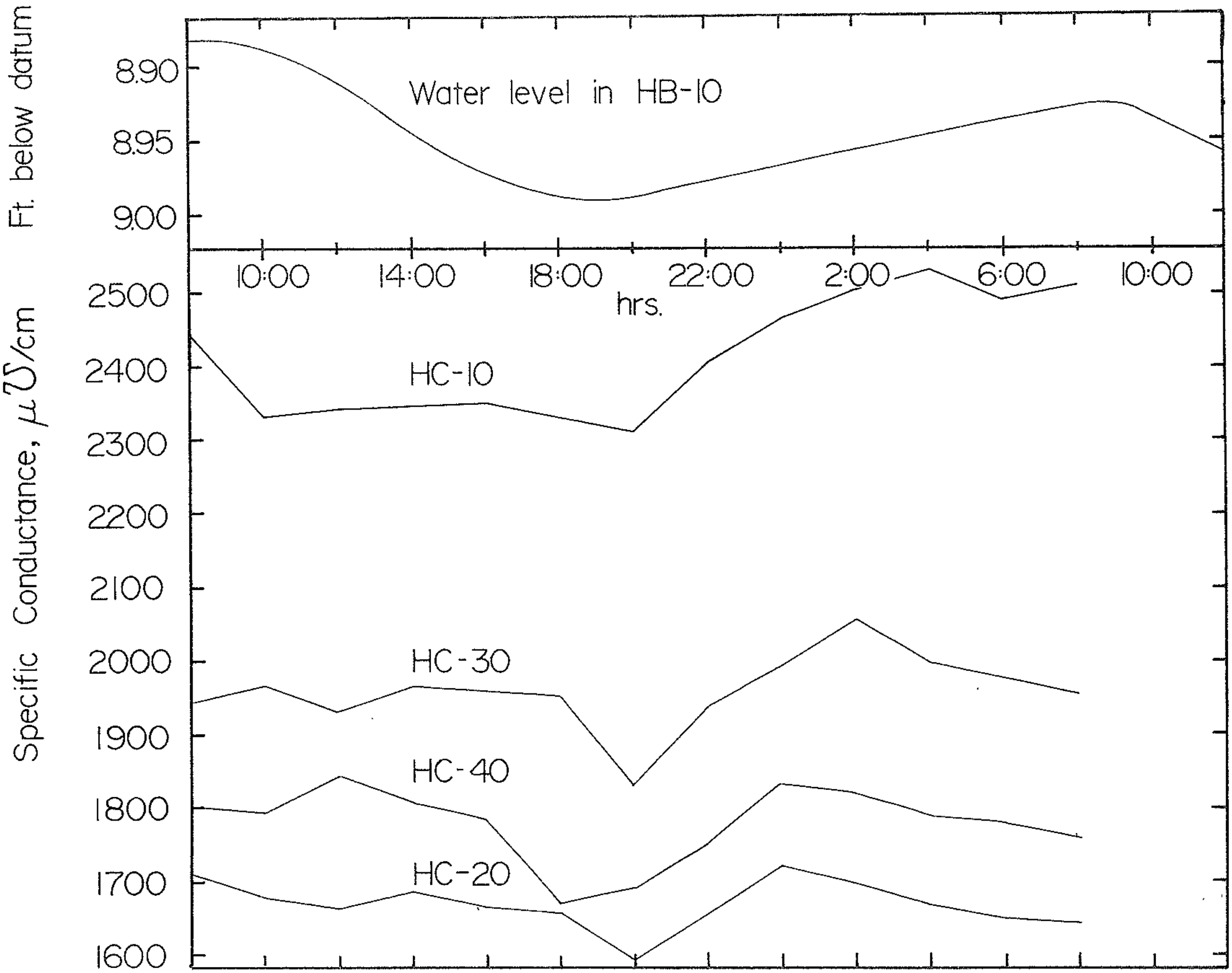


Figure 8 - Specific conductance (HC nest) and water level variations (HB-10) between 9/21/71 and 9/22/71.

can not be established with certainty. If the fluctuations are indicative of a diurnal cyclic trend, then two other problems arise, if an interpretation is made in light of the aforementioned deposition-dissolution model. First, the amplitude of the water level fluctuation of Figure 8 was only about 0.1 ft. Second, the top of the screened interval of the shallowest piezometer was approximately 2 feet below the phreatic surface. These two factors would seem to preclude any attempt to explain diurnal fluctuations by means of the dissolution-deposition model, as it is doubtful that the effect of dissolution of salts by such a small water table fluctuation would appear at even the shallowest piezometer with the essentially instantaneous response indicated by Figure 8.

As an alternate hypothesis, it is suggested that diurnal water level fluctuations are associated with diurnal changes in the water table gradient, which in turn affect flow gradients throughout the aquifer system. Thus, it is not to be expected that a single streamline is associated with the water chemistry recorded at each piezometer. Rather, a number of streamlines responding to the diurnally changing water table gradient may have crossed the piezometer aperture, each carrying a water possessing a particular chemical character.

This latter hypothesis, then, is proposed by the present authors to explain the assumed cyclic conductivity trend. Maintenance of the erratic salinity distribution throughout the 24 hour period also agrees with this hypothesis.

Variation in vertical potential differences

The objective of nests containing multiple piezometers at the Hope Farms site was the measurement of variations in vertical gradient. It is not unreasonable to assume that as transpiration proceeded in the summer season, development of vertical potential gradients in excess of any winter vertical gradient would have been necessary to transfer significant quantities of water vertically out of the system. However, long term potential data collected at each nest indicate that very little seasonal variation in vertical gradient occurred. Figure 9 is typical of potential differences that resulted from water level measurements from any two piezometers in one nest. This plot is clearly unconformable with the concept of seasonal variation in vertical gradient.

The blocky nature of the graph on Figure 9, however, does indicate that the magnitudes of the vertical potential differences were at the practical limit of measurement with the field method employed (steel tape using top of piezometer casing as reference point). Thus, if a measurement at any one time was in error by one unit of the minimum measureable field unit (~0.01 ft.), then the resulting calculation of potential difference between any two piezometers could be in error by as much as 200%. Yet, if these errors are truly independent of each other, then the mean of the potential difference calculations should be at least indicative of the general vertical potential gradient at each

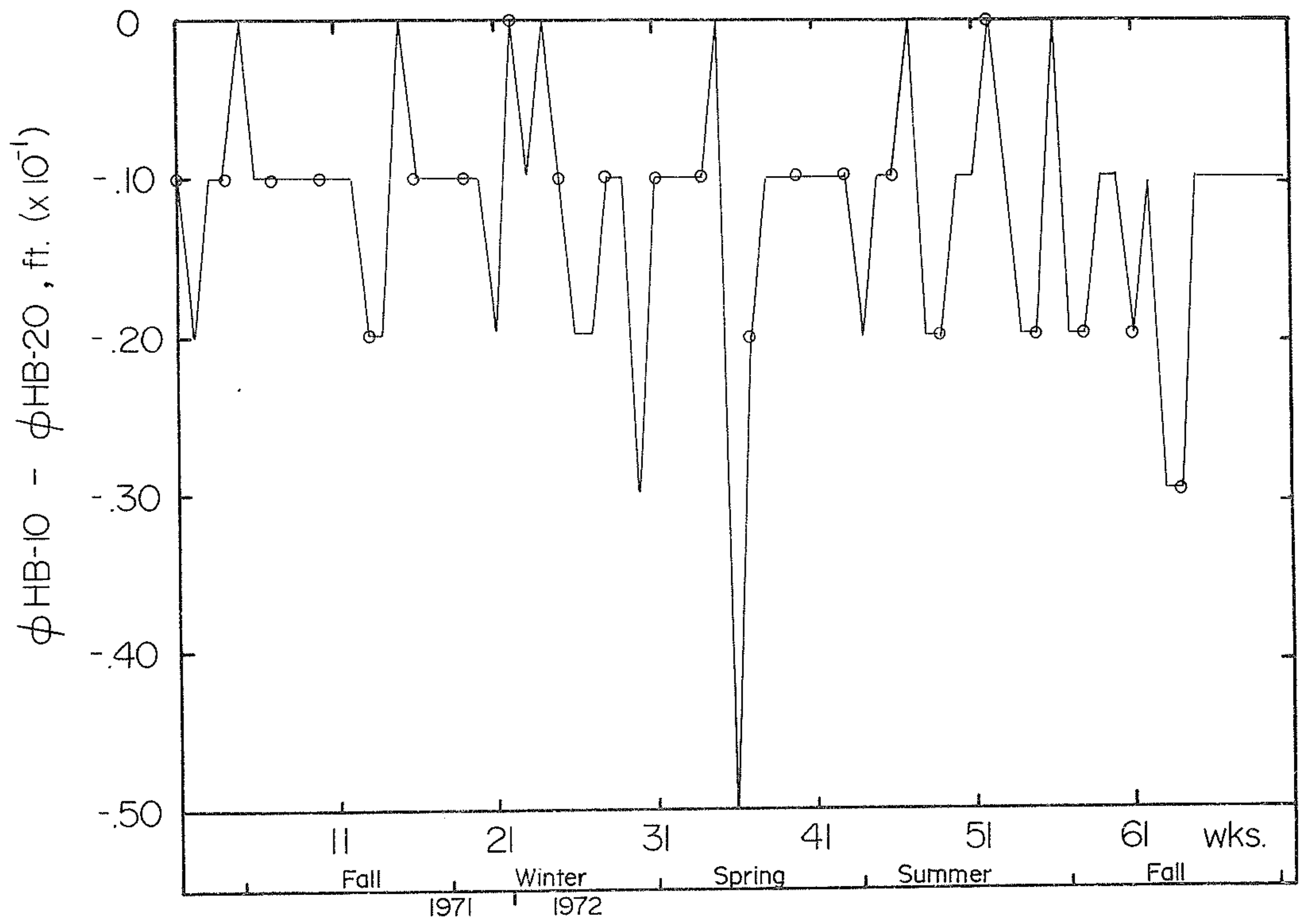


Figure 9 - Vertical potential difference between piezometers HB-10 HB-20.

site. That is, from Figure 9, it is clear that a general upward flow gradient was present in the upper ten feet of the aquifer at site B. Similarly, water level data from nests C and D also indicate upward flow gradients in the same reach of the aquifer, while data from nest A indicate a general downward gradient. In general, these vertical potential differences do not change with time, nor is the difference between the 10-ft and 40-ft piezometers appreciably greater than that between 10-ft and 20-ft.

At first appearance, these gradients are not conformable with the concepts previously outlined in the section on Plant and hydraulic considerations. However, it must be remembered that none of the shallow piezometers actually sampled the phreatic surface, since all screened intervals were more than one foot below the surface. Thus if any potential differences occurred between the phreatic surface and some depth in the aquifer, they would not have been recorded by these arrays. It is possible that seasonal variations in vertical gradient in the immediate vicinity of the water table did occur, but were not recorded. Therefore, the authors suspect that the vertical potentials recorded in each nest are probably related to the more "regional" flow system of the aquifer rather than to the local one created by phreatophyte discharge.

The horizontally averaged model of salinity variation

Evapotranspiration at the Hope Farms site should have affected the phreatic surface uniformly. Therefore, any variation in specific conductance of the aquifer fluid should have had a larger vertical than horizontal range. To test this concept, the specific conductance data, which had previously been averaged, were further averaged horizontally over space (i.e., all data from a specific depth, regardless of the nest with which they were originally associated, were averaged together). In this manner, a horizontally averaged model of vertical variability in specific conductance at the Hope Farms site was constructed.

Figure 10 shows the time-variant behavior of this model. One of the more obvious features of the figure is the absence of a consistent specific-conductance stratification, prevailing either in depth or in time. Specific conductance decreases with depth in only a few minor instances. Ideally, stratification should probably have fallen into two classes: (1) a systematic downward decrease in specific conductance, with only the zone immediately below the phreatic surface subject to seasonal variations; (2) a seasonal variation confined to within ten feet or so from the phreatic surface. Of these two possible stratifications, only the latter appears to have some validity, as it describes rather well the last one third of the plot on Figure 10. Thus, with this one exception, simple horizontal convection would appear to have been the dominant means of salt transport.

Another objective of using a horizontal averaging scheme was to reduce the effect of scatter in the conductivity values measured at any one piezometer or nest. If it is assumed that Figure 10 is representative of the average vertical specific-conductance variations at the Hope Farms site, its overall appearance is that of an oddly strati-

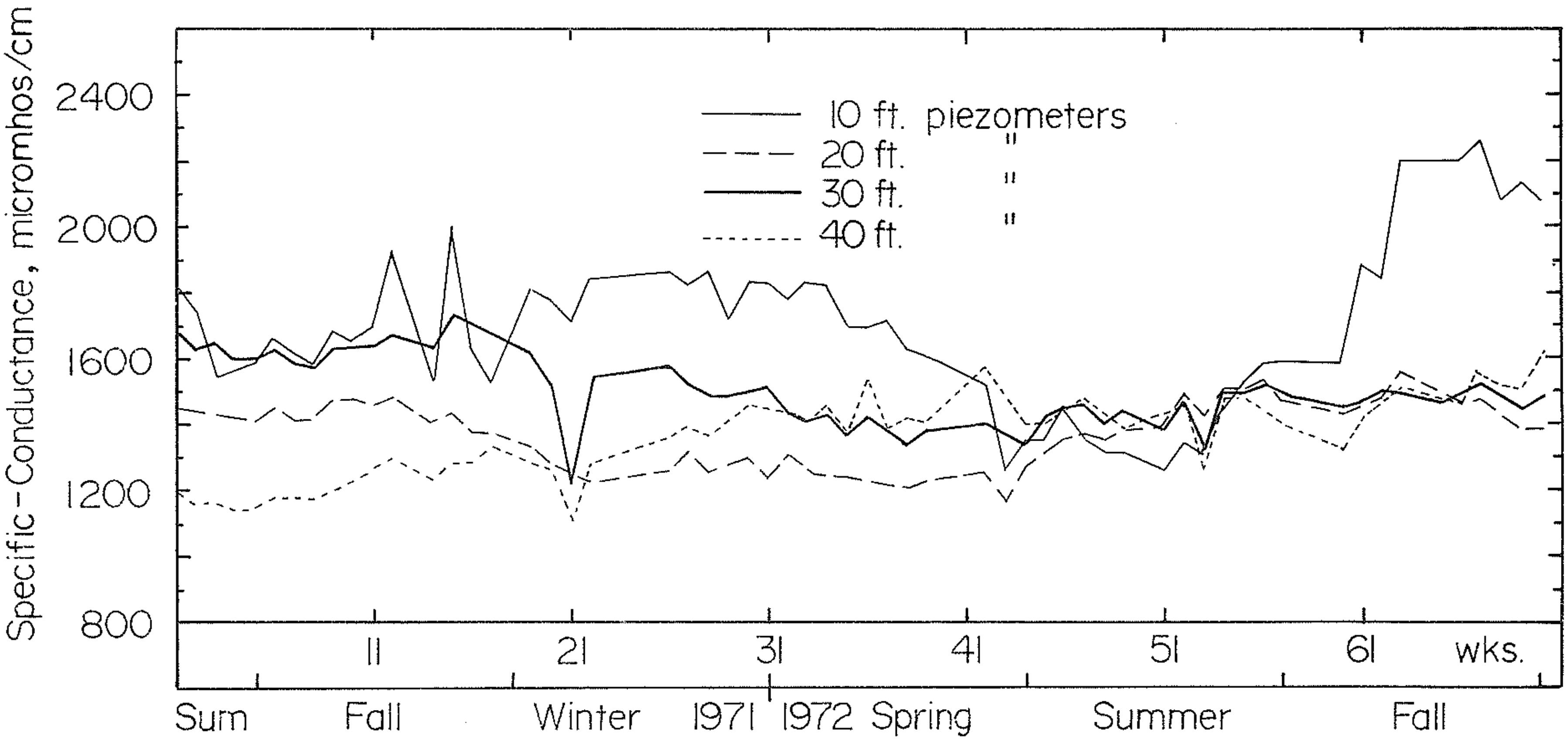


Figure 10. Horizontally averaged specific-conductance data.

fied system bearing only slight resemblance to previously proposed classes of salinity models affected by evapotranspiration. These specific-conductance stratifications are at best difficult to explain and are probably related to conditions peripheral to the site of investigation (viz.: irrigation). As these stratifications are unrelated to the objectives of this study, further speculation upon their origin will not be pursued.

Let it be assumed that the annual effect of evapotranspiration upon the specific conductance of the aquifer fluid was observable in the ten foot piezometer (a concept which in itself may be questionable because the 10 ft. piezometers were generally as much as one to three feet below the phreatic surface depending upon the nest in question and time of year). Comparing the horizontally averaged data from the 10-ft. depth to averaged data from the twenty foot piezometer, an approximation of the effect of evapotranspiration on water chemistry can be obtained. In light of the previous discussion on horizontal stratification of specific conductance, it is clear that use of specific-conductance data obtained from the twenty foot piezometer as a base level for measuring the evapotranspirative effect is at best an approximation. However, for lack of a better base level and because significant inferences may be obtained by this procedure, differences in averaged specific-conductance between these two depths were computed and plotted as shown on Fig. 11.

From Fig. 11, a strong annual cycle in the averaged conductivity

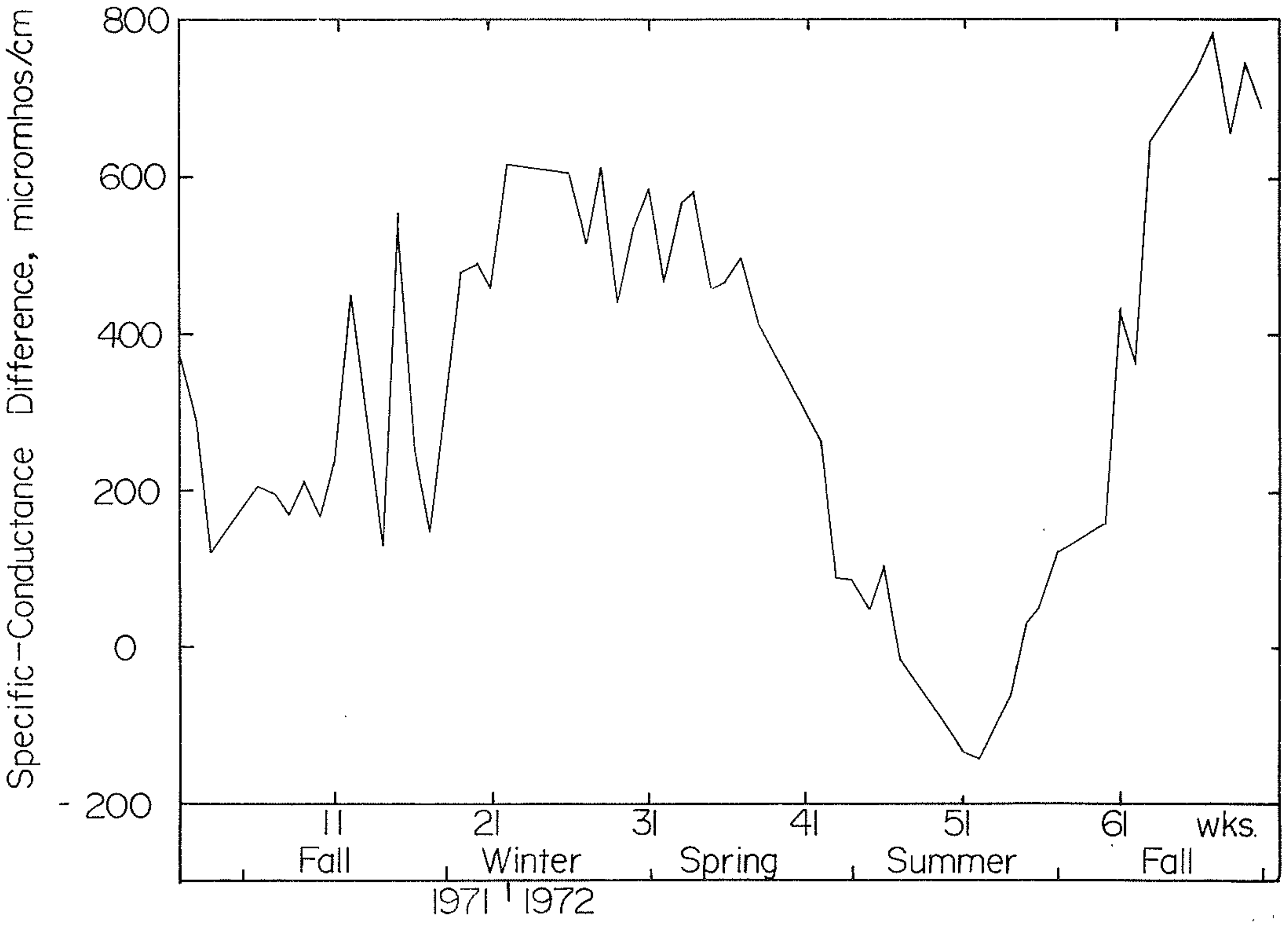


Figure 11. Difference in horizontally averaged specific-conductances, 10 ft. and 20 ft. piezometers.

difference between the ten and twenty foot piezometers is apparent. Fig. 12 is a plot of the average depth to water in the 10-ft piezometers at the Hope Farms site, as measured from an arbitrary datum. As previously noted, the strong cycle on this figure is the result of evapotranspirative losses during the growth season at the Hope Farms site. By comparing these two figures, it is evident that a strong inverse correlation between the two phenomena exists. The multiple regression/correlation program gave a correlation coefficient of -0.78. A similar correlation coefficient (-0.79) was obtained by direct correlation with calculated evapotranspiration for the period of record in which it is available (Figure 5). The similarity in correlation of these two phenomena with difference in specific conductance is expected, since computed evapotranspiration is based upon diurnal fluctuations in the phreatic surface, the long term trend of which is the annual cycle of Figure 12. The notable result here is that evapotranspiration correlates inversely with salinity difference, as measured by specific conductance, which is in agreement with the proposed salinity model discussed above (see <u>Proposed mechanism of salinity variations</u>).

