A FIELD STUDY OF EPHEMERAL STREAM INFILTRATION AND RECHARGE

by

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ABSTRACT

A field study was performed to investigate infiltration and ground-water recharge due to seepage in ephemeral channels. Two streams, the Rio Puerco and the Rio Salado north of Socorro, New Mexico, were instrumented with monitor wells, neutron access tubes, stream stage recorders and tensiometers. A primary objective of the study was to characterize the nature of stream-aquifer interaction.

The Rio Puerco and Rio Salado exhibit very different channel morphologies, flow patterns and sediment characteristics. The Rio Puerco has a well-defined channel with a small width to depth ratio. Flow in the Rio Puerco is in response to both winter and summer precipitation, as well as spring runoff. The stream carries a large suspended sediment load which results in the development of a clogging layer on the channel bottom. The Rio Salado has a large width-depth ratio and a braided channel filled mostly with permeable sand and gravel. The Rio Salado flows mostly in the summer in response to thunderstorms.

Results of this study indicate that full hydraulic connection to the underlying aquifer is dependent on type of sediment lining the channel, duration of flow and height of stage, local channel characteristics and depth to groundwater. For the Rio Puerco, unsaturated conditions developed in response to the formation of a clogging layer on the stream bed. This clogging layer is intermittently deposited and scoured away, but not in direct relationship to the height of stage or duration of flow. For the Rio Salado, full hydraulic connection during streamflow is highly dependent on depth to groundwater.

Results of recharge analyses on both streams indicate that the Rio Salado is much more effective in recharging the underlying aquifer, primarily due to its wide braided nature and coarse channel sediments. Recharge for the Rio Puerco was computed to be only about 5 percent of that for the Rio Salado, even though the Rio Puerco flowed more than twice as often.

These results are relevant to conceptual models of stream aquifer interaction, calculation of channel losses and flow and solute transport studies in ephemeral stream systems.

Keywords: Infiltration, recharge, ephemeral streams, clogging layer, stream-aquifer interaction.

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1.0 INTRODUCTION

Recharge is the process by which water is added to the saturated zone of an aquifer. Recharge can occur in many ways and is dependent on the particular physical setting in which it occurs. The process of recharge also has a great impact on the environment in which it takes place. There can be recharge on an areal basis by infiltration of precipitation. There also may be highly localized recharge, which can occur along mountain fronts when highly permeable sediments or lithologic units are present.

This study focuses on the process of infiltration and the quantification of recharge from ephemeral streams. Recharge from ephemeral streams is a short duration, highly localized process that is one of the most significant in terms of the amount of water it delivers to an aquifer. In arid regions, such as New Mexico, the replenishment of ground water is of great economic importance. For wilderness areas, recharge to a shallow unconfined aquifer often dictates the character of plant and animal life that may be found.

Ephemeral stream infiltration and ground-water recharge are two of the most difficult parameters to quantify. This is especially true over large areas in a semi-arid climate where the meteorological, hydrologic, and geological conditions are highly variable. The hydrodynamic processes which lead to recharge from ephemeral streams have not been studied in detail, and they are not well understood. There are many factors which affect recharge from ephemeral streams such as stream bed permeability, channel geometry, streamflow duration, discharge rate, suspended sediment load, stratification of underlying sediments, and depth to the water table.

In many instances infiltration beneath a channel may occur under unsaturated flow conditions, rather than saturated conditions as is commonly assumed. When the pores beneath the channel are only partially filled with water, the hydraulic conductivity of the sediments beneath the channel is substantially diminished, and the water moves more slowly to the aquifer. Infiltration from the ephemeral channel may spread laterally to a great extent at relatively shallow depths under unsaturated conditions, and recharge may be reduced as a result of evapotranspiration. When unsaturated conditions prevail, then the stream and aquifer are said to be only partially hydraulically connected. When saturated conditions prevail between the stream and the aquifer the two are fully hydraulically connected. Whether a stream and an aquifer are fully connected dictates the gross behavior of the system and the boundary conditions that are applied.