In addition to the previous parameters, correlation coefficients were also obtained for a number of other flow system properties. The most interesting of these is the averaged horizontal gradient of the system as calculated by dividing the four nests into two three-point problems and averaging the results (Figure 13). This average gradient also had a high inverse correlation with the aforementioned average

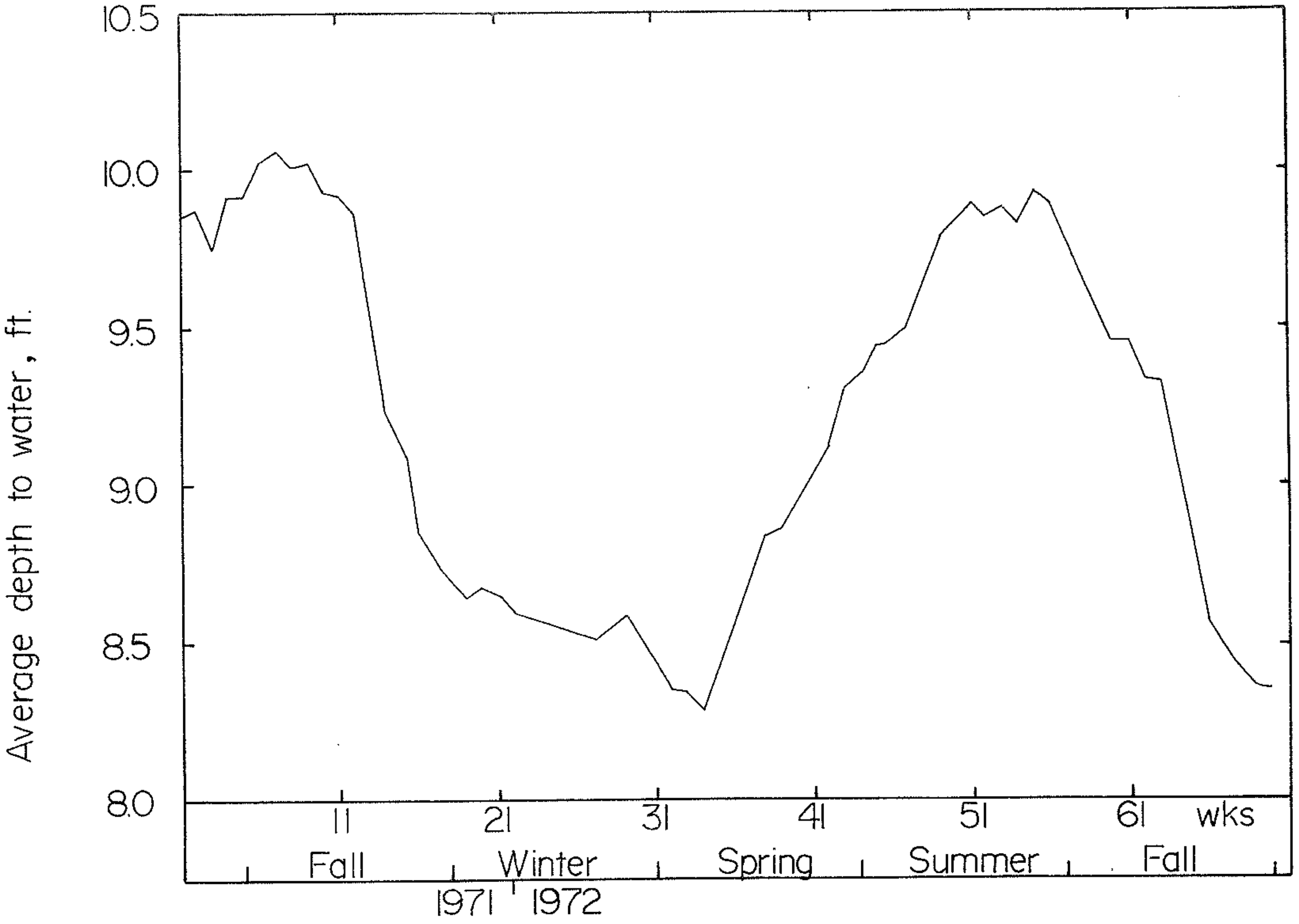


Figure 12. Average depth to water, 10 ft. piezometers

specific-conductance difference, yielding a correlation coefficient of -0.79. Averaged vertical potential differences for the 10-ft and 20-ft piezometers, on the other hand, correlate poorly with average specific-conductance difference from the same piezometers, giving a correlation coefficient of only -0.11. From the previous discussion on vertical potential differences, this result could also be expected.

In relation to the conceptual salinity model, Figures 10 and 11 provide additional information about the salt balance within the flow system. Both figures indicate that, after an increase in salinity in the winter months, the salt content of water in the vicinity of the ten foot piezometers returns to the base level in the summer months. Thus, if lateral transport of excess salts derived from evapotranspiration occurs, it must do so during the winter months when the phreatic surface is generally higher. During the summer months, however, when little or no lateral transport apparently occurs, evapotranspiration is continually removing water from the system, allowing for increased accumulation of salts in the unsaturated zone. It is tentatively concluded that a net accretion of salts should be occurring in the root zone of the phreatophytes. It should also be noted that this model again calls for an upward flow gradient in the vicinity of the phreatic surface during the summer months, although this was not found by direct measurement, or noted in the discussion on vertical potential differences.

In addition to the above correlation procedures, an attempt was made to correlate serially average specific-conductance data obtained

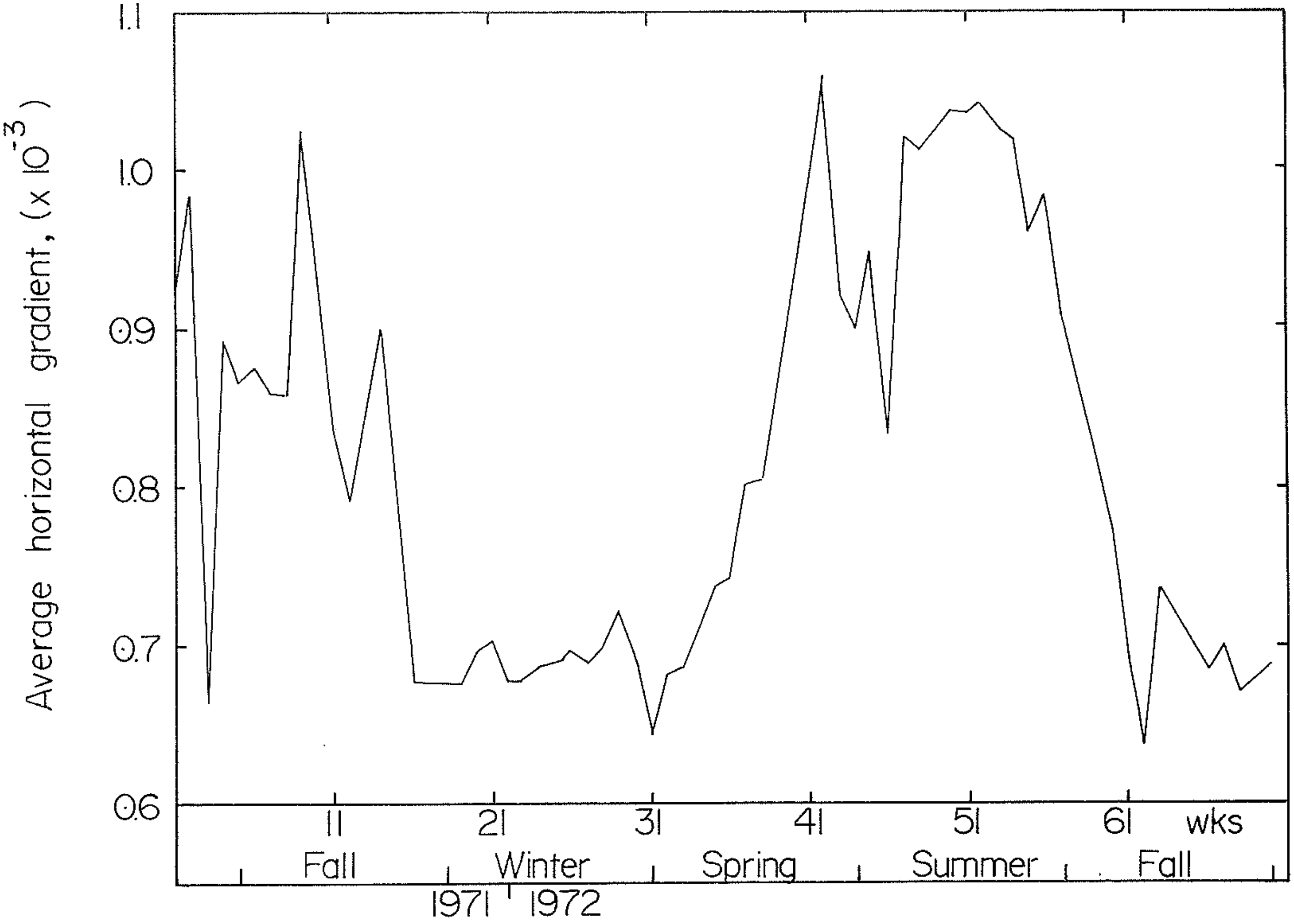


Figure 13. Average horizontal water table gradient at Hope Farms site.

from piezometers at various depths. By this method, it was hoped that any downward transport of salts, possibly by diffusion or dispersion, could be detected. In general, this procedure did not yield satisfactory correlation coefficients.

Time-variant behavior of specific conductance from individual piezometers

Graphs of specific-conductance measurements from each piezometer vs. time were constructed and a quick visual examination was made of each graph for time-variant characteristics, as well as for possible inter-piezometer relationships. The results of this examination are shown in Table I where the time-variant behavior of each graph, as determined by its visual appearance, has been summarized. Consistency in behavior was not usually demonstrated by specific-conductance data from different piezometers in the same nest, nor by piezometers of different nests. Specific-conductance data from 40 foot piezometers in nests A, B and D evinced the most consistent behavior; each has a positive trend, indicating a net increase in salt load of the aquifer fluid during the period of record. However, data from HC-40 show, if anything, the opposite trend indicating a net decrease in salt load.

Another salient feature of Table I is that either a strong stochastic component (noise) or cyclic behavior was evidenced by the specific-conductance data from the 10-ft piezometers, while trends and only a moderate stochastic component were dominant in data from deep piezometers. This observation suggests that a component of time-variant conductivity in the 10-ft piezometers which can be ascribed to evapotranspirative

Table I . Time-variant specific-conductance behavior.

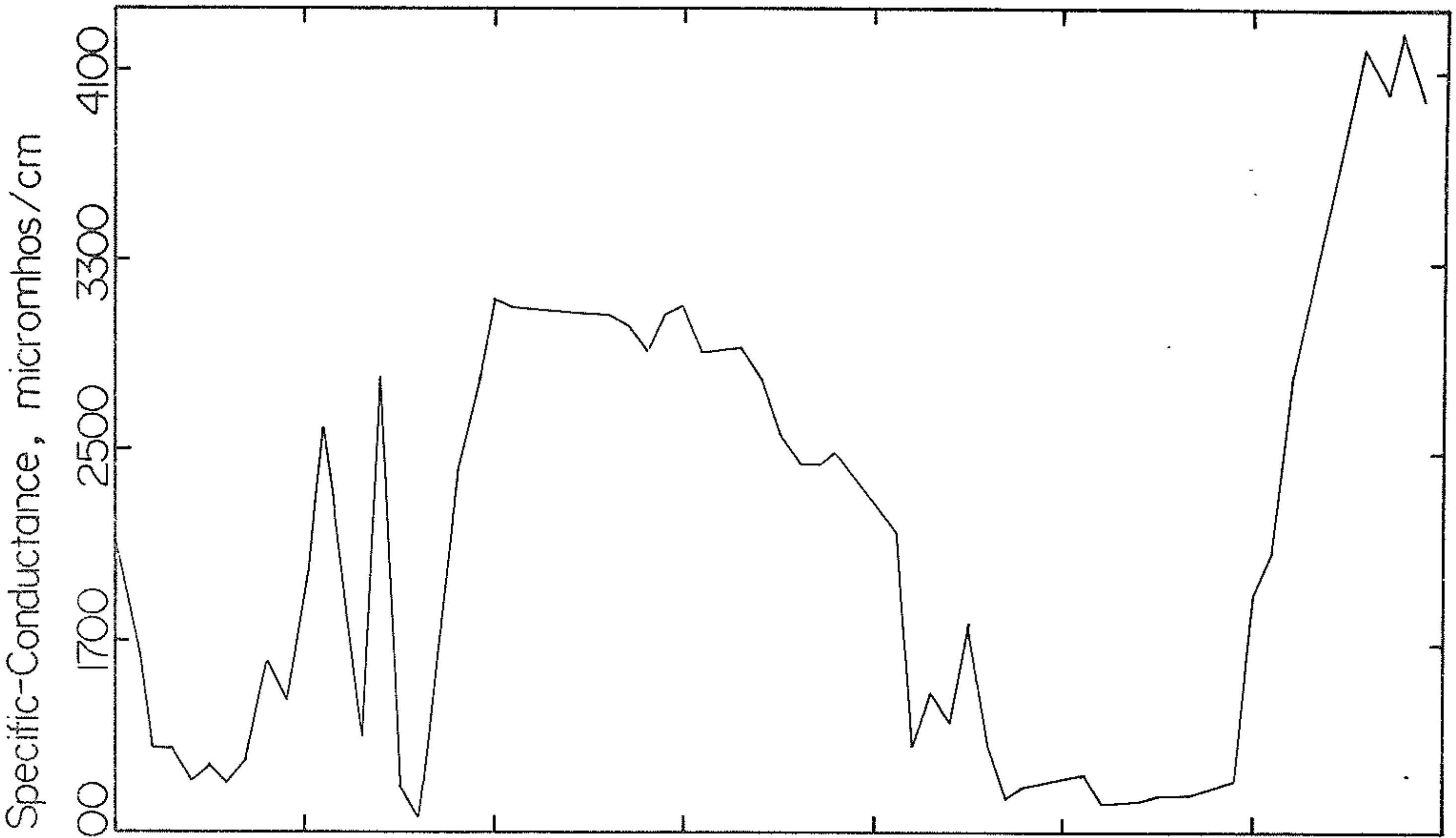
Piezometer depth, ft.	Nest			
	A	B	D	C
10	constant, much noise	constant, much noise	cyclic, moderate noise	cyclic, moderate noise
20	Slight positive trend, much noise	oscillatory, much noise	positive trend, noise	cyclic, little noise
30	slight negative trend, moderate noise	positive trend becoming constant, noise	positive trend, moderate noise	negative trend with slight cycle, moderate noise
40	positive trend, noise	positive trend, noise	positive trend, moderate noise	negative trend with superimposed cycle, moderate noise

Explanation of terms

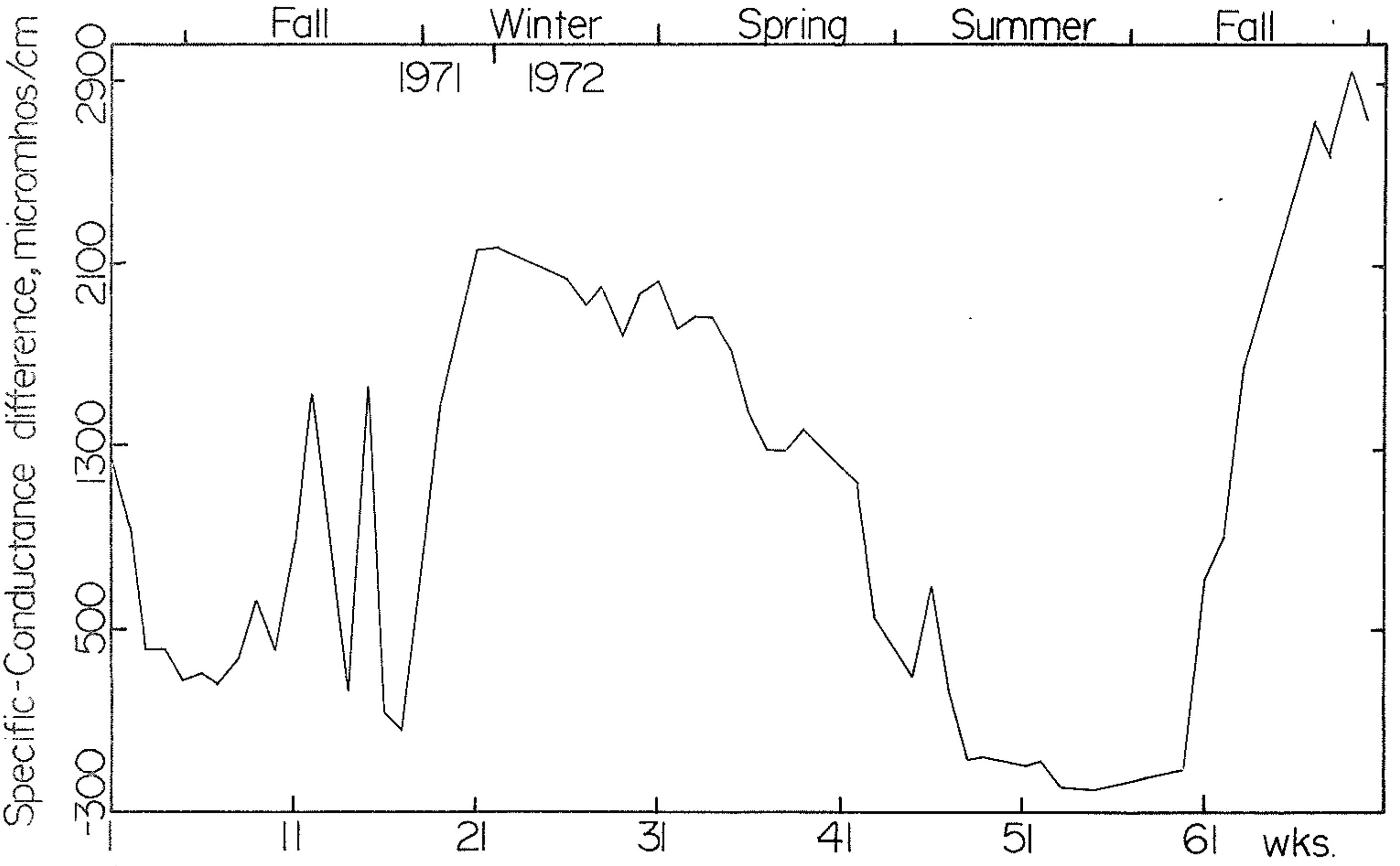
Constant - deterministic component has constant value.
Trend - deterministic component has slope.
cyclic - deterministic component contains periodicity.
oscillatory - deterministic component oscillates without periodicity.

effects was probably superimposed on another pattern present in the aquifer. This other pattern is represented by time-variant data from deeper piezometers. If it is assumed that the time-variant specific-conductance behavior of data from deeper piezometers is representative of the long-term behavior at that nest, then the more erratic behavior of the data from the 10-ft depth was probably the result of evapotranspiration.

Specific-conductance data from HD-10 demonstrated a behavior most like that found for waters at this depth in the aquifer from the horizontally averaged data, a pronounced annual cycle was present which could be attributed to evapotranspiration (Figure 14a). The strength of this cycle can be found by removing the assumed long term behavior as represented by the time-variant behavior of data from HD-20. Subtracting the average daily value (averaged for one week) of HD-10 from that of HD-20 (Figure 14b), a maximum amplitude on the order of 3000 μmho/cm is obtained. The large amplitude of the cycle from this piezometer is probably the principal reason for the well defined cycle observed in the horizontally averaged model, because the strength of this cycle is greater than either the erratic behavior of data from HA-10 and HB-10 or the unusual cycle (discussed below) present in the data of HC-10. In fact, the specific-conductance difference between HB-10 and HB-20 is actually negative throughout the period of record (i.e., specific conductances from HB-20 are slightly greater than those from HB-10).



(a) Specific conductance, HD-10, daily average on weekly basis.



(b) Difference in average daily specific conductance, HD-10 − HD-20

Figure 14

Time-variant specific-conductance data from HC-10 (Figure 15) also show a strong cycle, but with peak specific conductances occurring in late summer and with a conductivity trough centered over the winter and spring seasons. Thus, in relationship to the theoretical cycle attributed to evapotranspiration, the HC-10 cycle appears to be offset by approximately one season, the peak arriving approximately three months too early. However, if the evapotranspirative effect has actually been superimposed on a cyclic behavior of the specific conductances in the flow system, as was previously surmised, then one must look to a combination of effects for an explanation of this cyclic behavior. The time-variant conductivity from HC-20 (Figure 15) has a very similar cyclic behavior, except that it lacks the slight hump found in the center of the specific-conductance trough of data from HC-10. If the HC-20 data represent the type of ambient behavior without evapotranspiration which should underlie the cycle in data from HC-10, then the slight hump in the specific-conductance trough of HC-10 may well represent the total effect of evapotranspiration superimposed on the ambient system.

Thus we conclude: if specific conductances prior to evapotranspiration were high in relationship to the total evapotranspirative effect on salt level and if they contained a prior time-variant behavior, the effect of evapotranspiration on the salinity of the system could easily have been obscured. Therefore, it is valid to average out drift or scatter, and to remove prior time-variant behavior in the salt load, although the method utilized in the section on Horizontally averaged model may not be the most appropriate.

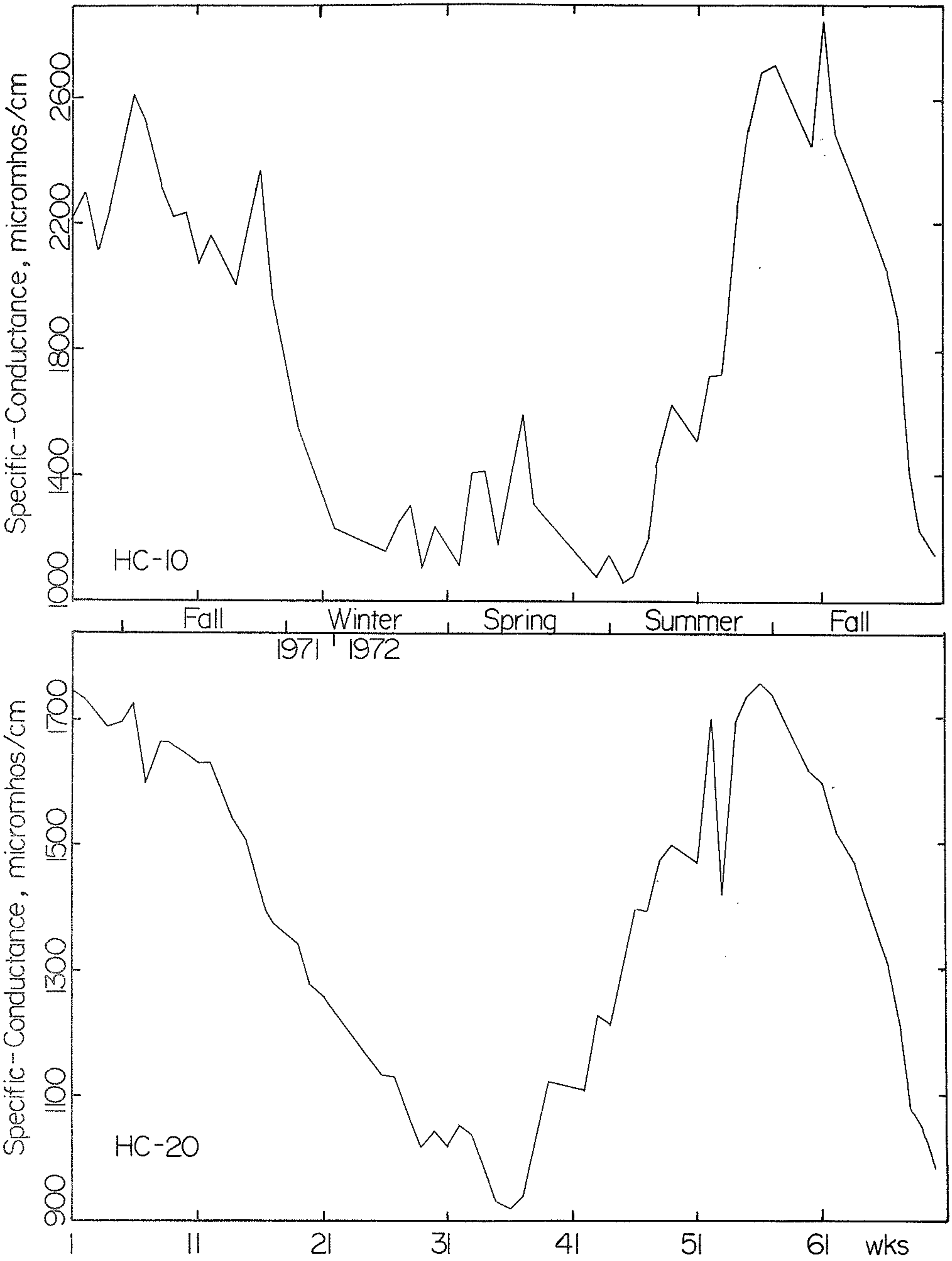


Figure 15. Specific-conductance, C nest, daily average on weekly basis.

For the specific-conductance differences obtained from data of piezometers HD-10 and HD-20 (Figure 14b), correlation coefficients for various flow parameters of the system were calculated by means of the aforementioned regression/correlation program. The most significant correlation found was an inverse relationship between specific-conductance difference and depth to water in HD-10 (-0.80). Average water table gradient, calculated as before, resulted in a correlation coefficient of -0.67 with specific-conductance difference, a notably poorer correlation than that found for the horizontally averaged data. For this individual nest, water table fluctuations (and therefore evapotranspiration) appear to have been a significant control on the water chemistry.

Chemical analysis

At irregular intervals throughout the data collection period, water samples were collected from all piezometers for chemical analysis (Appendix D). The results of these analyses were appropriately reduced and plotted on the rhombic center of Piper diagrams in order to determine if any significant patterns existed. Because the sampling periods varied (two weeks to five months), it was impossible to detect significant time-variant behavior. In addition, visual inspection failed to reveal a correlation between percentages of ionic constituents and depth of piezometer or depth to water level. However, a possible relationship between relative ionic concentration and percentage of ionic constituents was demonstrated on some of the modified Piper diagrams.

The most consistent relationship between relative ionic concentration and percentage of ionic constituents can be observed on Figure 16, a modified Piper diagram plot of data from HC-40. The chemical character of the water varied from a moderately (Ca^{++} + Mg^{++}) ($SO_4^{=}$ + Cl^{-}) water to a water rather strong in the same character. Those waters of a moderate character generally had significantly lower ionic concentration than those with a stronger character.

In addition to the preceding behavior, which was observed in chemical data from about one third of the piezometers, analyses from two of the remaining piezometers demonstrated a different pattern. Figure 17, a modified Piper diagram of analyses from HB-30 is typical of this other behavior, indicating that a relative increase in (Na^{+} + K^{+}) occurred with increasing ionic concentration; the proportions of anions remaining approximately constant.

The latter behavior was restricted to the two deeper piezometers in nest B, while the former occurred most frequently in, but was not restricted to, the deeper piezometers of the other nests at the Hope Farms site. About half of the Piper diagrams, particularly those resulting from analyses of water from shallower piezometers, indicate little or no concentration dependent behavior. All analyses showed that water with a (Ca^{++} + Mg^{++}) ($SO_4^{=}$ + Cl^{-}) character dominated the flow system. Upon closer inspection, it was found that Ca^{++} and $SO_4^{=}$ were the most prevalent species.

Explanation of these concentration patterns is tenuous at best.

number	date	total ionic constituents	depth to phreatic surface	relative ionic concentration
1	6-15-71	39.16 epm	10.01 ft.	(6)
2	6-30-71	37.26	9.94	(5)
3	7-29-71	43.70	10.48	(8)
4	10-7-71	42.66	10.44	(7)
5	3-7-72	36.34	8.79	(4)
6	6-12-72	19.95	9.99	(2)
7	8-21-72	18.54	10.43	(1)
8	11-27-72	24.88	8.78	(3)

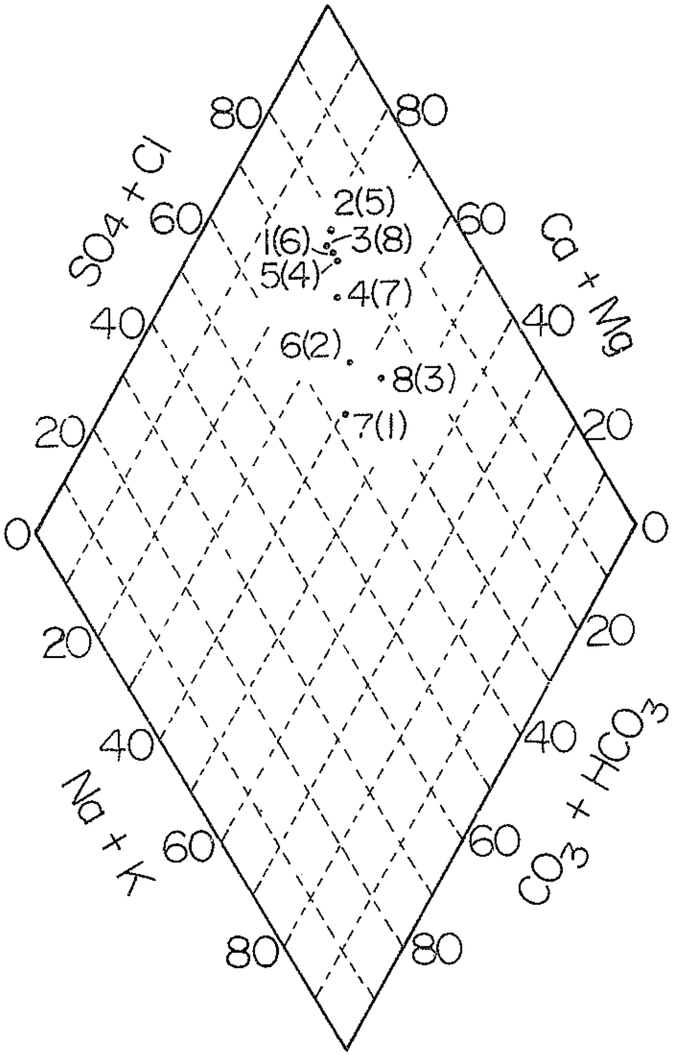


Figure 16. Modified Piper diagram of chemical analysis of water samples from piezometer HC-40.

As most samples came from a considerable depth below the phreatic surface, any direct relationship with evapotranspiration would appear unlikely. The rather large variation in ionic concentrations measured in waters from any one piezometer is suggestive of a mixing interface between waters of slightly different character but of rather large differences in ionic concentration. If the interface were more or less horizontal, as would be the case with a horizontally stratified system, then very slight changes in vertical gradient, and therefore flow direction, could easily have accounted for these variations in water quality.

number	date	total ionic constituents	depth to phreatic surface	relative ionic concentration
1	6-15-71	41.32 epm	9.52 ft.	(4)
2	6-30-71	28.66	9.64	(1)
3	7-29-71	31.27	9.98	(2)
4	10-7-71	40.05	9.92	(3)
5	3-7-72	42.48	8.38	(5)
6	6-12-72	46.56	9.52	(7)
7	8-21-72	44.21	9.95	(6)
8	11-27-72	49.46	8.38	(8)

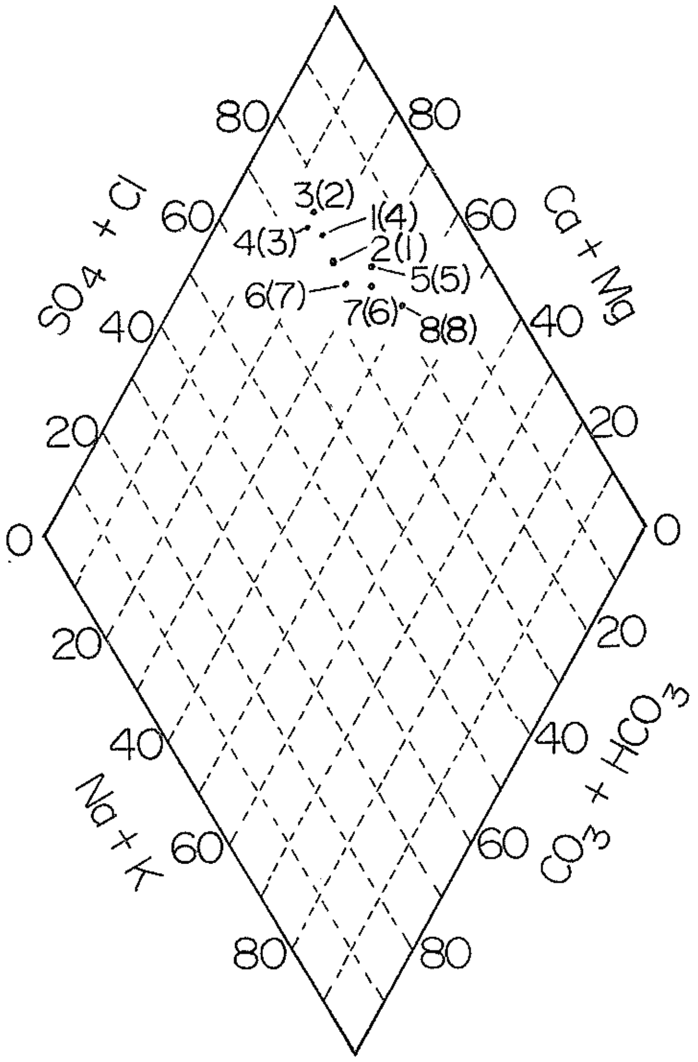


Figure 17. Modified Piper diagram of chemical analysis of water samples from piezometer HB-30.

CONCLUSIONS AND RECOMMENDATIONS

One objective of this study was to determine whether monitoring of water levels and water chemistry in a single piezometer nest, or a group of nests, will allow calculation of transpiration rates. As discussed in the section on Consumptive use, White's (1932) method for evaluating evapotranspiration does provide a means of estimating consumptive use from water level fluctuations. This method, however, is only an approximation, as it depends upon linearization of a non-linear phenomenon. Also, during the winter season, the method may produce erratic results, because it is dependent upon water table fluctuations caused by transpiring phreatophytes.

The evapotranspiration estimates produced by White's method do correlate reasonably well with maximum daily temperatures recorded at the nearby Socorro weather station. In addition, periods of precipitation apparently caused decreased evapotranspiration rates, although other factors may be involved. Evidence was also presented which indicates that very little precipitation became recharge at the Hope Farms site.

Finally, it was found that estimated evapotranspiration correlates inversely with horizontally averaged specific conductance difference as calculated from the 10-ft and 20-ft piezometers. However, because of the apparently indirect relationship between water chemistry and evapotranspiration, it was not considered feasible to use specific conductance for direct calculation of evapotranspiration.

With regard to water chemistry, two features in the report stand out. First, water chemistry parameters measured across the aperture of the piezometers at the Hope Farms site were subject to fluctuations not directly caused by evapotranspiration. This was demonstrated both in the section on <u>Chemical analysis</u> and in the section on <u>Diurnal variation of specific electrical conductance</u>. These chemical fluctuations are attributed to local variations in vertical hydraulic gradient that resulted from removal of water by evapotranspiration. In turn, these variations of vertical gradient probably caused mixing of waters of slightly different chemical composition which pre-existed in the aquifer. However, no seasonal fluctuation in the vertical potential difference was observed in the piezometers of any one nest. Thus, further research on the possible role of such fluctuations is required.

The second significant feature is that, to a large degree, the conceptual salinity model proposed to explain seasonal variations in conductivity was substantiated. This model proposes that phreatophyte transpiration concentrates salts in and above the capillary fringe during the growing season; the salts are removed again in fall and early winter when the phreatic surface rises. Although final verification requires further tests, the results of the sections on <u>Horizontally averaged model</u> and <u>Time-variant behavior of specific conductances from individual piezometers</u> are adequately explained by this model.

From the previous discussion, it is apparent that no attempt was made to quantify the chemical patterns noted in this report. This was due to the irregular nature of the field set-up, which prevented flow volume calculations. As an alternative, it is suggested that a finite-difference array, similar to that described by Weeks and Sorey (1973) would be very beneficial in overcoming this deficiency.

The use of field finite-difference arrays is a relatively new procedure which can yet be improved upon. It is suggested by the authors of this report, that if a polygonal field element is utilized, better accuracies will be obtained. Furthermore, it is suggested that addition of a piezometer on each element boundary would allow for increased accuracy in determination of flow gradients across boundaries. If the element is assumed to be three-dimensional, additional piezometers should be installed to monitor gradients across the bottom boundary. Boundary piezometers could be used to monitor chemistry as well as gradients. In this manner, both flow volumes and salt balances for the element could be accurately estimated.

In addition to the above field array, it would also be desirable to monitor the moisture content of the unsaturated zone in order to establish the nature of the specific yield of this zone. It has also been suggested to the authors that this type of experimental set-up is adaptable to optimization procedures which would enable one to determine the best piezometer spacing (Lynn Gelhar, oral communication, 1974). It would also be necessary to devise very precise methods of measuring water levels in order for this method to succeed. Finally it is suggested that a site should be selected which is not subject to the influences of man (viz.:irrigation).

The analysis of data may be improved by a time series method of the type used by Jackson, Gilliland and Adamowski (1973) in a Manitoba (Canada) groundwater discharge area.

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APPENDIX A: PIEZOMETER LOGS (HOPE FARMS)

Nest A, 40ft piezometer, (450, 1163)*.

depth, ft.	description
0 - 8	sand; very clayey and silty.
8 - 35	sand, very coarse to medium; gravelly (very fine).
35 - 38	sand, fine; few small pebbles.
38 - 50	sand, very coarse to medium; few pebbles.

Nest B, 40ft piezometer, (329, 647)*.

depth, ft.	description
0 - 4	black soil; sandy, moist at 4' depth.
4 - 14	sand; clayey, water at 7'.
14 - 21	gravel; runney, water bearing.
21 - 25	sand, coarse to very coarse; water bearing
25 - 29	gravel, very fine; sandy.
29 - 34	sand.
34 - 36	thin silty or clayey layers.
36 - 39	snad, fine.
39 - 43	snad, coarse; with very fine gravel.

Nest C, 40ft piezometer, (305, 0.0)*.

depth, ft.	description
0 - 10	sand, clayey and silty, becoming moist at 10'.
10 - 23	sand, coarse to medium; clayey and silty.
23 - 40	sand, coarse to medium; clayey and silty with some fine gravel.
40 - 43	sand, medium to fine; water bearing.
43 - 48	sand, coarse to medium.

Nest D, 40ft(?) piezometer, (625, 592)*.

depth, ft.	description
0 - 5	silt and clay.
5 - 7	clay.
7 - 9	sand, fine.
9 - 11	sand, coarse.
11 - 13	sand, coarse; clayey.
13 - ?	snad, coarse.

*Coordinate location of nest. X - coordinate is in reference to railroad track to west. Y - coordinate is in reference to C - nest. Coordinates are in feet.