The objectives of the field study upon which this report is based were formulated to achieve specific goals in the gathering of data to document the occurrence of unsaturated flow beneath ephemeral streams and to assess its significance. Specifically, these goals were:

1. To place instrumentation near ephemeral streams to study the role of unsaturated flow on seepage and recharge
2. To compare the seepage characteristics of ephemeral streams having different channel geometries, sediment loads, channel bottom permeabilities, and geologic settings
3. To quantify recharge from ephemeral streams using field measurements of the hydraulic responses in the unsaturated and saturated zones beneath the channel
4. To determine whether chemical changes occur in water which seeps from the channel toward the water table.

In order to achieve the goals and objectives, the nature of surface-water and ground-water interaction was studied on the Rio Puerco near Bernardo, New Mexico and on the Rio Salado near San Acacia, New Mexico. Both streams are ephemeral tributaries of the Rio Grande, and represent the end members of ephemeral streams in terms of channel geometry, sediment load, flow regimes, source areas, and interaction with the underlying aquifer. Field instrumentation was placed to gather data on stream stage, water table elevations, soil moisture, head distribution in the vadose zone and chemical evolution of infiltrating water.

2.0 RELATED RESEARCH

Stream-aquifer interactions rely on the process of infiltration. The process of recharge is synonymous with the process of infiltration when all infiltrating water reaches the water table. The word recharge is often used to refer to a specific quantity of infiltration that has reached the water table rather than a reference to the process itself. In this paper the emphasis is on the study of the process of infiltration in ephemeral stream systems, as well as the quantification of recharge.

The first investigator to be widely recognized in the literature regarding the analysis of the rise of a water table in response to a uniform distribution of downward percolating water was Polubarinova-Kochina (1951). Linearized solutions of Dupuit equations were used to describe the spreading of recharge water over both a two-dimensional strip of finite width and a circular region of finite radius.

One of the first major works dedicated almost exclusively to the subject of infiltration and recharge was a treatise by R. E. Glover (1960). This work was an extension of the analytical work done previously by Baumann (1952) and Bittinger and Trelease (1960). In the work by Glover many different geometric conditions such as line source, circular, square, and rectangle recharge areas, as well as the ground-water mound that would develop were dealt with. In addition, such cases as perching layers, layered soils, and shallow water table conditions were analyzed. Transient, as well as steady state cases were included. At that time, numerical techniques were in their infancy, and the solid state computer had just arrived on the market. Electric analogs were the only simulation tool other than an actual laboratory experiment.

The next analytical step came through a series of papers by Madi S. Hantush (1963, 1967) and M. A. Marino Marino (1965, 1967). In these papers, solutions were developed for infinitely long recharge areas and rectangular and circular areas. The improvements over the earlier Glover solutions consisted of the applicability of the solutions where the rise of the water table relative to the initial depth of saturation was as high as 50%, as opposed to less than 2% for the earlier solutions. Hantush presented tabulations of the functions to afford a means of calculating the water table rise through simple calculations.

Hunt (1971) compared the solutions based upon the Dupuit equation with an alternative method of linearization subject to a linearized boundary condition on the free surface in the same way that similar problems are solved in small-amplitude wave mechanics. He concluded that there was not much difference between his solutions and the Dupuit solutions for relatively small aquifer depths.

Hall and Moench (1972) derived equations for stationary linear stream-aquifer systems based on the previous work of Monech and Kisiel (1970) using the convolution relation as described by Eagleson et. al. (1966). The convolution relation is based on the Wiener-Hoft theory of optimum linear systems and relates system output to a given system input through the system impulse response function. In the case of stream-aquifer interaction, the system input is infiltration arriving at the water table surface, and the output is the water level in a single well.

Bouwer (1969) developed solutions for seepage from open channels derived from Darcy's equation and electric analog models. His solutions require knowledge of stream stage, hydraulic conductivity of the channel bottom sediments, depth to static ground water, and channel geometry.

Burkham (1970) developed an empirical relationship between channel infiltration in a reach and surface discharge that compared favorably with results using the convolution approach.