APPENDIX - B

PIEZOMETER WATER LEVELS AT HOPE FARMS SITE IN FEET BELOW ARBITRARY DATUM FOR THE PERIOD MAY, 1971, THROUGH DECEMBER, 1972

PIEZOMETER WATER LEVELS AT HOPE FARMS SITE
in feet below arbitrary datum

Levels for Nests A and B

	Nest A					Nest B				
Date	Time	10'	20'	30'	40'	Time	10'	20'	30'	40'
5/25/71	13:38	8.27	8.25	8.27	8.25	14:18	8.95	8.95	8.94	8.92
5/28/71	10:24	8.26	8.34	8.34	8.33	11:10	9.00	9.00	9.00	8.97
6/4/71	10:12	8.53	8.51	8.50	8.48	11:01	9.15	9.33	9.20	8.97
5/15/71	9:29	8.90	8.88	8.87	8.86	10:39	9.53	9.53	9.52	9.49
6/17/71	9:53	8.70	8.69	8.66	8.65		9.51	9.52	9.50	9.47
6/18/71	9:48	8.75	8.73	8.71	8.68	10:08	9.51	9.51	9.51	9.48
6/21/71	9:44	8.80	8.79	8.78	8.75	10:00	9.57	9.57	9.56	9.53
6/23/71	15:10	8.87	8.86	8.86	8.83	10:42	9.63	9.64	9.63	9.60
6/25/71	9:44	8.96	8.93	8.94	8.72	10:03	9.67	9.70	9.68	9.65
6/28/71	9:35	8.96	8.95	8.94	8.92	9:58	9.63	9.64	9.63	9.60
6/30/71	9:36	9.05	9.03	9.00	9.01	9:46	9.63	9.64	9.64	9.60
7/2/71	13:52	9.01	9.00	8.98	8.96	14:16	9.61	9.61	9.59	9.57
7/5/71	13:14	9.08	9.07	9.06	9.06	13:33	9.62	9.77	9.76	9.73
7/7/71	10:46	9.09	9.06	9.08	9.04	10:15	9.76	9.77	9.75	9.74
7/9/71	10:21	8.95	8.93	8.91	8.86	9:56	9.65	9.68	9.66	9.63
7/12/71	9:42	8.85	8.83	8.84	8.80	9:58	9.71	9.71	9.70	9.67
7/14/71	11:40	9.08	9.06	9.07	9.06	11:20	9.85	9.86	9.84	9.83
7/16/71	11:35	9.12	9.14	9.14	9.12	10:53	9.89	9.90	9.89	9.86
7/19/71	9:20	9.24	9.22	9.22	9.20	9:47	9.96	9.96	9.97	9.94
7/21/71	15:16	9.26	9.25	9.25	9.23	15:28	9.98	9.99	9.97	9.94
7/23/71	12:05	9.18	9.17	9.17	9.14	11:46	9.85	9.88	9.86	9.83
7/26/71	10:08	9.17	9.16	9.15	9.13	11:35	9.92	9.93	9.91	9.89
7/29/71	12:56	9.27	9.25	9.26	9.22	13:14	9.98	10.01	9.98	9.96
7/30/71	10:58	9.26	9.26	9.25	9.21	11:16	9.91	9.92	9.92	9.88
8/2/71	11:42	9.22	9.20	9.20	9.18	12:11	9.84	9.85	9.84	9.81
8/4/71	11:31	9.26	9.24	9.24	9.22	11:50	9.90	9.91	9.88	9.88
8/6/71	11:21	9.27	9.25	9.25	9.22	11:36	9.91	9.92	9.90	9.88
8/9/71	12:05	9.33	9.31	9.31	9.30	12:38	9.97	9.99	9.96	9.95
8/11/71	10:17	9.27	9.25	9.23	9.21	10:02	9.93	9.95	9.93	9.90
8/13/71	11:24	9.07	9.05	9.03	9.01	14:39	9.89	9.90	9.86	9.84
8/16/71	12:08	9.19	9.18	9.17	9.16	12:20	9.85	9.87	9.86	9.82
8/18/71	12:23	9.20	9.22	9.24	9.20	12:38	8.89	9.90	9.89	9.85
8/20/71	11:16	9.28	9.28	9.26	9.25	11:41	9.92	9.94	9.93	9.88
8/23/71	11:24	9.32	9.31	9.31	9.28	12:22	9.98	9.99	9.98	9.95
8/25/71	10:59	9.33	9.32	9.31	9.28	11:14	9.93	9.94	9.93	9.90
8/27/71	13:23	9.33	9.32	9.33	9.30	13:40	9.96	9.97	9.96	9.94
8/30/71	14:40	9.32	9.31	9.31	9.30	15:04	9.95	9.96	9.95	9.92
9/1/71	12:02	9.33	9.31	9.32	9.30	12:21	9.94	9.95	9.94	9.91
9/3/71	11:18	9.37	9.35	9.36	9.33	11:30	9.99	9.97	9.97	9.94
9/7/71	14:48	9.43	9.41	9.41	9.39	15:03	10.09	10.11	10.09	10.06
9/9/71	10:28	9.45	9.41	9.40	9.38	10:39	10.02	10.03	10.02	10.00
9/16/71	9:10	9.50	9.48	9.46	9.45	9:37	10.08	10.09	10.09	10.06

Levels for Nests A and B

	Nest A					Nest B				
Date	Time	10'	20'	30'	40'	Time	10'	20'	30'	40'
9/20/71	13:37	9.45	9.44	9.42	9.44	13:54	10.03	10.04	10.03	10.00
9/30/71	13:16	9.33	9.31	9.29	9.26	14:05	10.07	10.08	10.07	10.04
10/4/71	13:52	9.31	9.29	9.31	9.29	14:18	10.01	10.02	10.02	10.00
10/7/71	12:05	9.29	9.28	9.28	9.27	12:18	9.91	9.93	9.92	9.89
10/11/71	12:00	9.35	9.34	9.34	9.32	12:05	9.92	9.94	9.93	9.91
10/14/71	14:00	9.40	9.39	9.38	9.38	14:17	9.98	9.99	9.98	9.96
10/2/71	12:22	9.36	9.39	9.34	9.32	14:43	9.90	9.91	9.91	9.88
11/1/71	13:55	8.65	8.63	8.62	8.61	14:25	9.23	9.25	9.24	9.23
11/4/71	15:30	8.68	8.67	8.67	8.65	16:00	9.25	9.28	9.28	9.25
11/11/71	14:31	8.63	8.64	8.61	8.59	15:00	9.15	9.15	9.16	9.13
11/18/71	12:33	8.45	8.43	8.42	8.40	12:54	8.90	8.91	8.91	8.89
11/23/71	12:49	8.36	8.34	8.32	8.30	13:06	8.80	8.81	8.81	8.79
12/9/71	13:54	8.23	8.21	8.20	8.19	14:26	8.67	8.68	8.68	8.66
12/16/71	12:18	8.26	8.24	8.23	8.21	13:24	8.72	8.73	8.72	8.70
12/23/71	13:20	8.23	8.22	8.21	8.19	13:40	8.68	8.70	8.70	8.69
12/30/71	12:25	8.19	8.19	8.16	8.15	12:47	8.63	8.63	8.64	8.63
1/25/72	14:45	8.11	8.10	8.10	8.07	15:10	8.56	8.58	8.58	8.56
2/1/72	13:47	8.09	8.07	8.06	8.05	14:11	8.53	8.55	8.55	8.53
2/8/72	13:55	8.12	8.11	8.10	8.09	14:23	8.58	8.59	8.59	8.58
2/18/72	11:00	8.15	8.13	8.12	8.12	11:00	8.61	8.62	8.63	8.62
2/24/72	14:00	8.09	8.05	8.04	8.03	14:20	8.51	8.54	8.54	8.53
2/29/72	14:30	8.03	7.99	7.96	7.96	15:00	8.42	8.43	8.45	8.43
3/7/72	15:20	7.95	7.93	7.90	7.89	15:47	8.37	8.38	8.38	8.37
3/16/72	13:00	7.92	7.90	7.90	7.87	13:10	8.36	8.37	8.37	8.35
3/21/72	13:10	7.85	7.86	7.84	7.84	12:49	8.32	8.33	8.32	8.32
3/30/72	10:10	7.96	7.94	7.93	7.93	10:35	8.43	8.43	8.51	8.43
4/6/72	13:25	8.08	8.04	8.02	8.03	13:45	8.59	8.64	8.58	8.58
4/13/72	14:02	8.21	8.22	8.19	8.18	15:00	8.73	8.75	8.74	8.73
4/20/72	12:45	8.32	8.30	8.29	8.29	12:53	8.86	8.87	9.00	8.87
4/28/72	14:10	8.30	8.28	8.27	8.25	14:27	8.94	8.95	8.94	8.93
5/17/72	10:25	8.42	8.40	8.38	8.35	10:53	9.18	9.19	9.19	9.18
5/25/72	11:20	8.70	8.66	8.66	8.66	11:35	9.36	9.37	9.35	9.33
5/30/72	10:55	8.84	8.80	8.79	8.80	11:15	9.41	9.43	9.43	9.42
6/2/72	10:00	8.66	8.61	8.58	8.58	10:20	9.38	9.39	9.38	9.39
6/6/72	13:40	8.78	8.78	8.78	8.77	13:32	9.50	9.51	9.51	9.50
5/9/72	13:52	8.82	8.81	8.81	8.80	14:07	9.51	9.52	9.51	9.50
6/12/72	9:13	8.89	8.88	8.88	8.87	9:25	9.50	9.52	9.52	9.52
6/15/72	8:42	8.94	8.93	8.92	8.91	9:02	9.48	9.48	9.50	9.50
6/19/72	12:10	8.74	8.73	8.74	8.75	12:29	9.55	9.56	9.56	9.56
6/22/72	12:02	8.90	8.88	8.88	8.89	12:36	9.62	9.61	9.62	9.61
6/26/72	11:30	8.91	8.90	8.90	8.91	11:53	9.67	9.71	9.70	9.67
6/30/72	12:28	9.06	9.06	9.05	9.05	13:00	9.79	9.79	9.80	9.77
7/4/72	13:21	9.15	9.16	9.13	9.12	13:50	9.87	9.88	9.90	9.87
7/7/72	13:10	9.03	9.03	9.02	9.01	13:38	9.86	9.87	9.88	9.85
7/21/72	13:37	9.22	9.21	9.20	9.20	13:56	9.97	9.98	9.97	9.96

Levels for Nests A and B

		Nest A				Nest B				
Date	Time	10'	20'	30'	40'	Time	10'	20'	30'	40'
7/24/72	11:23	9.15	9.13	9.12	9.12	11:45	9.92	9.92	9.90	9.91
8/4/72	11:05	9.21	9.19	9.19	9.19	11:32	9.94	9.95	9.94	9.92
8/7/72	11:12	9.18	9.17	9.17	9.19	11:35	9.90	9.92	9.91	9.89
8/10/72	11:25	9.17	9.16	9.15	9.15	11:37	9.88	9.91	9.87	9.89
8/14/72	11:20	9.28	9.27	9.27	9.27	11:43	9.99	10.00	10.00	10.00
8/17/72	11:00	9.34	9.33	9.32	9.33	11:18	10.00	10.02	10.02	10.00
8/21/72	12:13	9.22	9.20	9.20	9.22	12:39	9.95	9.96	9.95	9.95
8/24/72	11:10	9.26	9.25	9.23	9.23	11:28	9.98	9.97	9.97	9.97
8/31/72	11:27	9.15	9.14	9.13	9.13	11:50	9.79	9.81	9.81	9.78
9/22/72	13:15	8.98	8.96	8.95	8.93	13:50	9.50	9.51	9.57	9.53
9/29/72	12:38	9.02	9.00	8.99	8.99	12:55	9.50	9.52	9.51	9.51
10/2/72	10:40	9.03	8.99	8.99	8.99	11:13	9.46	9.46	9.47	9.46
10/6/72	12:40	8.86	8.85	8.82	8.81	13:05	9.15	9.16	9.16	9.15
10/10/72	13:13	8.89	8.87	8.87	8.88	13:56	9.35	9.38	9.37	9.37
11/3/72	12:36	8.11	8.10	8.08	8.07	13:00	8.55	8.56	8.56	8.55
11/6/72	10:10	8.08	8.06	8.05	8.05	10:35	8.52	8.53	8.53	8.53
11/10/72	12:38	8.01	7.99	7.98	7.98	13:25	8.44	8.46	8.45	8.45
11/13/72	10:20	8.02	7.99	7.98	7.99	10:50	8.45	8.46	8.46	8.46
11/17/72	12:45	7.94	7.92	7.91	7.91					
11/20/72	10:07	7.94	7.92	7.91	7.91	10:46	8.38	8.39	8.39	8.39
11/27/72	10:07	7.92	7.90	7.89	7.89	10:35	8.37	8.38	8.38	8.38
12/1/72	12:55	7.93	7.90	7.91	7.91	13:25	8.40	8.41	8.41	8.41

PIEZOMETER WATER LEVELS AT HOPE FARMS SITE
in feet below arbitrary datum

Levels for Nests C and D

		Nest C				Nest D				
Date	Time	10'	20'	30'	40'	Time	10'	20'	30'	40'
5/25/71	13:58	9.69	9.42	9.41	9.44					
5/28/71	11:43	9.72	9.46	9.45	9.47					
6/4/71	11:18	9.79	9.66	9.66	9.66					
5/15/71	11:11	9.81	10.01	10.01	10.01					
6/17/71		10.04	10.03	10.03	10.04					
6/18/71	10:26	10.04	10.05	10.03	10.04					
6/21/71	10:15	10.14	10.08	10.09	10.15					
6/23/71	15:27	10.23	10.22	10.23	10.23					
6/25/71	10:30	10.22	10.20	10.21	10.21					
6/28/71	10:16	9.94	9.93	9.92	9.93					
6/30/71	10:30	9.94	9.94	9.93	9.94					
7/2/71	14:30	10.01	10.00	10.00	10.01					
7/5/71	14:02	10.25	10.21	10.20	10.20					
7/7/71	10:58	10.22	10.17	10.21	10.22					
7/9/71	10:37	10.17	10.17	10.17	10.18					
7/12/71	10:18	10.26	10.30	10.26	10.27					
7/14/71	11:51	10.37	10.38	10.37	10.38					
7/16/71	11:11	10.39	10.40	10.32	10.41					
7/19/71	9:44	10.46	10.46	10.45	10.48					
7/21/71	15:44	10.44	10.44	10.44	10.45					
7/23/71	12:20	10.30	10.30	10.31	10.31					
7/26/71	12:34	10.42	10.42	10.43	10.43					
7/29/71	13:36	10.46	10.46	10.47	10.48					
7/30/71	11:36	10.38	10.39	10.40	10.38					
8/2/71	12:30	10.28	10.28	10.29	10.30					
8/4/71	12:09	10.35	10.35	10.34	10.36					
8/6/71	11:53	10.38	10.38	10.37	10.40	12:06	9.98	10.01	10.01	9.98
8/9/71	13:06	10.44	10.45	10.44	10.46	12:56	10.02	10.06	10.06	10.06
8/11/71	9:51	10.40	10.41	10.40	10.43	9:37	9.97	10.01	10.00	10.04
8/13/71	15:08	10.40	10.40	10.41	10.41	15:22	9.91	9.96	9.94	9.94
8/16/71	12:40	10.31	10.31	10.31	10.33	12:52	9.87	9.91	9.91	9.91
8/18/71	13:09	9.34	9.34	9.34	9.37	12:58	9.90	9.97	9.94	9.95
8/20/71	12:08	10.36	10.36	10.37	10.40	11:59	9.94	9.99	10.05	9.98
8/23/71	12:32	10.43	10.44	10.44	10.45	12:40	10.01	10.06	10.05	10.04
8/25/71	11:42	10.38	10.39	10.38	10.39	11:36	9.97	9.99	9.99	9.99
8/27/71	14:06	10.41	10.41	10.41	10.43	13:54	9.97	10.02	10.02	10.01
8/30/71	15:40	10.39	10.39	10.37	10.41	15:26	9.97	10.01	10.00	10.00
9/1/71	12:02	10.38	10.39	10.38	10.41	12:54	9.95	10.00	10.00	10.00
9/3/71	12:02	10.40	10.40	10.41	10.41	11:48	9.99	10.03	10.02	10.02
9/7/71	15:26	10.54	10.56	10.55	10.58	15:16	10.14	10.18	10.17	10.18
9/9/71	11:02	10.46	10.46	10.47	10.48	10:52	10.05	10.09	10.08	10.08
9/16/71	10:31	10.54	10.54	10.54	10.55	10:06	10.14	10.17	10.18	10.17

Levels for Nests C and D

	Nest C					Nest D				
Date	Time	10'	20'	30'	40'	Time	10'	20'	30'	40'
9/20/71	14:26	10.49	10.50	10.50	10.52	14:15	10.07	10.11	10.12	10.12
9/30/71	14:28	10.57	10.58	10.58	10.58	14:43	10.12	10.14	10.14	10.14
10/4/71	14:56	10.50	10.51	10.52	10.54	14:42	10.06	10.08	10.07	10.08
10/7/71	12:51	10.41	10.43	10.43	10.44	12:36	9.97	10.01	9.99	10.00
10/11/71	12:40	10.38	10.39	10.39	10.40	12:30	9.95	10.00	9.98	9.98
10/14/71	15:02	10.41	10.43	10.45	10.44	14:42	10.00	10.04	10.03	10.03
10/2/71	13:19	10.32	10.33	10.34	10.34	13:04	9.91	9.95	9.94	9.94
11/1/71	15:05	9.78	9.79	9.80	9.81	14:50	9.28	9.33	9.32	9.33
11/4/71	16:31	9.75	9.77	9.76	9.77	16:17	9.25	9.30	9.29	9.29
11/11/71	15:45	9.59	9.60	9.60	9.61	15:30	9.10	9.14	9.12	9.14
11/18/71	13:43	9.29	9.30	9.30	9.30	13:50	8.80	8.82	8.81	8.82
11/23/71	13:41	9.20	9.20	9.20	9.20	13:30	8.69	8.73	8.72	8.72
12/9/71	14:56	9.07	9.08	9.07	8.98	14:42	8.57	8.63	8.63	8.63
12/16/71	13:53	9.12	9.13	9.13	9.14	13:45	8.63	8.69	8.67	8.68
12/23/71	14:08	9.10	9.10	9.11	9.11	14:00	8.62	8.66	8.65	8.66
12/30/71	13:09	9.03	9.04	9.04	9.05	12:59	8.54	8.59	8.58	8.59
1/25/72	15:47	8.97	8.99	8.98	8.99	15:35	8.51	8.55	8.54	8.55
2/1/72	14:30	8.94	8.96	8.95	8.97	14:40	8.48	8.51	8.50	8.51
2/8/72	14:40	8.98	9.00	9.00	9.02	14:50	8.53	8.57	8.56	8.56
2/18/72	11:00	9.04	9.05	9.04	9.07	11:00	8.57	8.61	8.60	8.60
2/24/72	14:40	8.95	8.95	8.95	8.96	14:53	8.46	8.50	8.49	8.50
2/29/72	15:10	8.83	8.83	8.83	8.84	15:05	8.34	8.37	8.39	8.36
3/7/72	16:00	8.80	8.79	8.79	8.79	16:20	8.27	8.31	8.29	8.30
3/16/72	13:30	8.77	8.76	8.77	8.78	13:52	8.28	8.30	8.30	8.30
3/21/72	12:40	8.73	8.73	8.71	8.75	13:23	8.22	8.25	8.26	8.25
3/30/72	11:00	8.87	8.86	8.85	8.88	11:15	8.38	8.41	8.41	8.43
4/6/72	14:00	8.99	8.99	9.00	9.01	14:45	8.55	8.56	8.54	8.56
4/13/72	14:45	9.19	9.18	9.18	9.20	14:18	8.74	8.78	8.76	8.77
4/20/72	13:07	9.30	9.31	9.30	9.34	13:12	8.86	8.89	8.89	8.88
4/28/72	14:35	9.43	9.41	9.42	9.44	14:53	8.93	8.98	8.96	8.94
5/17/72	11:15	9.71	9.72	9.70	9.73	11:30	9.20	9.24	9.24	9.24
5/25/72	11:55	9.82	9.80	9.78	9.81	12:08	9.34	9.38	9.36	9.36
5/30/72	11:30	9.87	9.89	9.87	9.89	11:45	9.42	9.47	9.46	9.47
6/2/72	10:30	9.82	9.82	9.82	9.83	10:46	9.40	9.44	9.41	9.43
6/6/72	13:20	9.95	9.96	9.95	9.94	13:06	9.52	9.52	9.53	9.52
5/9/72	14:30	9.96	9.98	9.97	9.99	14:45	9.51	9.56	9.54	9.56
6/12/72	9:45	9.97	9.98	9.97	9.99	10:05	9.53	9.57	9.56	9.57
6/15/72	9:26	9.87	9.89	9.88	9.89	9:41	9.50	9.55	9.54	9.54
6/19/72	12:51	10.04	10.05	10.04	10.04	13:00	9.54	9.57	9.58	9.57
6/22/72	12:26	10.08	10.08	10.08	10.08	12:14	9.58	9.61	9.60	9.62
6/26/72	12:15	10.16	10.16	10.15	10.15	12:31	9.65	9.68	9.67	9.67
6/30/72	13:34	10.26	10.27	10.24	10.25	13:55	9.75	9.79	9.78	9.78
7/4/72	14:35	10.33	10.34	10.33	10.33	15:10	9.84	9.87	9.87	9.86
7/7/72	14:10	10.34	10.35	10.35	10.36	14:35	9.84	9.88	9.87	9.87
7/21/72	14:16	10.48	10.48	10.47	10.47	14:30	9.94	9.98	9.97	9.97

Levels for Nests C and D

	Nest C					Nest D				
Date	Time	10'	20'	30'	40'	Time	10'	20'	30'	40'
7/24/72	12:06	10.42	10.43	10.43	10.42	12:19	9.87	9.91	9.91	9.91
8/4/72	11:59	10.46	10.47	10.46	10.46	12:07	9.92	9.96	9.95	9.95
8/7/72	11:55	10.43	10.43	10.42	10.42	12:08	9.87	9.92	9.90	9.91
8/10/72	12:02	10.39	10.40	10.39	10.39	12:11	9.86	9.90	9.90	9.90
8/14/72	12:03	10.50	10.49	10.48	10.48	12:12	9.95	9.99	9.99	9.99
8/17/72	11:43	10.47	10.49	10.47	10.48	11:58	9.97	10.01	10.00	10.01
8/21/72	13:01	10.44	10.44	10.44	10.43	13:10	9.91	9.95	9.95	9.94
8/24/72	11:55	10.45	10.45	10.45	10.45	12:11	9.92	9.96	9.96	9.95
8/31/72	12:10	10.25	10.26	10.25	10.25	12:17	8.75	8.78	8.78	8.78
9/22/72	14:07	9.94	9.95	9.93	9.93	14:20	9.41	9.46	9.45	9.46
9/29/72	13:05	9.88	9.88	9.86	9.87	13:20	9.41	9.46	9.45	9.46
10/2/72	11:05	9.82	9.80	9.76	9.79	10:52	9.39	9.42	9.42	9.42
10/6/72	12:15	9.60	9.61	9.60	9.61					
10/10/72	13:43	9.81	9.82	9.81	9.82	13:25	9.24	9.30	9.30	9.31
11/3/72	12:47	8.94	8.95	8.94	8.95					
11/6/72	10:18	8.91	8.92	8.91	8.92	10:47	8.43	8.46	8.45	8.46
11/10/72						12:41	8.36	8.39	8.38	8.39
11/13/72	10:59	8.85	8.86	8.86	8.87	10:37	8.36	8.40	8.39	8.39
11/17/72	13:15	8.77	8.78	8.78	8.80	12:58	8.29	8.33	8.32	8.32
11/20/72	11:04	8.78	8.79	8.78	8.81	11:20	8.30	8.33	8.31	8.33
11/27/72	10:56	8.77	8.78	8.78	8.78	10:20	8.29	8.33	8.32	8.32
12/1/72	13:45	8.80	8.81	8.81	8.82	13:08	8.33	8.37	8.36	8.36

APPENDIX - C

SPECIFIC ELECTRICAL CONDUCTANCE OF WATER SAMPLES FROM HOPE FARMS AND BOSQUE DEL APACHE SITES FOR THE PERIOD MARCH, 1971 THROUGH APRIL, 1973

SPECIFIC ELECTRICAL CONDUCTANCE
(MICROMHOS AT 25°C)

DATE	TIME	HA-10	HA-20	HA-30	HA-40	REMARKS
5/28/71	10:20	1942	1298	1628	1250	
6/04/71	10:15	2106	1371	1791	1212	
6/15/71	9:25	2549	1763	2337	1572	C
6/17/71	10:05	2047	1419	1760	1279	
6/18/71	9:50	2200	1623	2041	1346	
6/21/71	9:45	1685	1226	1461	985	
6/23/71	15:15	1998	1093	1666	1223	L
6/25/71	9:45	1636	1180	1526	1013	
6/28/71	9:35	1263	1004	1202	943	L
6/30/71	9:35	1832	1099	1433	946	C
7/02/71	13:50	1232	1242	1754	1162	M
7/05/71	13:15	1966	1298	1903	1237	L
7/07/71	10:45	1774	1320	2052	1280	
7/09/71	10:40	1986	1306	2031	1240	
7/12/71	9:40	1882	1275	1941	1163	
7/14/71	11:40	1786	1207	1861	1140	
7/16/71	11:35	2038	1375	2102	1279	
7/19/71	9:20	1943	1339	2012	1255	
7/21/71	15:10	2043	1435	2166	1400	
7/23/71	12:05	2056	1394	2089	1283	
7/26/71	12:10	1976	1373	2235	1200	
7/29/71	13:00	1954	1368	2124	1243	C
7/30/71	11:00	2002	1374	2156	1282	
8/02/71	11:40	2012	1380	2184	1309	
8/04/71	11:30	1980	1343	2115	1288	
8/06/71	11:25	1984	1350	2358	1300	
8/09/71	12:10	2081	1366	2104	1299	
8/11/71	10:15	1957	1423	2124	1280	
8/13/71	11:25	1865	1323	2100	1242	
8/16/71	12:10	1952	1375	2225	1318	
8/18/71	10:25	1942	1342	2156	1295	
8/20/71	11:20	1966	1336	2173	1306	
8/23/71	11:25	1878	1340	2097	1275	
8/25/71	11:00	1910	1360	2135	1310	
8/27/71	13:20	1915	1345	2120	1290	
8/30/71	14:40	1960	1420	2195	1355	
9/01/71	12:00	1815	1390	2035	1290	
9/03/71	11:15	1975	1400	2210	1350	
9/07/71	14:45	1881	1376	2216	1345	
9/09/71	10:30	1931	1364	2134	1330	
9/16/71	9:10	1932	1306	2092	1393	
9/20/71	13:35	1874	1377	2128	1363	L
9/30/71	13:15	1967	1396	2160	1394	

C-CHEMICAL ANALYSIS; L-CONDUCTIVITY RUN ONE DAY AFTER SAMPLING
M-CONDUCTIVITY RUN FIVE TO 10 DAYS AFTER SAMPLING;
N-CONDUCTIVITY RUN 19 TO 35 DAYS AFTER SAMPLING

SPECIFIC ELECTRICAL CONDUCTANCE (MICROMHOS AT 25°C)

DATE	TIME	HA-10	HA-20	HA-30	HA-40	REMARKS
10/04/71	13:50	1996	1414	2051	1410	
10/07/71	12:05	1972	1465	2207	1417	C
10/11/71	12:00	1760	1411	2032	1335	
10/14/71	13:55	1973	1403	2155	1413	
10/21/71	12:20	2012	1403	2176	1441	
11/01/71	13:55	1910	1406	2052	1406	L
11/04/71	15:30	2029	1402	2106	1468	L
11/11/71	14:30	2079	1394	2125	1442	
11/19/71	12:30	2090	1469	2205	1465	
11/23/71	12:45	2120	1474	2116	1513	
12/09/71	13:55	2106	1369	2136	1428	
12/16/71	12:20	1834	1313	1986	1365	L
12/23/71	13:20	1264	1275	1092	1147	
12/30/71	12:25	1939	1325	2054	1379	
1/25/72	14:45	2071	1420	2035	1339	
2/01/72	13:45	2057	1369	2015	1325	
2/08/72	13:55	2180	1392	1949	1333	
2/18/72	11:00	1830	1386	1905	1337	
2/24/72	14:00	1908	1396	2012	1307	
2/29/72	14:30	1896	1338	1973	1388	L
3/07/72	15:20	1885	1374	1920	1399	C
3/08/72	13:45	1908	1406	1900	----	
3/16/72	13:00	1871	1406	1895	1379	L
3/21/72	13:10	1907	1385	1860	1377	L
3/30/72	10:20	1890	1373	1835	1369	
4/06/72	13:25	1848	1448	1866	1810	
4/13/72	14:00	1847	1415	1853	1338	L
4/20/72	12:45	1749	1372	1704	1290	L
4/28/72	14:10	1661	1368	1887	1441	
5/17/72	10:25	1713	1499	1889	1522	
5/25/72	11:20	1690	1420	1887	1457	
5/30/72	10:55	1715	1367	1793	1475	L
6/02/72	10:00	1707	1500	1407	1506	L
6/06/72	13:40	1872	1459	1914	1514	
6/09/72	13:50	1855	1446	1882	1551	
6/12/72	9:10	1850	1466	1876	1617	C
6/15/72	8:40	1808	1588	1855	1548	
6/19/72	12:10	1814	1506	1951	1650	
6/22/72	12:00	1846	1415	1855	1550	
6/26/72	11:30	1746	1418	1804	1567	
6/30/72	12:30	1700	1335	1767	1547	
7/04/72	13:20	1633	1452	1800	1542	
7/07/72	13:10	1643	1380	1719	1553	

C-CHEMICAL ANALYSIS; L-CONDUCTIVITY RUN ONE DAY AFTER SAMPLING
M-CONDUCTIVITY RUN FIVE TO 10 DAYS AFTER SAMPLING;
N-CONDUCTIVITY RUN 19 TO 35 DAYS AFTER SAMPLING

SPECIFIC ELECTRICAL CONDUCTANCE
(MICROMHOS AT 25°C)

DATE	TIME	HA-10	HA-20	HA-30	HA-40	REMARKS
7/21/72	13:40	1667	1345	1694	1462	
7/24/72	11:25	1700	1530	1815	1609	M
8/04/72	11:05	1764	1393	1121	1431	
8/07/72	11:10	1735	1485	1750	1627	
8/10/72	11:25	1809	1552	1759	1785	
8/14/72	11:20	1842	1501	1763	1766	
8/17/72	11:00	1811	1458	1742	1665	
8/21/72	12:15	1803	1552	1692	1646	C
8/24/72	11:10	1816	1632	1706	1642	
8/31/72	11:25	1823	1496	1696	1657	
9/22/72	13:15	1865	1465	1725	1502	
9/29/72	12:40	1941	1454	1691	1583	
10/02/72	10:40	1902	1480	1722	1641	
10/06/72	12:40	1910	1412	1700	1641	
10/10/72	13:15	1934	1535	1747	1604	
11/03/72	12:35	1946	1361	1955	1728	
11/06/72	10:10	1990	1323	1927	1776	
11/10/72	12:40	1984	1296	1849	1762	
11/13/72	10:20	1763	----	1830	1713	
11/17/72	12:45	1983	1248	1906	1651	
11/20/72	10:05	1948	1236	1827	1677	
11/27/72	10:05	1955	1258	1942	1766	C
12/01/72	12:55	2112	1397	2021	1859	
12/08/72	12:35	1898	1480	1748	1624	
12/15/72	11:00	1818	1341	1813	----	

C-CHEMICAL ANALYSIS; L-CONDUCTIVITY RUN ONE DAY AFTER SAMPLING
M-CONDUCTIVITY RUN FIVE TO 10 DAYS AFTER SAMPLING;
N-CONDUCTIVITY RUN 19 TO 35 DAYS AFTER SAMPLING

SPECIFIC ELECTRICAL CONDUCTANCE
(MICROMHOS AT 25°C)

DATE	TIME	HB-10	HB-20	HB-30	HB-40	REMARKS
3/22/71	-----	1523	1762	1320	1077	N
4/07/71	-----	1510	1879	1656	1173	N
4/16/71	-----	1513	1747	1730	1209	M
4/26/71	-----	1513	----	----	1221	
5/28/71	11:10	1341	1630	1770	1135	
6/04/71	10:55	1242	1754	1803	1016	
6/15/71	10:35	1708	2024	2106	1285	C
6/17/71	10:25	1368	1727	1743	982	
6/18/71	10:10	1363	1704	1702	656	
6/21/71	10:15	1347	1908	1459	949	
6/23/71	10:45	1249	1550	1465	900	L
6/25/71	10:10	1039	1296	1152	787	
6/28/71	10:00	1172	1558	1479	782	L
6/30/71	9:45	1227	1622	1365	913	C
7/02/71	14:15	1114	1511	1265	868	M
7/05/71	13:35	1113	1588	1181	892	L
7/07/71	10:15	1080	1588	1187	766	
7/09/71	9:55	997	1623	1262	895	
7/12/71	9:55	1045	1611	1226	860	
7/14/71	11:20	1037	1640	1223	872	
7/16/71	10:50	1074	1720	1274	910	
7/19/71	9:50	1040	1699	1279	879	
7/21/71	15:25	1051	1812	1488	957	
7/23/71	11:50	953	1601	1364	835	
7/26/71	11:35	956	1610	1303	784	
7/29/71	13:15	971	1746	1297	849	C
7/30/71	11:15	860	1725	1383	853	
8/02/71	12:15	971	1846	1465	878	
8/04/71	11:50	906	1773	1424	842	
8/06/71	11:40	921	1800	1556	850	
8/09/71	12:40	908	1859	1437	812	
8/11/71	10:00	867	1825	1503	811	
8/13/71	14:40	881	1776	1578	778	
8/16/71	12:20	867	1792	1533	814	
8/18/71	12:40	888	1812	1582	794	
8/20/71	11:40	894	1848	1631	803	
8/23/71	12:20	824	1807	1600	794	
8/25/71	11:15	875	1800	1610	795	
8/27/71	13:35	900	1786	1576	795	
8/30/71	15:05	890	1890	1620	815	
9/01/71	12:20	860	1800	1590	820	
9/03/71	11:30	795	1385	1630	835	
9/07/71	15:05	987	1899	1735	964	

C-CHEMICAL ANALYSIS; L-CONDUCTIVITY RUN ONE DAY AFTER SAMPLING
M-CONDUCTIVITY RUN FIVE TO 10 DAYS AFTER SAMPLING;
N-CONDUCTIVITY RUN 19 TO 35 DAYS AFTER SAMPLING

SPECIFIC ELECTRICAL CONDUCTANCE
(MICROMHOS AT 25°C)

DATE	TIME	HB-10	HB-20	HB-30	HB-40	REMARKS
9/09/71	10:40	895	1793	1682	883	
9/16/71	9:35	887	1903	1665	931	
9/20/71	13:55	929	1785	1553	948	L
9/30/71	14:05	945	1862	1635	1053	
10/04/71	14:15	927	1735	1545	1104	
10/07/71	12:15	943	1864	1756	1220	C
10/11/71	12:15	1000	1697	1599	1274	
10/14/71	14:15	952	1806	1854	1268	
10/21/71	12:40	943	1801	1801	1323	
11/01/71	14:25	865	1604	1810	1215	L
11/04/71	16:00	906	1631	2065	1333	L
11/11/71	15:00	879	1644	2186	1410	
11/19/71	12:55	991	1685	2151	1542	
11/23/71	13:05	1057	1749	2162	1674	
12/09/71	14:25	1158	1661	2028	1641	
12/16/71	13:20	1105	1604	1849	1695	L
12/23/71	13:40	1087	1484	1517	1152	
12/30/71	12:45	1113	1441	1829	1669	
1/25/72	15:10	1149	1431	2065	1852	
2/01/72	14:10	930	1615	1963	2078	
2/08/72	14:25	947	1520	1944	1876	
2/18/72	11:00	1037	1584	2020	1892	
2/24/72	14:20	1110	1634	1955	1898	
2/29/72	15:00	1140	1506	2114	1905	L
3/07/72	15:45	1180	1700	1964	1912	C
3/16/72	13:10	1095	1541	1904	1727	L
3/21/70	12:50	1038	1539	2050	1991	L
3/30/72	10:35	911	1579	1869	1751	
4/06/72	13:45	952	1417	2037	1822	
4/13/72	15:00	961	1367	1905	1782	L
4/20/72	12:55	1006	1293	1872	1889	L
4/28/72	14:25	1034	1320	1851	1815	
5/17/72	10:50	1072	1378	1908	2277	
5/25/72	11:35	1025	1327	1871	2275	
5/30/72	11:15	1056	1367	2112	2173	L
6/02/72	10:20	1081	1355	1992	2156	L
6/06/72	13:30	1107	1370	2012	2215	
6/09/72	14:05	1165	1414	2070	2321	
6/12/72	9:25	1142	1385	2085	2356	C
6/15/72	9:00	1129	1443	2153	2374	
6/19/72	12:30	1127	1550	2136	2500	
6/22/72	12:35	1112	1512	2022	2386	
6/26/72	11:55	1097	1496	1899	2463	

C-CHEMICAL ANALYSIS; L-CONDUCTIVITY RUN ONE DAY AFTER SAMPLING
M-CONDUCTIVITY RUN FIVE TO 10 DAYS AFTER SAMPLING;
N-CONDUCTIVITY RUN 19 TO 35 DAYS AFTER SAMPLING

SPECIFIC ELECTRICAL CONDUCTANCE
(MICROMHOS AT 25°C)

DATE	TIME	HB-10	HB-20	HB-30	HB-40	REMARKS
6/30/72	13:00	963	1400	1990	2137	
7/04/72	13:50	893	1481	2128	2052	
7/07/72	13:40	879	1380	2080	2168	
7/21/72	13:55	749	1547	1882	2361	
7/24/72	11:45	805	1494	2114	2267	M
8/04/72	11:30	771	1670	2157	1782	
8/07/72	11:35	777	1616	2133	2296	
8/10/72	11:35	774	1552	2171	2258	
8/14/72	11:45	773	1556	2097	2187	
8/17/72	11:20	790	1579	2108	2386	
8/21/72	12:40	799	1529	2067	2168	C
8/24/72	11:30	782	1565	2319	2351	
8/31/72	11:50	806	1470	2126	2079	
9/22/72	13:50	921	1406	1944	1909	
9/29/72	12:55	852	1569	2016	2135	
10/02/72	11:15	890	1577	2094	2266	
10/06/72	13:05	930	2031	2109	2220	
10/10/72	13:55	1648	1992	2021	2244	
11/03/72	13:00	967	1782	1770	2122	
11/06/72	10:35	984	1947	2129	2365	
11/10/72	13:25	1030	1904	2245	2249	
11/13/72	10:50	1029	1968	2137	2190	
11/20/72	10:45	1094	1958	2010	2104	
11/27/72	10:35	1151	2049	2011	2402	C
12/01/72	13:25	1155	1994	2164	2425	

C-CHEMICAL ANALYSIS; L-CONDUCTIVITY RUN ONE DAY AFTER SAMPLING
M-CONDUCTIVITY RUN FIVE TO 10 DAYS AFTER SAMPLING;
N-CONDUCTIVITY RUN 19 TO 35 DAYS AFTER SAMPLING

SPECIFIC ELECTRICAL CONDUCTANCE
(MICROMHOS AT 25°C)

DATE	TIME	HC-10	HC-20	HC-30	HC-40	REMARKS
5/28/71	11:40	1936	1724	2087	1608	
6/04/71	11:15	2081	1780	2119	1683	
6/15/71	11:10	2426	2277	2583	2025	C
6/17/71	10:50	1747	1976	2146	1560	
6/18/71	10:30	1904	2002	2243	1731	
6/21/71	10:00	1811	2054	2110	1605	
6/23/71	15:30	1788	1921	2019	1579	L
6/25/71	10:30	1489	1578	1598	1309	
6/28/71	10:20	984	1706	1055	728	L
6/30/71	10:30	1724	1734	1853	1452	C
7/02/71	14:00	1819	1924	1984	1578	M
7/05/71	14:00	2032	1953	2030	1651	L
7/07/71	11:00	2010	1896	1961	1653	
7/09/71	10:20	2216	2011	2178	1749	
7/12/71	10:20	1923	1835	2060	1717	
7/14/71	11:50	1906	1922	2008	1692	
7/16/71	11:10	1937	1950	2251	1956	
7/19/71	9:40	1953	1845	2215	1867	
7/21/71	15:45	2109	1919	2301	1940	
7/23/71	12:20	1835	1384	1367	1768	
7/26/71	12:35	1836	1816	2261	1933	
7/29/71	13:40	2130	1750	2168	1967	C
7/30/71	11:35	2179	1770	2195	1967	
8/02/71	12:30	1930	1783	2243	2029	
8/04/71	12:10	2391	1716	2124	1942	
8/06/71	11:55	2353	1746	2164	1941	
8/09/71	13:10	2415	1752	2050	1960	
8/11/71	9:45	2330	1693	2086	1946	
8/13/71	15:05	2184	1760	2057	1910	
8/16/71	12:40	2221	1685	2067	1940	
8/18/71	13:05	2087	1708	2013	1911	
8/20/71	12:10	2036	1729	2006	1922	
8/23/71	12:30	2016	1695	1910	1851	
8/25/71	11:45	2308	1700	1960	1880	
8/27/71	14:05	2420	1675	1945	1835	
8/30/71	15:40	2290	1745	1920	1855	
9/01/71	13:20	2320	1660	1830	1760	
9/03/71	12:00	2800	----	----	----	
9/07/71	15:25	2569	1784	1879	1787	
9/09/71	11:05	2667	1666	1828	1810	
9/16/71	10:30	2529	1599	1809	1740	
9/20/71	14:25	2324	1671	1812	1723	L
9/21/71	8:15	2429	1707	1944	1802	

C-CHEMICAL ANALYSIS; L-CONDUCTIVITY RUN ONE DAY AFTER SAMPLING
M-CONDUCTIVITY RUN FIVE TO 10 DAYS AFTER SAMPLING;
N-CONDUCTIVITY RUN 19 TO 35 DAYS AFTER SAMPLING

SPECIFIC ELECTRICAL CONDUCTANCE
(MICRCMHOS AT 25°C)

DATE	TIME	HC-10	HC-20	HC-30	HC-40	REMARKS
9/21/71	10:00	2324	1673	1969	1799	
9/21/71	12:00	2340	1663	1928	1840	
9/21/71	14:00	2351	1682	1964	1802	
9/21/71	16:00	2349	1662	1961	1784	
9/21/71	18:00	2323	1657	1955	1669	
9/21/71	20:00	2307	1590	1826	1691	
9/21/71	22:00	2392	1648	1936	1746	
9/21/71	24:00	2459	1719	1988	1828	
9/22/71	2:00	2497	1695	2058	1818	
9/22/71	4:15	2528	1662	1997	1784	
9/22/71	6:00	2484	1645	1970	1775	
9/22/71	8:00	2503	1640	1959	1759	
9/30/71	14:30	2220	1665	1870	1671	
10/04/71	14:55	2177	1696	1846	1681	
10/07/71	12:50	2292	1599	1958	1768	C
10/11/71	12:40	2009	1612	1896	1720	
10/14/71	15:00	2137	1647	1952	1724	
10/21/71	13:20	2165	1633	1922	1703	
11/01/71	15:05	1963	1556	1733	1514	C
11/04/71	16:30	2039	1515	1730	1494	L
11/11/71	15:45	2195	1509	1768	1533	
11/19/71	13:40	2366	1421	1662	1402	
11/23/71	13:40	1960	1378	1613	1411	
12/09/71	14:55	1554	1344	1472	1284	
12/16/71	13:50	1442	1279	1489	1293	L
12/23/71	14:10	1337	1263	1507	1354	
12/30/71	13:10	1232	1236	1483	1325	
1/25/72	15:45	1149	1132	1342	1476	
2/01/72	14:30	1243	1126	1277	1408	
2/08/72	14:40	1306	1065	1239	1501	
2/18/72	11:00	1102	1018	1178	1640	
2/24/72	14:40	1240	1048	1151	1833	
2/29/72	15:10	1156	1017	1114	1724	L
3/07/72	16:00	1109	1052	998	1652	C
3/16/72	13:30	1414	1038	919	1734	L
3/21/72	12:40	1415	972	899	1636	L
3/30/72	11:00	1173	928	865	1577	
4/06/72	14:00	1412	917	867	1663	
4/13/72	14:45	1600	937	841	1613	L
4/20/72	13:05	1304	1026	837	1586	L
4/28/72	14:35	1250	1124	832	1508	
5/17/72	11:15	1111	1111	828	1620	
5/25/72	11:55	1078	1229	736	1133	