Abdulrazzk and Morel-Seytoux (1983) developed an approximate analytical solution to predict the time dependence of recharge rates for wide streams and shallow water table conditions; this solution compared favorably with laboratory experiments. Freyberg (1983) also utilized laboratory methods and a Green-Ampt model to show the importance of the variability in the wetted perimeter of the ephemeral stream channel on infiltration rate.

Duffy et al. (1979) clearly established the relationship between discharge in ephemeral streams and water level fluctuations in nearby wells. Mechanisms which control channel losses were studied by Renard (1970) and include flow duration, channel length and width, antecedent moisture content, peak discharge, flow sequences, character of alluvium, and suspended clay. Sediment loading of streams has been shown by Matlock (1966a) to decrease infiltration rates through the channel bottom. Seasonal effects play a role in the amount of sediment carried by a stream, and therefore, create a seasonal effect on recharge.

Field instrumentation, such as neutron access tubes and tensiometers, have been used to detect infiltration from channels and canals (Wilson and DeCook, 1968, Brockway and Worstell, 1967) and to study the role of the vadose zone in the infiltration and recharge processes.

Recharge from ephemeral streamflow can also be analyzed with the isotopic composition of ground water. For example, tritium has been found useful in the Rio Hondo drainage in New Mexico to identify a relatively rapid recharge component from stream bed infiltration (Gross et al., 1976). Gallaher (1979) used stable isotopes of oxygen and deuterium in wells along the Santa Cruz River in Tucson, Arizona, to show seasonal differences in the sources of recharge.

Recently, stochastic analysis of ground-water level and stream flow time series have been used by Gelhar et al. (1979) in the Hondo Valley of New Mexico and by Naff and Gutjahr (1983) in Minnesota.

3.0 METHODS OF ANALYSIS

3.1 General Information.

In this field study there were two central objectives. The first was to investigate the role that unsaturated conditions play in the process of stream infiltration. The second was to quantify the amount of recharge occurring in the two systems under study. Stream stage, soil moisture content, and water levels in wells were used to determine the manner in which unsaturated conditions affect stream-aquifer interaction.

Recharge was calculated using these four methods: 1) the convolution method applied to water level fluctuations in wells, 2) channel hydraulic characteristics, 3) channel losses between gaging stations (Rio Puerco only), 4) the volume of water stored in a ground-water mound (Rio Salado only). The volume of the ground-water mound was determined numerically using data from a grid of wells placed alongside the stream. By applying a factor for the storage coefficient, the amount of water that had reached the water table was determined. This method was utilized to check on the other methods, since very good resolution was obtained in the determination of the ground-water mound shape.

Chemical data were obtained on surface, vadose, and saturated zone water in order to study the chemical evolution of the infiltrated water. Chemical data were collected only for the Rio Puerco in this study. No recharge calculations were made based on these chemical data, but a mixing scenario was formulated that gives a qualitative view of the chemical interactions that take place during infiltration.

3.2 Analytical Analysis.

The ephemeral stream system is idealized as a line source of infinite length but of finite width, where infiltration occurs at a continuous fixed rate, at least for some discrete time period. The system is linear, and therefore, the solutions for the system have the property of superposition or additivity. The governing equation is:

$$\alpha \frac{\partial^2 h}{\partial x^2} = \frac{\partial h}{\partial t} \qquad (1)$$

where

h = the height of the ground-water mound above the original water table (L)

x = the distance measured horizontally from the center of the recharge strip (L)

t = time (T)

$\alpha = \frac{KD}{V}$ (L/T)

and where

K = the aquifer saturated hydraulic conductivity (L/T)

D = the original saturated depth of the aquifer (L)

V = the drainable or fillable voids expressed as a ratio to the entire volume. (L^3/L^3)

The boundary and initial conditions on equation (1) are:

$$\frac{\partial h}{\partial x\ (0,t)} = \frac{q_1}{-2KD} \quad \text{for} \quad t > 0$$

$$h\ (x,0) = 0$$

$$h\ (\infty,t) = 0$$

A solution to (1) which meets the boundary and initial conditions is:

$$h = \frac{q_1 x}{2\pi KD} \sqrt{\pi} \int \frac{e^{-u^2}}{u^2}\, du \qquad (2)$$

where q_1 is specified in terms such as cubic centimeters per second per centimeter reach of channel. The above solution is that of Glover (1960) and relies on some simplifying assumptions about the geometry of the system. In addition, Dupuit type flow is assumed.