C-CHEMICAL ANALYSIS; L-CONDUCTIVITY RUN ONE DAY AFTER SAMPLING
M-CONDUCTIVITY RUN FIVE TO 10 DAYS AFTER SAMPLING;
N-CONDUCTIVITY RUN 19 TO 35 DAYS AFTER SAMPLING

SPECIFIC ELECTRICAL CONDUCTANCE
(MICROMHOS AT 25°C)

DATE	TIME	HC-10	HC-20	HC-30	HC-40	REMARKS
5/30/72	11:30	1188	1245	750	1109	L
6/02/72	10:30	1109	1182	745	1031	L
6/06/72	13:20	1046	1297	779	958	
6/09/72	14:30	1065	1302	783	960	
6/12/72	9:45	1077	1331	859	962	C
6/15/72	9:25	1106	1471	832	932	
6/19/72	12:50	1147	1350	841	970	
6/22/72	12:25	1243	1439	832	972	
6/26/72	12:15	1445	1556	866	978	
6/30/72	13:35	1482	1399	892	968	
7/04/72	14:35	1650	1401	806	967	
7/07/72	14:10	1593	1602	939	1026	
7/21/72	14:15	1507	1473	943	967	
7/24/72	12:05	1720	1705	953	988	M
8/04/72	12:00	1723	1422	999	866	
8/07/72	11:55	2117	1702	1044	902	
8/10/72	12:00	2274	1696	1032	914	
8/14/72	12:05	2457	1752	1101	921	
8/17/72	11:45	2575	1734	1108	927	
8/21/72	13:00	2666	1768	1115	886	C
8/24/72	11:55	2726	1758	1139	861	
8/31/72	12:10	2721	1742	1116	870	
9/22/72	14:05	2439	1621	1083	896	
9/29/72	13:05	2851	1601	1131	953	
10/02/72	11:05	2713	1593	1177	902	
10/06/72	12:55	2283	1472	1090	898	
10/10/72	13:45	2405	1503	1172	1185	
11/03/72	12:45	2061	1329	----	1001	
11/06/72	10:20	1905	1250	997	1141	
11/13/72	11:00	1523	1086	939	1195	
11/17/72	13:15	1318	1080	895	1168	
11/20/72	11:05	1225	1053	917	1203	
11/27/72	10:55	1168	968	828	1193	C
12/01/72	13:45	1139	1003	845	1110	
12/15/72	11:30	902	953	----	----	

C-CHEMICAL ANALYSIS; L-CONDUCTIVITY RUN ONE DAY AFTER SAMPLING
M-CONDUCTIVITY RUN FIVE TO 10 DAYS AFTER SAMPLING;
N-CONDUCTIVITY RUN 19 TO 35 DAYS AFTER SAMPLING

SPECIFIC ELECTRICAL CONDUCTANCE
(MICROMHOS AT 25°C)

DATE	TIME	HD-10	HD-20	HD-30	HD-40	REMARKS
8/06/71	12:10	2139	869	864	648	
8/09/71	12:55	1990	845	866	594	
8/11/71	9:30	1843	818	811	614	
8/13/71	15:25	1550	830	760	614	
8/16/71	12:55	1280	854	764	598	
8/18/71	12:55	1215	834	791	606	
8/20/71	11:55	1256	852	760	606	
8/23/71	12:40	1250	813	715	612	
8/25/71	11:35	1245	835	735	600	
8/27/71	13:55	1240	850	760	615	
8/30/71	15:25	1140	845	770	615	
9/01/71	12:55	1090	825	755	600	
9/03/71	11:45	1095	825	730	610	
9/07/71	15:15	1188	888	799	649	
9/09/71	10:55	1170	855	753	627	
9/16/71	10:05	1092	843	782	637	
9/20/71	14:15	1213	841	782	657	L
9/30/71	14:45	1617	980	851	675	
10/04/71	14:40	1267	988	786	664	
10/07/71	12:35	1619	1101	920	667	C
10/11/71	12:30	1501	1032	737	680	
10/14/71	14:40	2235	1078	841	739	
10/21/71	13:05	2617	1095	808	716	
11/01/71	14:50	1193	1033	746	683	L
11/04/71	16:15	1368	1104	805	718	L
11/11/71	15:30	2825	1187	837	741	
11/19/71	13:50	1086	957	803	740	
11/23/71	13:30	958	907	823	723	
12/09/71	14:40	2426	942	796	771	
12/16/71	13:45	2722	929	761	724	L
12/23/71	13:55	3147	979	801	741	
12/30/71	12:55	3098	906	832	747	
1/25/72	15:35	3078	1038	855	739	
2/01/72	14:40	3075	1147	809	739	
2/08/72	14:50	3029	1035	816	747	
2/18/72	11:00	2907	1129	842	755	
2/24/72	14:55	3086	1111	867	781	
2/29/72	15:05	3116	1087	843	759	L
3/07/72	16:20	2910	1096	857	789	C
3/16/72	13:50	2932	1055	906	783	L
3/21/72	12:25	2937	1067	899	795	L
3/30/72	11:15	2804	1071	913	782	
4/06/72	14:15	2569	1127	933	860	

C-CHEMICAL ANALYSIS; L-CONDUCTIVITY RUN ONE DAY AFTER SAMPLING
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N-CONDUCTIVITY RUN 19 TO 35 DAYS AFTER SAMPLING

SPECIFIC ELECTRICAL CONDUCTANCE
(MICROMHOS AT 25°C)

DATE	TIME	HD-10	HD-20	HD-30	HD-40	REMARKS
4/13/72	14:15	2441	1156	917	831	L
4/20/72	13:15	2439	1154	926	882	L
4/28/72	14:50	2496	1113	944	860	
5/17/72	11:30	2167	1022	953	873	
5/25/72	12:10	1231	686	948	1057	
5/30/72	11:45	1477	1079	966	852	L
6/02/72	10:45	1515	1066	955	848	L
6/06/72	13:05	1342	1085	992	858	
6/09/72	14:45	1371	1082	965	852	
6/12/72	10:05	1765	1080	994	872	C
6/15/72	9:40	1737	1057	983	865	
6/19/72	13:00	1414	1100	1005	895	
6/22/72	12:15	1116	1067	998	879	
6/26/72	12:30	1047	1104	1011	853	
6/30/72	13:55	1012	1103	977	872	
7/04/72	15:10	1030	1147	1002	878	
7/07/72	14:35	1154	1162	1002	895	
7/21/72	14:30	1114	1211	996	936	
7/24/72	12:20	1148	1225	1001	927	M
8/04/72	12:10	1009	1195	1038	963	
8/07/72	12:10	1019	1220	1028	973	
8/10/72	12:10	1029	1237	1030	976	
8/14/72	12:15	1038	1219	1019	973	
8/17/72	12:00	999	1231	1020	992	
8/21/72	13:10	1051	1229	1035	972	C
8/24/72	12:10	1051	1252	1026	981	
8/31/72	12:20	1042	1201	1012	982	
9/22/72	14:20	1120	1225	1045	986	
9/29/72	13:20	1876	1166	1039	1013	
10/02/72	10:50	2065	1155	1032	1011	
10/10/72	13:25	2818	1193	1032	993	
11/06/72	10:45	4181	1303	1011	987	
11/10/72	12:50	4141	1540	1026	995	
11/13/72	10:35	3941	1439	1017	993	
11/17/72	13:00	4053	1374	1042	1016	
11/20/72	10:20	4256	1285	1024	1021	
11/27/72	10:20	3555	1231	1006	1024	C
12/01/72	13:10	4387	1210	1023	1013	
12/08/72	12:50	3798	1218	1005	1028	
12/15/72	11:45	3487	1245	1016	1023	

C-CHEMICAL ANALYSIS; L-CONDUCTIVITY RUN ONE DAY AFTER SAMPLING
M-CONDUCTIVITY RUN FIVE TO 10 DAYS AFTER SAMPLING;
N-CONDUCTIVITY RUN 19 TO 35 DAYS AFTER SAMPLING

SPECIFIC ELECTRICAL CONDUCTANCE
(MICROMHOS AT 25°C)

DATE	TIME	BA-15	BA-20	BA-45	REMARKS
7/02/71	15:40	1725	1882	1093	M
7/05/71	15:15	1927	2040	2081	L
7/07/71	14:10	2068	2103	2065	
7/09/71	11:35	1261	1081	1528	
7/12/71	11:10	1897	1855	1739	
7/14/71	10:05	1956	1760	1732	
7/16/71	8:55	1903	1803	1736	
7/19/71	10:55	2073	1915	1844	
7/21/71	14:15	2054	1922	1856	
7/23/71	10:05	1959	1968	1643	
7/26/71	10:00	1593	1736	1777	
7/28/71	11:30	2073	1977	1841	C
7/30/71	10:15	2071	2350	1785	
8/02/71	10:25	2119	2012	1823	
8/04/71	10:30	1999	1979	1761	
8/06/71	10:15	2063	1930	1744	
8/09/71	10:30	1982	1942	1746	
8/11/71	12:00	1766	1943	2019	
8/13/71	10:35	1958	1912	1712	
8/16/71	10:45	1971	1890	1701	
8/18/71	11:15	2028	1951	1723	
8/20/71	10:25	2002	1923	1733	
8/23/71	10:35	1957	1886	1715	
8/25/71	10:15	1970	1975	1695	
8/27/71	12:05	1925	1865	1685	
8/30/71	11:15	1955	1980	1710	
9/01/71	10:20	1865	1840	1630	
9/03/71	10:25	1970	2010	1750	
9/07/71	13:35	1998	2032	1769	
9/09/71	9:40	2019	2020	1713	
9/16/71	13:30	2028	2094	1760	
9/20/71	16:00	1999	2096	1663	L
9/30/71	12:00	2019	2120	1726	
10/04/71	16:45	1986	2010	1715	
10/07/71	11:10	2007	2113	1722	C
10/11/71	14:20	1966	2021	1687	
10/14/71	12:15	2004	2096	1703	
10/21/71	11:20	2044	2113	1711	
11/01/71	17:00	2030	2078	1625	L
11/04/71	12:30	2006	2031	1678	L
11/11/71	13:00	2039	2039	1735	
11/18/71	11:30	2313	2087	1718	
11/23/71	11:35	2022	2078	1668	

C-CHEMICAL ANALYSIS; L-CONDUCTIVITY RUN ONE DAY AFTER SAMPLING
M-CONDUCTIVITY RUN FIVE TO 10 DAYS AFTER SAMPLING;
N-CONDUCTIVITY RUN 19 TO 35 DAYS AFTER SAMPLING

SPECIFIC ELECTRICAL CONDUCTANCE
(MICROMHOS AT 25°C)

DATE	TIME	BA-15	BA-20	BA-45	REMARKS
12/09/71	12:30	2025	2068	1682	
12/23/71	11:40	2083	2020	1669	
12/30/71	10:45	2042	1967	1665	
1/26/72	15:25	2217	2113	1717	
2/02/72	14:55	2090	2141	1736	
2/09/72	14:20	2050	2101	1765	
2/18/72	14:00	2494	2192	1778	
2/25/72	17:00	2216	2127	1832	
2/29/72	16:50	2122	2158	1783	L
3/07/72	14:25	2138	2124	1753	C
3/16/72	16:20	2129	2189	1751	L
3/21/72	15:30	2124	2233	1720	L
3/30/72	13:30	2200	2201	1733	
4/07/72	15:20	2115	2178	1734	
4/13/72	16:30	2141	2193	1724	L
4/20/72	15:10	2124	2243	1713	L
4/28/72	16:55	2152	2243	1789	
5/17/72	14:25	2149	2261	1748	
5/25/72	15:00	2096	2235	1717	
5/30/72	14:55	2156	2245	1768	L
6/02/72	13:20	2135	2222	1766	L
6/06/72	12:15	2198	2245	1782	
6/09/72	12:45	2096	2236	1786	
6/12/72	12:55	2194	2233	1784	C
6/15/72	12:10	2229	2246	1867	
6/19/72	11:10	2171	2208	1812	
6/22/72	11:05	2207	2224	1791	
6/26/72	10:30	2177	2224	1830	
6/30/72	11:10	2097	1925	1721	
7/04/72	11:40	2048	2091	1814	
7/07/72	11:50	2158	2185	1812	
7/21/72	12:35	2097	2201	1820	
7/24/72	10:25	2195	2221	1904	M
8/04/72	10:10	2261	2217	1892	
8/07/72	10:20	2187	2224	1928	
8/10/72	10:25	2168	2202	1920	
8/14/72	10:20	2110	2136	1911	
8/17/72	10:10	2187	2132	1915	
8/21/72	11:20	2153	2190	1983	C
8/24/72	10:20	2140	2163	1922	
8/28/72	11:15	2189	2185	1943	
8/31/72	10:25	2112	2134	1936	
9/22/72	12:15	2085	1983	1898	

C-CHEMICAL ANALYSIS; L-CONDUCTIVITY RUN ONE DAY AFTER SAMPLING
M-CONDUCTIVITY RUN FIVE TO 10 DAYS AFTER SAMPLING;
N-CONDUCTIVITY RUN 19 TO 35 DAYS AFTER SAMPLING

SPECIFIC ELECTRICAL CONDUCTANCE
(MICROMHOS AT 25°C)

DATE	TIME	BA-15	BA-20	BA-45	REMARKS
10/03/72	13:20	2056	2050	1917	
10/06/72	11:45	2091	2065	1939	
10/17/72	13:30	2037	1937	1915	
10/24/72	13:45	2072	1974	1947	
11/03/72	11:45	2012	2002	1851	
11/10/72	11:50	2013	2004	1951	
11/14/72	13:35	1922	1995	2011	
11/17/72	12:00	1990	1992	2015	
11/21/72	13:15	1993	1891	1877	
11/24/72	10:25	1968	1986	2001	C
12/01/72	11:55	1999	2014	2003	
12/08/72	11:45	1997	2020	2027	
12/15/72	10:15	2020	1969	2021	
12/22/72	11:35	1876	2050	2145	
12/28/72	14:15	2015	2003	2088	
1/05/73	11:35	2055	2035	2147	
1/12/73	11:10	2075	2007	2146	
1/19/73	11:15	2009	2013	2164	
1/25/73	15:55	2096	2022	2167	
4/19/73	11:20	2292	2066	2237	C

C-CHEMICAL ANALYSIS; L-CONDUCTIVITY RUN ONE DAY AFTER SAMPLING
M-CONDUCTIVITY RUN FIVE TO 10 DAYS AFTER SAMPLING;
N-CONDUCTIVITY RUN 19 TO 35 DAYS AFTER SAMPLING

SPECIFIC ELECTRICAL CONDUCTANCE
(MICROMHOS AT 25°C)

DATE	TIME	BB-10	BB-20	BB-30	BB-40	REMARKS
7/21/71	-----	1908	1864	2012	2163	
7/23/71	10:40	2025	2369	1822	2399	
7/26/71	10:15	1966	2242	2265	2385	
7/28/71	10:55	1966	2121	2209	2264	C
7/30/71	9:35	1942	2039	2112	2222	
8/02/71	9:50	1968	2009	2152	2210	
8/04/71	10:00	1938	1980	2088	2243	
8/06/71	9:40	1909	1966	2117	2155	
8/09/71	9:50	1910	1965	2127	2155	
8/11/71	11:30	1896	1966	2140	2300	
8/13/71	10:00	1900	1905	2063	2204	
8/16/71	10:15	1969	2002	2114	2121	
8/18/71	10:35	1904	1940	2120	2097	
8/20/71	9:50	1920	1964	2103	2148	
8/23/71	10:00	1894	1930	2060	2116	
8/25/71	9:45	1940	1910	2110	2175	
8/27/71	11:35	1915	1935	2060	2085	
8/30/71	10:40	1930	1985	2060	2130	
9/01/71	9:45	1940	1950	2105	2170	
9/03/71	9:55	1975	1980	2115	2160	
9/07/71	13:10	1034	2019	2149	2206	
9/09/71	9:10	1876	1963	1995	2102	
9/16/71	13:40	1938	2009	2136	2150	
9/20/71	15:30	1937	1977	2092	2123	L
9/30/71	11:15	1948	1953	2118	2134	
10/04/71	16:10	1893	1932	2032	2080	
10/07/71	10:45	1947	1988	2124	2196	C
10/11/71	14:00	1928	1920	2010	2132	
10/14/71	11:40	1944	1970	2154	2141	
10/21/71	10:40	1951	1966	2139	2163	
11/01/71	16:45	1873	1954	2082	2029	L
11/04/71	11:40	1944	1935	2137	2139	L
11/11/71	12:45	1945	1970	2189	2178	
11/18/71	11:00	1986	2011	2204	2182	
11/23/71	10:55	1955	1942	2172	2160	
12/02/71	11:50	1979	1991	2214	2230	
12/09/71	11:40	1995	1891	2213	2205	
12/23/71	11:00	1937	1961	2220	2213	
12/30/71	10:10	1954	1934	2199	2189	
1/26/72	14:55	1970	1934	2219	2192	
2/02/72	14:20	1940	1915	2194	2197	
2/09/72	14:30	1965	1923	2192	2174	
2/18/72	14:00	1990	1963	2246	2227	

C-CHEMICAL ANALYSIS; L-CONDUCTIVITY RUN ONE DAY AFTER SAMPLING
M-CONDUCTIVITY RUN FIVE TO 10 DAYS AFTER SAMPLING;
N-CONDUCTIVITY RUN 19 TO 35 DAYS AFTER SAMPLING

SPECIFIC ELECTRICAL CONDUCTANCE
(MICROMHOS AT 25°C)

DATE	TIME	BB-10	BB-20	BB-30	BB-40	REMARKS
2/25/72	16:40	2042	2017	2260	2240	
2/29/72	16:40	1954	1984	2218	2244	L
3/07/72	13:55	2010	1991	2279	2264	C
3/16/72	16:00	1994	1963	2264	2246	L
3/21/72	15:20	1978	1982	2252	2277	L
3/30/72	12:50	1917	1944	2211	2192	
4/07/72	14:40	1986	1967	2268	2263	
4/13/72	16:10	1979	1985	2275	2264	L
4/20/72	14:35	1976	1984	2267	2319	L
4/28/72	16:30	1982	1982	2279	2315	
5/17/72	13:40	1942	2024	2259	2295	
5/25/72	14:20	1708	1975	2239	2272	
5/30/72	14:15	2005	1987	2256	2301	L
6/02/72	12:55	2535	1987	2383	2803	L
6/06/72	11:45	1991	1989	2283	2334	
6/09/72	12:05	1983	1990	2254	2331	
6/12/72	12:20	2034	1994	2272	2356	C
6/15/72	11:20	2044	2007	2287	2350	
6/19/72	10:30	2030	1995	2250	2361	
6/22/72	10:25	1996	2015	2176	2373	
6/26/72	9:45	1923	2030	2275	2369	
6/30/72	10:05	1877	1835	2174	2237	
7/04/72	10:30	1903	1952	2235	2371	
7/07/72	10:25	1979	1979	2287	2349	
7/21/72	12:00	1964	1987	2253	2350	
7/24/72	9:50	1951	2013	2248	2405	M
8/04/72	9:30	2034	2010	2090	2274	
8/07/72	9:40	2039	2020	2251	2403	
8/10/72	9:40	2042	2045	2233	2413	
8/14/72	9:40	2026	2012	2250	2413	
8/17/72	9:25	2017	2035	2199	2390	
8/21/72	10:35	1964	2000	2189	2425	C
8/24/72	9:45	1992	2017	2231	2411	
8/28/72	10:35	2009	2023	2243	2398	
8/31/72	9:50	1993	2007	2217	2413	
9/22/72	11:35	2020	2025	2187	2374	
10/03/72	12:45	1931	1934	2189	2368	
10/06/72	11:10	2019	2015	2177	2373	
10/17/72	12:55	1978	2020	2159	2358	
10/24/72	13:00	1947	1970	2143	2375	
11/03/72	11:10	2042	2050	2170	2403	
11/10/72	11:20	2012	2019	2155	2418	
11/14/72	13:05	2027	2022	2126	2368	

C-CHEMICAL ANALYSIS; L-CONDUCTIVITY RUN ONE DAY AFTER SAMPLING
M-CONDUCTIVITY RUN FIVE TO 10 DAYS AFTER SAMPLING;
N-CONDUCTIVITY RUN 19 TO 35 DAYS AFTER SAMPLING

SPECIFIC ELECTRICAL CONDUCTANCE
(MICROMHOS AT 25°C)

DATE	TIME	BB-10	BB-20	BB-30	BB-40	REMARKS
11/17/72	11:30	2014	1993	2115	2385	
11/21/72	12:45	1915	2000	2118	2366	
11/24/72	9:45	2029	1983	2118	2382	C
12/01/72	10:55	2038	2003	2113	2360	
12/08/72	11:15	1972	1945	2051	2320	
12/15/72	9:35	2022	1978	2050	2341	
12/22/72	10:55	2027	1972	2092	2378	
12/28/72	13:15	2048	1980	2058	2372	
1/05/73	10:50	2031	2031	2099	2379	
1/12/73	10:30	2038	1949	2065	2384	
1/19/73	10:40	2060	1936	2066	2354	
1/25/73	15:15	2014	1936	2087	2340	
4/19/73	10:30	2293	2287	2083	2351	C

C-CHEMICAL ANALYSIS; L-CONDUCTIVITY RUN ONE DAY AFTER SAMPLING
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N-CONDUCTIVITY RUN 19 TO 35 DAYS AFTER SAMPLING

SPECIFIC ELECTRICAL CONDUCTANCE
(MICROMHOS AT 25°C)

DATE	TIME	BC-20	BC-30	BC-40	BC-50	REMARKS
7/14/71	10:15	1929	2133	1917	2560	
7/16/71	9:10	1960	2147	1960	2332	
7/19/71	11:10	1965	2200	2000	2321	
7/21/71	13:55	1919	1920	1876	2134	
7/23/71	10:25	1865	1754	1292	2081	
7/26/71	10:30	1822	1809	1799	2066	
7/28/71	11:15	1914	1987	1889	2145	C
7/30/71	9:50	1848	1850	1848	1963	
8/02/71	10:05	1905	1919	1884	2046	
8/04/71	10:15	1831	1867	1853	1997	
8/06/71	9:55	1791	1777	1808	1999	
8/09/71	10:10	1820	1822	1846	1958	
8/11/71	11:45	1816	1873	1856	2014	
8/13/71	10:15	1478	1796	1847	1978	
8/16/71	10:30	1789	1876	1787	1971	
8/18/71	10:50	1789	1865	1804	1963	
8/20/71	10:10	1788	1839	1828	1975	
8/23/71	10:20	1790	1860	1815	1960	
8/25/71	10:00	1810	1880	1845	1980	
8/27/71	11:50	1795	1825	1770	1935	
8/30/71	11:00	1805	1895	1850	1975	
9/01/71	10:00	1770	1800	1760	1990	
9/03/71	10:10	1805	1890	1855	2060	
9/07/71	13:20	1845	1900	1876	2034	
9/09/71	9:25	1740	1849	1823	1937	
9/16/71	13:15	1844	1904	1873	2017	
9/20/71	15:45	1822	1751	1797	1989	L
9/30/71	11:30	1802	1901	1859	2001	
10/04/71	16:30	1762	1830	1874	2014	
10/07/71	10:30	1831	1930	1880	1999	C
10/11/71	14:10	1787	1881	1830	1987	
10/14/71	11:55	1827	1894	1855	2010	
10/21/71	11:05	1836	1846	1867	2013	
11/01/71	16:30	1789	1855	1790	1965	C
11/04/71	11:55	1803	1867	1850	2006	L
11/11/71	12:30	1842	1907	1882	2022	
11/18/71	11:15	1881	1915	1906	2069	
11/23/71	11:20	1808	1881	1864	2015	
12/02/71	10:55	1925	1903	1931	2039	
12/09/71	12:05	1820	1901	1861	2019	L
12/23/71	11:15	1799	1888	1859	2029	
12/30/71	10:25	1807	1888	1838	1980	
1/26/72	15:10	1932	2044	1851	2007	

C-CHEMICAL ANALYSIS; L-CONDUCTIVITY RUN ONE DAY AFTER SAMPLING
M-CONDUCTIVITY RUN FIVE TO 10 DAYS AFTER SAMPLING;
N-CONDUCTIVITY RUN 19 TO 35 DAYS AFTER SAMPLING

SPECIFIC ELECTRICAL CONDUCTANCE
(MICROMHOS AT 25°C)

DATE	TIME	BC-20	BC-30	BC-40	BC-50	REMARKS
2/02/72	14:40	1852	1904	1887	2028	
2/09/72	14:50	1853	1909	1876	2025	
2/18/72	14:00	1888	2009	2031	2055	
2/25/72	16:30	1931	1993	1934	2073	
2/29/72	16:30	1902	1950	1889	2062	L
3/07/72	14:10	1903	2050	1921	2094	C
3/16/72	15:50	1913	1984	1928	2082	L
3/21/72	15:10	1880	1971	1905	2079	L
3/30/72	12:40	1869	1888	1892	1868	
4/07/72	14:20	1862	1980	1930	2071	
4/13/72	16:20	1871	1983	1921	2072	L
4/20/72	14:50	1874	1987	1931	2090	L
4/28/72	16:45	1948	2018	1964	2073	
5/17/72	14:10	1929	2044	1930	2093	
5/25/72	14:40	1825	1980	1919	2083	
5/30/72	14:30	1959	2033	1946	2117	L
6/02/72	13:10	1441	1753	1646	1521	L
6/06/72	12:00	1964	2017	1956	2104	
6/09/72	12:30	1967	2047	1958	2100	
6/12/72	12:40	1989	2014	1964	2120	C
6/15/72	11:40	2006	2069	2007	2115	
6/19/72	10:50	1994	2066	1958	2111	
6/22/72	10:40	2013	2027	1888	2106	
6/26/72	10:00	2052	2052	1975	2111	
6/30/72	10:35	1939	1960	1924	2057	
7/04/72	11:00	2038	2018	1958	2103	
7/07/72	10:55	2052	2018	1991	2087	
7/21/72	12:25	2046	2073	1985	2113	
7/24/72	10:05	2132	2054	1982	2121	M
8/04/72	9:45	1941	2047	2014	1974	
8/07/72	10:00	2178	2050	2038	2116	
8/10/72	10:10	2169	2121	2041	2150	
8/14/72	10:05	2164	2074	2012	2106	
8/17/72	9:45	2181	2069	2039	2133	
8/21/72	11:05	2144	2102	2028	2124	C
8/24/72	10:00	2173	2064	2008	2115	
8/28/72	10:50	2169	2063	2018	2173	
8/31/72	10:10	2155	2074	2027	2136	
9/22/72	12:00	2131	2078	2034	2127	
10/03/72	13:05	2090	2106	2089	2096	
10/06/72	11:25	2033	2055	2031	2118	
10/17/72	13:15	2025	2084	2036	2106	
10/24/72	13:25	2027	2097	2034	2118	

C-CHEMICAL ANALYSIS; L-CONDUCTIVITY RUN ONE DAY AFTER SAMPLING
M-CONDUCTIVITY RUN FIVE TO 10 DAYS AFTER SAMPLING;
N-CONDUCTIVITY RUN 19 TO 35 DAYS AFTER SAMPLING

SPECIFIC ELECTRICAL CONDUCTANCE
(MICROMHOS AT 25°C)

DATE	TIME	BC-20	BC-30	BC-40	BC-50	REMARKS
11/03/72	11:30	2035	2117	2069	2139	
11/10/72	11:35	2042	2095	2039	2144	
11/14/72	13:15	2010	2064	2023	2114	
11/17/72	11:45	2018	2076	2004	2107	
11/21/72	13:00	2002	2073	2020	2137	
11/24/72	10:05	2011	2051	2012	2113	C
12/01/72	11:15	1990	2046	2004	2127	
12/08/72	11:25	1986	2031	2022	2093	
12/15/72	9:50	1980	2069	1995	2153	
12/22/72	11:15	2107	2027	2019	2090	
12/28/72	13:45	1991	2065	1996	2062	
1/05/73	11:15	2223	2130	2052	2078	
1/12/73	10:50	1992	2058	1975	2072	
1/19/73	10:55	2018	2096	1980	2055	
1/25/73	15:30	2048	2073	1994	2064	
4/19/73	11:00	2156	2203	1992	2110	C

C-CHEMICAL ANALYSIS; L-CONDUCTIVITY RUN ONE DAY AFTER SAMPLING
M-CONDUCTIVITY RUN FIVE TO 10 DAYS AFTER SAMPLING;
N-CONDUCTIVITY RUN 19 TO 35 DAYS AFTER SAMPLING

SPECIFIC ELECTRICAL CONDUCTANCE
(MICROMHOS AT 25°C)

DATE	TIME	BD-15	BD-20	BD-30	BD-40	REMARKS
7/28/71	-----	----	----	2294	----	
7/30/71	9:20	----	----	2327	----	
8/02/71	9:35	----	----	2341	----	
8/04/71	9:30	2215	2412	2250	2990	
8/06/71	9:25	3106	2516	2311	3463	
8/09/71	9:35	3117	2398	2301	2173	
8/11/71	11:10	3209	2382	2300	3121	
8/13/71	9:40	3038	2366	2232	2973	
8/16/71	10:00	2920	2388	2255	3000	
8/18/71	10:20	2854	2504	2276	2950	
8/20/71	9:35	2868	2532	2273	2936	
8/23/71	9:40	2574	2539	2260	2932	
8/25/71	9:30	2740	2460	2245	2945	
8/27/71	11:20	2710	2260	2235	2915	
8/30/71	10:25	2885	2350	2295	2950	
9/01/71	9:30	2890	2435	2245	2940	
9/03/71	9:35	2940	2465	2275	2970	
9/07/71	12:55	3342	2460	2336	3059	
9/09/71	8:55	2952	2366	2264	2959	
9/16/71	12:15	2614	2201	2239	2976	
9/20/71	15:15	2352	2158	2301	2885	L
9/30/71	10:50	2651	2225	2296	2989	
10/04/71	15:55	2605	2150	2228	2911	
10/07/71	10:20	2625	2087	2351	3050	C
10/11/71	13:30	2370	2083	2288	2853	
10/14/71	11:15	2384	2088	2300	3018	
10/21/71	10:25	2289	1996	2311	3005	
11/01/71	16:10	2229	2065	2264	2769	L
11/04/71	11:20	2367	2081	2295	3013	L
11/11/71	12:00	2602	2090	2315	3015	
11/18/71	10:40	2530	2368	2391	3113	
11/23/71	10:35	2434	2329	2309	3004	
12/02/71	11:25	2684	2251	2294	3113	
12/09/71	11:15	2447	2114	2203	2850	L
12/16/71	15:10	2549	2000	2237	2892	L
12/23/71	10:35	2307	2087	2292	2985	
12/30/71	10:00	2271	2056	2293	2945	
1/26/72	14:35	2367	2065	2295	2896	
2/02/72	14:05	2439	2159	2318	2880	
2/09/72	15:05	2428	2253	2343	2859	
2/18/72	14:00	2450	2165	2373	2872	
2/25/72	16:20	2408	2236	2389	2908	
2/29/72	16:20	2364	2199	2364	2896	L

C-CHEMICAL ANALYSIS; L-CONDUCTIVITY RUN ONE DAY AFTER SAMPLING
M-CONDUCTIVITY RUN FIVE TO 10 DAYS AFTER SAMPLING;
N-CONDUCTIVITY RUN 19 TO 35 DAYS AFTER SAMPLING

SPECIFIC ELECTRICAL CONDUCTANCE
(MICROMHOS AT 25°C)

DATE	TIME	BD-15	BD-20	BD-30	BD-40	REMARKS
3/07/72	13:40	2692	2157	2403	2912	C
3/16/72	15:30	2757	2184	2393	2910	L
3/21/72	15:00	2833	2174	2389	2875	L
3/30/72	12:25	2367	2010	2353	2861	
4/07/72	14:00	2293	2025	2383	2857	
4/13/72	16:00	2281	2013	2409	2868	L
4/20/72	14:20	2258	2030	2403	2868	L
4/28/72	16:15	2326	2023	2364	2843	
5/17/72	13:30	2448	2025	2350	2851	
5/25/72	14:05	2620	2019	2310	2793	
5/30/72	13:45	2619	2037	2407	2864	L
6/02/72	12:40	1504	1521	2245	2307	L
6/06/72	11:25	2526	2166	2423	2849	
6/09/72	11:30	2495	2218	2435	2843	
6/12/72	11:55	2519	2333	2407	2891	C
6/15/72	10:50	2474	2403	2423	2819	
6/19/72	10:00	2476	2375	2403	2868	
6/22/72	10:00	2515	2372	2459	2868	
6/26/72	9:15	2501	2395	2130	2858	
6/30/72	9:20	2046	2137	2345	2816	
7/04/72	9:45	2349	2232	2296	2796	
7/07/72	9:45	2323	2211	2335	2769	
7/21/72	11:40	2242	2565	2362	2822	
7/24/72	9:30	2327	2464	2398	2865	M
8/04/72	9:05	2371	2458	2403	2885	
8/07/72	9:15	2568	2450	2451	2871	
8/10/72	9:20	2542	2263	2445	2875	
8/14/72	9:20	2365	2196	2464	2920	
8/17/72	9:00	2612	2199	2476	2913	
8/21/72	10:20	2825	2142	2468	2882	C
8/24/72	9:15	2473	1967	2455	2861	
8/28/72	10:05	2417	1974	2506	2869	
8/31/72	9:25	2226	1975	2440	2868	
9/22/72	10:45	2141	2055	2409	2887	
10/03/72	12:25	2224	2005	2409	2858	
10/06/72	10:45	2210	1953	2450	2839	
10/17/72	12:35	2316	1944	2391	2860	
10/24/72	12:40	2222	1986	2451	2885	
11/03/72	10:50	2272	2101	2427	2993	
11/10/72	11:00	2193	2208	2378	2874	
11/14/72	12:40	2103	2131	2418	2878	
11/17/72	11:15	2108	2093	2379	2869	
11/21/72	12:30	2136	2062	2387	2859	

C-CHEMICAL ANALYSIS; L-CONDUCTIVITY RUN ONE DAY AFTER SAMPLING
M-CONDUCTIVITY RUN FIVE TO 10 DAYS AFTER SAMPLING;
N-CONDUCTIVITY RUN 19 TO 35 DAYS AFTER SAMPLING

SPECIFIC ELECTRICAL CONDUCTANCE
(MICROMHOS AT 25°C)

DATE	TIME	BD-15	BD-20	BD-30	BD-40	REMARKS
11/24/72	9:25	2143	2031	2397	2901	C
12/01/72	10:35	2181	2121	2448	2871	
12/08/72	10:50	2086	2077	2450	2868	
12/15/72	9:10	2113	2110	2388	2866	
12/22/72	10:20	2178	2068	2396	2859	
12/28/72	12:40	2490	2021	2352	2854	
1/05/73	10:25	2284	1999	2413	2865	
1/12/73	10:05	2246	2004	2357	2869	
1/19/73	10:10	2295	2028	2350	2871	
1/25/73	14:50	2246	2006	2358	2844	
4/19/73	10:05	2769	2131	2387	3000	C

C-CHEMICAL ANALYSIS; L-CONDUCTIVITY RUN ONE DAY AFTER SAMPLING
M-CONDUCTIVITY RUN FIVE TO 10 DAYS AFTER SAMPLING;
N-CONDUCTIVITY RUN 19 TO 35 DAYS AFTER SAMPLING

APPENDIX - D

CHEMICAL ANALYSES OF GROUNDWATER FROM HOPE FARMS AND BOSQUE DEL APACHE SITES FOR THE PERIOD JUNE, 1971, THROUGH APRIL, 1973

Chemical Analysis of Groundwater from Hope Farms
and Bosque del Apache Sites, Socorro Co., N.M.

(Analyzed by N. Mex. Bureau of Mines. Chemical constituents in milligrams/liter).

				CATIONS				ANIONS						
WELL No.	DATE	pH	SiO_2	(Ca^{+2})	(Mg^{+2})	(Na^+)	(K^+)	(CO_3^{-2})	(HCO_3^-)	(SO_4^{-2})	(Cl^-)	(NO_3^-)	(T.D.S.)	Specific Conductance*
H-A-10	6/15/71	8.08	——	235	33	273	17.7	——	420	685	97	——	1288	2549
	6/30/71	7.21	——	218	34.8	271	16	——	412	694	92	2.2	1100	1832
	7/29/71	7.57	——	235	26.2	203	13.3	——	474	677	107	2.2	1334	1954
	10/7/71	7.88	——	215	35	203	9.2	——	540	520	117	0.5	1340	1972
	3/7/72	7.67	30.8	220	31	180	10.3	——	376	562.4	123	——	1357	1885
	6/12/72	7.40	39.5	82	47.7	226	8.7	——	406	436	84.4	——	1017	1850
	8/21/72	7.45	35	166	23	200	9.7	——	356	510	100	——	1230	1803
	11/27/72	7.3	——	200	30	210	8.8	——	332	593	120	3.1	1263	1955

* in micromhos at 25°C

Chemical Analysis (Continued)

WELL No.	DATE	pH	SiO_2	(Ca^{+2})	(Mg^{+2})	(Na^{+})	(K^{+})	(CO_3^{-2})	(HCO_3^{-})	(SO_4^{-2})	(Cl^{-})	(NO_3^{-})	(T.D.S.)	Specific Conductance*
H-A-20	6/15/71	7.86	—	190	28.5	110	12.4	2	240	449	111	—	998	1763
	6/30/71	7.29	—	178	30	97	10.9	—	218	424	106	1.3	932	1099
	7/29/71	7.75	—	170	26.5	84	9.1	—	220	367	134	1.3	906	1368
	10/7/71	8.13	—	200	26	91.5	8.8	—	292	410	137	1.1	1018	1465
	3/7/72	7.90	32.4	182	28.1	90	8.1	—	276	381.7	113	—	969	1374
	6/12/72	7.40	43.	200	27	96.5	7.6	—	238	372	105.2	—	898	1466
	8/21/72	7.45	26	197	27	110	8.5	—	276	452	104	—	1088	1552
	11/27/72	7.4	—	160	23	77	6.5	—	186	326	111	3.1	833	1258
H-A-30	6/15/71	7.97	—	210	32.8	195	15.6	—	284	634	142	—	1244	2337
	6/30/71	7.27	—	215	34.8	192	14.3	—	274	678	146	2.2	1342	1433
	7/29/71	7.64	—	228	40.3	212	13	—	322	701	185	1.3	1524	2124
	10/7/71	7.9	—	260	38	218	10.4	—	259	724	178	.13	1586	2207
	3/7/72	7.39	39.5	208	33.2	185	9.9	—	449	544.7	103	—	1331	1920
	6/12/72	7.37	34	207	28.5	197	8.9	—	320	511	105	—	1146	1876
	8/21/72	7.60	26	168	25	172	10	—	276	488	114	—	1183	1692
	11/27/72	7.4	—	229	34	171	8.2	—	306	607	140	3.6	1292	1942
H-A-40	6/15/71	7.95	—	182	29.3	64	11.6	—	226	368	90	2.7	964	1572
	6/30/71	6.97	—	153	29	62	10.1	—	188	368	88	1.3	884	946
	7/29/71	7.60	—	172	28.5	57	8.8	—	212	344	116	1.8	1008	1243
	10/7/71	7.85	—	205	30	62.5	7.8	—	259	399	136	1.11	1090	1417
	3/7/72	7.31	30.7	210	33.2	65	8	—	150	331.3	131	2	1025	1399
	6/12/72	7.29	32	217	36.8	65	8	—	200	483	142	—	1145	1617
	8/21/72	7.52	21	213	38	80	9.1	—	184	510	145	—	1150	1646
	11/27/72	7.33	—	264	43	82	8.2	—	212	588	145	4.5	1216	1766

* in micromhos at 25°C

Chemical Analysis (Continued)

WELL No.	DATE	pH	SiO_2	(Ca^{+2})	(Mg^{+2})	(Na^{+})	(K^{+})	(CO_3^{-2})	(HCO_3^{-})	(SO_4^{-2})	(Cl^{-})	(NO_2^{-})	(T.D.S.)	Specific Conductance
H-B-10	6/15/71	7.58	——	178	24.3	92	11.8	——	238	390	105	2.7	918	1708
	6/30/71	7.22	——	150	25	75	11	——	208	308	94	3.1	790	1227
	7/29/71	7.62	——	122	20	54	7.1	——	150	277	84	1.8	696	971
	10/7/71	8	——	120	16	58	7.3	——	218	211	79	1.1	644	943
	3/7/72	7.53	29.4	150	22.7	77.5	6.1	——	204	284.3	91.4	——	794	1180
	6/12/72	7.53	36	150	20.3	76	6.7	——	232	244	80	——	650	1142
	8/21/72	7.48	29	86	11	62	6.2	——	160	164	56	——	503	799
	11/27/72	7.52	——	144	22	62	6.4	——	216	259	96	5.6	641	1151
H-B-20	6/15/71	7.65	——	216	36.5	85	12.4	——	290	461	138	.4	1102	2024
	6/30/71	7.34	——	195	35.2	73	11.7	——	250	414	126	3.5	944	1622
	7/29/71	7.57	——	273	43.3	82	10.5	——	308	553	184	.4	1460	1746
	10/7/71	7.93	——	280	40.5	98.5	9.9	——	387	523	187	2.08	1408	1864
	3/7/72	7.35	34.4	222	30.8	120	8.4	——	314	431.3	140	——	1202	1700
	6/12/72	7.43	——	170	17.2	104	7.5	——	258	296	105	——	821	1385
	8/21/72	7.42	32	161	24	124	9	——	246	360	123	——	1042	1529
	11/27/72	7.36	——	228	33	170	9	——	336	502	193	3.8	1150	2049
H-B-30	6/15/71	7.97	——	280	40	90	13.2	——	292	525	144	1.8	1380	2106
	6/30/71	7.25	——	160	32	70	10.9	——	224	378	112	3.1	916	1365
	7/29/71	7.37	——	182	35.5	70	9.6	——	230	394	142	3.1	966	1297
	10/7/71	7.98	——	230	41	102	10.4	——	318	495	177	.13	1540	1756
	3/7/72	7.13	21.7	225	49.2	145	10.1	——	240	548.3	187	3.01	1413	1964
	6/12/72	7.23	32.5	265	44	146	9.9	——	344	591	183	——	1349	2085
	8/21/72	7.26	24	227	47	162	11	——	282	554	196	——	1453	2067
	11/27/72	7.24	——	202	43	195	9.3	——	244	576	195	2.2	1270	2011