Convolution is a matching of the input and output of a system through a response function. For the case of stream-aquifer interaction, the response function is Darcy's Law. Most analytical approaches are designed to predict water level fluctuations resulting from constant recharge rates. Convolution is concerned with solving the inverse problem of obtaining the time-wise variation of recharge from water level measurements made in a single well.

The conceptual model of the system used in the convolution approach is the same as for the Glover solution, that is, an unconfined aquifer below an ephemeral stream. The aquifer receives recharge over a region of finite width, and it is assumed that the aquifer is infinite in horizontal extent, homogeneous, isotropic, and underlain by an impermeable base. In accordance with the Dupuit-Forchheimer theory, the streamlines are assumed to be horizontal, and the velocities associated with these streamlines are proportional to the slope of the free water surface but independent of depth. The system is assumed to be linear and time invariant (aquifer coefficients are not a function of water level fluctuations and do not change in time.)

A solution to this boundary value problem for the region external to the zone of recharge is

$$h = H \frac{1}{\sqrt{\pi}} \int_{u_1}^{u_2} e^{-u^2} du \qquad (3)$$

where

H = height of the ground-water mound at x = 0

$$u_1 = \frac{x-w/2}{\sqrt{4\alpha t}}$$

$$u_2 = \frac{x+w/2}{\sqrt{4\alpha t}}$$

w = width over which recharge occurs

In a slightly different form, equation (3) is the same as equation (1). Equation (3) is derived for a unit instantaneous pulse at the source. Since the system has been assumed to be linear, the convolution relation may be applied. To express the water level fluctuations in an aquifer as a function of an arbitrary recharge rate, an equation must be formulated relating the two. This is accomplished by coupling the input and output of the system through a response function, i.e., equation (3).

In continuous time the equation has the form:

$$G(x,t) = \int_0^t F(\tau)h(x,t-\tau)d\tau \qquad (4)$$

Here h(x,t) is the response function, $F(\tau)$ is the recharge rate operating over the width of the channel, and G(x,t) is the water level at position x and time t. The integral represents a summation of the continuous variations in recharge that occur over time. If F(t) were constant, then equation (4) would reduce to the case of continuous input. In discrete time, the recharge rate is thus assumed to be constant over some small time interval (Δt) and the instantaneous impulse is calculated from equation (3).

The continuous form, having been discretized, takes the form:

$$G(i) = \sum_{j=1}^{i} F(i-j+1)h(j)\Delta j \qquad (5)$$

Through the use of synthetic division, the equation can be algebraically rearranged to solve for unique values of F(i):

$$F(i) = \left\{G(i) - \sum_{j=2}^{i} h(j)F(i-j+1)\right\} \frac{1}{h(1)} \qquad (6)$$

Total recharge can be computed by summation of the individual rates and then multiplying by the width of the source (w) and the storage coefficient (s):

$$\text{Recharge} = \left\{ \sum_{j=1}^{i} F(j) \right\}\left\{w\right\}\left\{s\right\} \qquad (7)$$

For simplified channel geometries, Bouwer (1969) developed a solution for steady state channel seepage rate, I_s, which is analogous to Darcy's equation. For a trapezoidal channel with a clogging layer and a deep water table, Bouwer indicates that:

$$I_s = \frac{K_a}{W_s L_a} \left\{ (H_w - h_{cr}) W_b + (H_w - 2h_{cr}) \frac{H_w}{\sin\alpha} \right\} \quad (8)$$

where

K_a = saturated hydraulic conductivity of clogging layer(LT^{-1})

W_s = water surface width (L)

L_a = thickness of clogging layer (L)

H_w = depth of water in channel (L)

W_b = width of bottom of channel (L)

α = stream bank angle from horizontal (degrees)

h_{cr} = pressure head of soil beneath clogging layer (L)

For the related case when the clogging layer is absent and the water table is shallow, the stream and aquifer are likely to be fully hydraulically connected. That is, the water table intersects the stream channel. Bouwer (1969) developed a graphical method to compute steady state channel seepage rates based on electric analog models for a Dupuit-Forchheimer flow system. Required parameters include depth to ground water (D_w), distance from the channel bottom to the base of the aquifer (D_i), as well as W_b and H_w. Bouwer refers to these two analytical approaches as relevant to conditions C and B, respectively, as shown in Figure 1.