Chemical Analysis (Continued)

WELL No.	DATE	pH	SiO_2	(Ca^{+2})	(Mg^{+2})	(Na^{+})	(K^{+})	(CO_3^{-2})	(HCO_3^{-})	(SO_4^{-2})	(Cl^{-})	(NO_3^{-})	(T.D.S.)	Specific Conductance
H-B-40	6/15/71	8	—	124	21.5	53	9.8	—	190	233	75	.9	644	1285
	6/30/71	7.27	—	105	19.5	54	8.1	—	146	275	46	2.2	614	913
	7/29/71	7.59	—	100	18.5	43	6.8	—	164	186	80	1.8	622	849
	10/7/71	7.90	—	170	25.5	51	7.9	—	259	297	109	.44	940	1220
	3/7/72	7.22	28.4	250	52	95	9.1	—	272	544.8	183	—	1470	1912
	6/12/72	7.33	29	325	54	145	10.9	—	392	689	209	—	1554	2356
	8/21/72	7.28	23	208	44	200	12	—	332	575	204	—	1519	2168
	11/27/72	7.25	—	255	44	225	10	—	218	662	209	3.8	1484	2402
H-C-10	6/15/71	8.04	—	184	27.3	245	15.6	—	376	560	145	3.5	1210	2426
	6/30/71	7.19	—	178	32	266	18	—	530	578	138	1.3	1216	1724
	7/29/71	7.40	—	211	35.8	253	13.9	—	380	682	199	3.1	1488	2130
	10/7/71	7.90	—	255	38	235	11.2	—	482	627	222	.75	1530	2292
	11/1/71	8.10	—	145	25.2	251	12	—	336	419	186	.62	1372	1963
	3/7/72	7.50	34.4	108	17.2	110	5.9	—	194	235.9	90.2	—	746	1109
	6/12/72	7.50	41	125	18.1	83	6.1	—	182	247	86	—	673	1077
	8/21/72	7.27	35	385	60	143	11	—	236	770	267	—	2081	2666
	11/27/72	7.51	—	131	23	86	6.1	—	208	288	89	4.3	732	1168
H-C-20	6/15/71	7.86	—	178	30.5	226	16.5	—	376	543	136	3.5	1240	2277
	6/30/71	7.27	—	180	31.8	227	15.2	—	350	556	138	1.3	1260	1734
	7/29/71	7.52	—	155	26.8	211	11.5	—	320	457	151	1.3	1160	1750
	10/7/71	7.92	—	160	23	192	10.3	—	361	418	142	.04	1150	1599
	11/1/71	8.10	—	120	22.9	198	9.8	—	308	387	130	.27	1092	1556
	3/7/72	7.38	29.6	85	14.3	123	6.4	—	192	226.8	79.6	—	698	1052
	6/12/72	7.45	24	135	14	140	7.5	—	232	306	108	—	820	1331
	8/21/72	7.61	32	199	32	128	9	—	282	441	149	—	1242	1768
	11/27/72	7.64	—	99	15.5	88	5.6	—	192	220	75	4.1	570	968

Chemical Analysis (Continued)

WELL No.	DATE	pH	SiO_2	(Ca^{+2})	(Mg^{+2})	(Na^{+})	(K^{+})	(CO_3^{-2})	(HCO_3^{-})	(SO_4^{-2})	(Cl^{-})	(NO_3^{-})	(T.D.S.)	Specific Conductance
H-C-30	6/15/71	7.95	—	260	44.5	197	18	—	380	689	180	3.5	1518	2583
	6/30/71	6.98	—	235	43.2	188	17	—	134	674	180	4.9	1394	1853
	7/29/71	7.40	—	229	46.7	211	15	—	368	650	209	3.5	1484	2168
	10/7/71	7.95	—	185	32.5	238	9.5	—	415	511	171	.13	1440	1958
	11/1/71	8.15	—	200	29.4	192	11.8	—	317	467	140	.31	1166	1733
	3/7/72	7.39	23	68	12.1	135	6.6	—	188	221.7	72	.42	655	998
	6/12/72	7.40	30	50	8.2	103	5.6	—	166	168	41.8	—	519	859
	8/21/72	7.62	25	86	15	116	7.6	—	184	250	79	—	713	1115
	11/27/72	7.44	—	63	12.5	86	5.4	—	160	198	51	4.7	518	828
H-C-40	6/15/71	8.05	—	233	38	100	14.7	—	274	531	146	2.7	1330	2025
	6/30/71	7.06	—	215	39.5	85	13.3	—	240	498	142	1.3	1238	1452
	7/29/71	7.48	—	255	47.8	100	12.8	—	318	555	198	3.5	1420	1967
	10/7/71	7.92	—	235	38	134	11	—	354	553	156	.22	1410	1768
	11/1/71	8.20	—	200	40.5	87	11.8	—	224	439	145	.31	1035	1514
	3/7/72	7.24	27.7	200	45.2	100	9.9	—	250	476	143	1.68	1231	1652
	6/12/72	7.44	35	105	17.5	86	7.3	—	178	221	64.4	—	490	962
	8/21/72	7.72	21	85	15	83	7.4	—	208	193	65	—	570	886
	11/27/72	7.76	—	107	22	121	7.3	—	208	303	91	4.9	732	1193
H-D-10	10/7/71	8.3	—	200	29	97	8	—	312	410	157	.22	944	1619
	3/7/72	6.78	36.8	430	20.9	165	10.5	—	468	850.8	316	1.73	2361	2910
	6/12/72	7.24	33	250	34.8	91	6.3	—	288	460	157	—	1091	1765
	8/21/72	7.27	33	131	17	46	5.6	—	116	237	97	—	657	1051
	11/27/72	6.99	—	651	95	218	11	—	424	1035	795	4.3	2922	3555

Chemical Analysis (Continued)

WELL No.	DATE	pH	SiO_2	(Ca^{+2})	(Mg^{+2})	(Na^{+})	(K^{+})	(CO_3^{-2})	(HCO_3^{-})	(SO_4^{-2})	(Cl^{-})	(NO_2^{-})	(T.D.S.)	Specific Conduc-tance
H-D-20	10/7/71	8.3	—	145	20	48	6.6	—	206	210	108	.13	670	1101
	3/7/72	6.66	18.8	145	44	50	5.9	—	146	258.6	116	.25	791	1096
	6/12/72	7.43	27.5	155	20	46	6.2	—	154	265	108	—	689	1080
	8/21/72	7.57	21	167	21	53	6.5	—	186	290	122	—	800	1229
	11/27/72	7.26	—	174	24	49	3.9	—	196	299	135	5.8	828	1231
H-D-30	10/7/71	7.4	—	98	11.5	36	5.1	—	139	170	78	.27	500	920
	3/7/72	6.80	15.8	108	15.4	37.5	5	—	128	190.4	91.6	.19	609	857
	6/12/72	7.56	22	135	17.2	43	5.9	—	150	214	99.2	—	631	994
	8/21/72	7.39	27	131	17	48	6.1	—	156	217	98	—	621	1035
	11/27/72	7.38	—	140	20	45	3.3	—	160	226	109	5.2	653	1006
H-D-40	10/7/71	7.93	—	97	10	40	5.5	—	136	141	69	.18	432	667
	3/7/72	6.85	23.1	92	13.5	37	5.5	—	124	159.2	74.4	.27	522	789
	6/12/72	7.67	26	110	15.5	43	5.7	—	136	198	80.2	—	575	872
	8/21/72	7.59	28	123	18	42	6.2	—	144	220	88	—	617	972
	11/27/72	7.55	—	136	19	49	3.1	—	158	234	109	4.5	662	1024
B-A-15	7/28/71	7.36	—	200	51.5	224	10	—	412	547	229	1.3	1622	2073
	10/7/71	7.93	—	155	49.5	250	8.3	—	501	461	222	.18	1288	2007
	3/7/72	7.10	32.4	175	57	250	8.3	—	472	414.1	211	—	1453	2138
	6/12/72	7.09	34	190	54	235	8	—	490	430	209	—	1728	2194
	8/21/72	7.36	37	170	58	236	9.1	—	494	429	203	—	1434	2153
	11/24/72	7.30	—	150	53	210	7.3	—	472	380	177	3.1	1110	1968
	4/19/73	7.22	28.6	175.1	59.5	238	8.7	—	474	461	192.1	4.16	1359	2292

Chemical Analysis (Continued)

WELL No.	DATE	pH	SiO_2	(Ca^{+2})	(Mg^{+2})	(Na^{+})	(K^{+})	(CO_3^{-2})	(HCO_3^{-})	(SO_4^{-2})	(Cl^{-})	(NO_2^{-})	(T.D.S.)	Specific Conductance
	7/28/71	7.56	—	137	41.9	250	10.4	—	448	454	201	1.3	1388	1977
B-A-20	10/7/71	8.10	—	160	44	260	7.6	—	528	444	208	.13	1248	2113
	3/7/72	7.17	29.7	165	48.2	260	9.9	—	456	402	211	—	1423	2124
	6/12/72	7.16	35	200	52	240	8.8	—	494	453	219	—	1193	2233
	8/21/72	7.23	50	185	50	231	9.2	—	504	430	201	—	1444	2190
	11/24/72	7.30	—	152	48	223	7.5	—	508	350	174	1.6	1037	1986
	4/19/73	7.25	51.5	158.4	49	220	8.9	—	492	376	168.3	3.54	1219	2066
	7/28/71	7.74	—	35	9.05	369	8	—	346	388	208	2.7	1360	1841
B-A-45	10/7/71	8.36	—	55	7	326	5.8	—	398	301	174	.13	1084	1722
	3/7/72	7.50	27.1	35	8.3	365	6.4	—	340	301.2	170	—	1118	1753
	6/12/72	7.54	32	35	9	355	5.7	—	356	295	179	—	1101	1784
	8/21/72	7.60	32	37	9	360	7.3	—	380	316	193	—	1197	1983
	11/24/72	7.60	—	41	11	388	5.5	—	402	328	203	2.9	1205	2001
	4/19/73	7.81	34.4	45.9	14.1	425	7.7	—	500	333	216	1.59	1324	2237
	7/28/71	7.56	—	114	27.8	276	10	—	430	390	200	2.2	1250	1966
B-B-10	10/7/71	7.92	—	125	22.5	326	6.7	—	518	391	200	.13	1142	1947
	3/7/72	7.15	36.5	162	35	255	7.8	—	478	375.1	179	—	1362	2010
	6/12/72	7.25	34	165	32	256	7.5	—	480	395	174	—	1728	2034
	8/21/72	7.23	43	145	28	251	8.2	—	462	372	175	—	1339	1964
	11/24/72	7.30	—	150	34	265	6.9	—	474	383	178	5.4	1078	2029
	4/19/73	7.32	43.6	149.1	37	297	8.5	—	544	412	173.5	2.57	1290	2293
	7/28/71	7.37	—	100	15.2	336	9.1	—	416	440	213	3.5	1522	2121
B-B-20	10/7/71	8.31	—	95	15	360	6.7	—	510	385	198	.4	1162	1988
	3/7/72	7.08	39.1	98	17.4	350	7.8	—	422	368.2	182	—	1313	1991
	6/12/72	7.17	38	120	19.9	280	7.4	—	454	376	171	—	1097	1994
	8/21/72	7.13	47	126	24	290	8.3	—	438	381	176	—	1339	2000
	11/24/72	7.30	—	130	23.4	286	6.8	—	440	385	177	3.6	1117	1983
	4/19/73	7.41	43.6	143.9	27	322	8.8	—	540	412	179.8	3.19	1287	2287

Chemical Analysis (Continued)

WELL No.	DATE	pH	SiO_2	(Ca^{+2})	(Mg^{+2})	(Na^{+})	(K^{+})	(CO_3^{-2})	(HCO_3^{-})	(SO_4^{-2})	(Cl^{-})	(NO_2^{-})	(T.D.S.)	Specific Conductance
B-B-30	7/28/71	7.18	—	62	12.7	381	9.4	—	420	371	240	1.3	1342	2209
	10/7/71	8.32	—	75	9.5	444	6	—	561	415	237	.13	1326	2124
	3/7/72	7.16	27.1	45	7.3	470	6.8	—	438	380.0	230	.21	1460	2279
	6/12/72	7.55	31	40	4.7	465	5.8	—	458	401	218	—	1383	2272
	8/21/72	7.30	44	38	5.7	448	6.1	—	450	384	202	—	1426	2189
	11/24/72	7.70	—	280	4.6	410	4.4	—	458	362	178	2.9	1342	2118
	4/19/73	7.69	42.7	24.63	4.5	456	5.5	—	476	358	160	2.12	1300	2083
B-B-40	7/28/71	7.27	—	38	7.25	430	8.7	—	400	460	236	1.8	1472	2264
	10/7/71	8.30	—	55	3.3	490	4.9	—	448	450	244	.18	1372	2196
	3/7/72	7.44	36.8	35	6	500	6.5	—	484	399	204	—	1445	2264
	6/12/72	7.52	30	40	6	490	6.3	—	474	421	225	—	1442	2356
	8/21/72	7.31	49	40	6.8	518	7.7	—	476	414	232	—	1535	2425
	11/24/72	7.60	—	37	7.2	460	5.8	—	484	414	230	4.5	1495	2382
	4/19/73	7.66	38.7	35.98	6.9	464	7.1	—	496	412	203	2.12	1455	2351
B-C-20	7/28/71	7.38	—	117	22.6	278	10.6	—	406	427	179	.9	1220	1914
	10/7/71	8.15	—	165	25	249	7.9	—	503	363	162	.22	1090	1831
	11/1/71	7.45	—	200	23.3	218	6.2	—	418	373	171	.40	1180	1789
	3/7/72	7.18	31.9	130	25.8	270	8.7	—	422	380.2	174	—	1282	1903
	6/12/72	7.15	36	145	25	276	8.5	—	440	381	172	—	1066	1989
	8/21/72	7.48	37	139	25	297	9.9	—	414	415	187	—	1478	2144
	11/24/72	7.46	—	121	24	300	7.6	—	440	385	180	6.1	1201	2011
	4/19/73	7.22	31.5	109.25	23.5	332	9.1	—	388	423	201.7	3.10	1314	2156
B-C-30	7/28/71	7.35	—	147	24.7	260	10.7	—	430	429	197	1.3	1384	1987
	10/7/71	8.30	—	140	20.8	276	8.3	—	505	365	183	.13	1096	1930
	11/1/71	7.70	—	150	19.6	262	7	—	446	370	170	.44	1214	1855
	3/7/72	7.39	39	108	21.5	275	9	—	450	364.9	177	—	1338	2050
	6/12/72	7.28	43	105	19	324	8.2	—	448	382	178	—	1219	2014
	8/21/72	7.43	40	114	22	312	9.8	—	450	388	186	—	1386	2102
	11/24/72	7.94	—	112	21.5	314	7.4	—	468	394	184	5.8	1170	2051
	4/19/73	7.19	44.4	110.37	21.5	342	9.1	—	464	406	191.7	2.04	1362	2203

Chemical Analysis (Continued)

WELL No.	DATE	pH	SiO_2	(Ca^{+2})	(Mg^{+2})	(Na^{+})	(K^{+})	(CO_3^{-2})	(HCO_3^{-})	(SO_4^{-2})	(Cl^{-})	(NO_2^{-})	(T.D.S.)	Specific Conductance
B-C-40	7/28/71	7.48	—	90	17.0	310	9.2	—	390	400	189	.4	1246	1889
	10/7/71	8.30	—	95	16	354	6.9	—	480	370	174	.13	1120	1880
	11/1/71	7.90	—	108	11.7	294	8.1	—	426	372	172	.35	1210	1790
	3/7/72	7.42	31.2	100	18.6	300	7.6	—	440	433.4	161	—	1266	1921
	6/12/72	7.38	38	120	18.2	295	7.2	—	456	371	157	—	1079	1964
	8/21/72	7.67	31	101	19	317	8.9	—	456	373	166	—	1338	2028
	11/24/72	7.69	—	101	19.4	320	6.3	—	464	368	171	6.3	1109	2012
	4/19/73	7.47	48.1	82.70	18.8	326	7.7	—	436	369	165.3	1.42	1210	1992
B-C-50	7/28/71	7.66	—	270	11.6	376	10.2	—	430	962	173	1.3	2476	2145
	10/7/71	8.3	—	78	10	374	6.2	—	537	404	178	.22	1220	1999
	11/1/71	7.40	—	74	10	380	8.3	—	452	401	160	.53	1360	1965
	3/7/72	7.48	35.7	65	10.6	410	7.7	—	468	364.6	172	—	1377	2094
	6/12/72	7.46	36	50	9.7	425	7.1	—	474	393	175	—	1290	2120
	8/21/72	7.72	6	56	8.9	404	8.6	—	468	385	172	—	1382	2124
	11/24/72	7.57	—	56	9.7	380	6.1	—	458	387	179	2.3	1261	2113
	4/19/73	7.49	54.6	56.05	10	396	7.4	—	464	377	163.3	1.59	1260	2110
B-D-15	10/7/71	8.30	—	125	19	440	8.0	—	550	561	247	.22	1506	2625
	3/7/72	7.26	26.2	158	26.8	460	9.9	—	564	610.7	256	—	1837	2692
	6/12/72	7.23	29	165	25	422	8.9	—	570	505	216	—	1355	2519
	8/12/72	7.65	27	182	29	438	11	—	648	583	240	—	1901	2825
	11/24/72	7.57	—	123	20.5	308	7	—	508	400	190	3.8	1157	2143
	4/19/73	7.37	25.3	139.98	24.5	450	9.5	—	628	514	223.5	2.57	1632	2769

Chemical Analysis (Continued)

WELL No.	DATE	pH	SiO_2	(Ca^{+2})	(Mg^{+2})	(Na^{+})	(K^{+})	(CO_3^{-2})	(HCO_3^{-})	(SO_4^{-2})	(Cl^{-})	(NO_2^{-})	(T.D.S.)	Specific Conduc-tance
B-D-20	10/7/71	8.30	—	115	15	330	7.9	—	542	390	192	.13	1272	2087
	3/7/72	7.37	35.2	110	16.8	360	8.6	—	516	380.4	194	1.51	1430	2157
	6/12/72	7.39	38	150	21.6	400	8.5	—	578	414	203	—	1258	2333
	8/21/72	7.58	47	115	18	336	9	—	514	361	180	—	1386	2142
	11/24/72	7.46	—	103	16	320	6.6	—	480	356	178	5.4	1223	2031
	4/19/73	7.39	35.7	103.94	16.5	342	8.2	—	428	380	199.5	2.43	1342	2131
B-D-30	7/28/71	7.75	—	137	18.3	400	11.7	—	518	503	250	1.8	1906	2294
	10/7/71	8.30	—	110	15	525	7.7	—	598	440	411	.35	1910	2351
	3/7/72	7.45	27.6	110	17.4	410	8.9	—	472	347.5	264	.34	1569	2403
	6/12/72	7.44	30.5	120	16.5	430	8.1	—	459	450	268	—	1381	2407
	8/21/72	7.64	31	107	16	430	9.6	—	454	430	274	—	1565	2468
	11/24/72	7.55	—	105	15	390	6.9	—	452	434	263	4.3	1465	2397
	4/19/73	7.59	49.5	86.48	12.8	420	7.8	—	440	422.6	239.6	1.59	1467	2387
B-D-40	10/7/71	8.10	—	149	12.5	400	10.5	—	481	617	225	.27	1764	3050
	3/7/72	7.43	23.4	128	14.4	542	9.4	—	436	537.6	364	.44	1889	2912
	6/12/72	7.48	28	110	15.5	550	5.8	—	448	531	354	—	1671	2891
	8/21/72	7.62	36	103	14	518	10	—	452	531	350	—	1848	2882
	11/24/72	7.70	—	108	14.4	498	7.2	—	444	545	353	2.7	1673	2901
	4/19/73	7.72	34	103.12	15	530	9.4	—	460	537.8	348.9	3.10	1807	3000