The transmission losses between gaging stations were previously computed by Heath (1983) for the Rio Puerco. These data are used in the present study for comparison to other methods of determining channel losses and recharge. No transmission loss data are available for the Rio Salado that are reliable enough to use for comparison to other methods of determining stream infiltration.

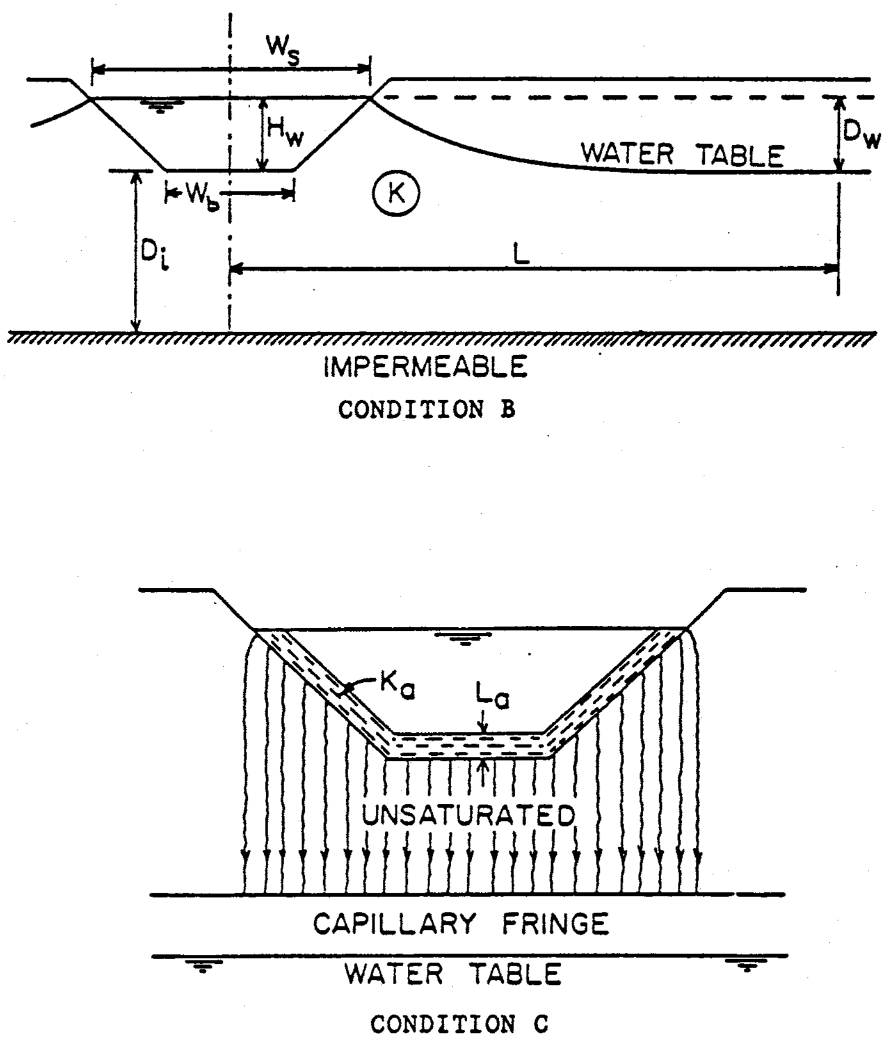

Figure 1. Flow system for computing seepage from channels with and without a clogging layer (from Bouwer 1969).

3.3 Numerical Methods.

For the Rio Salado, since transmission loss data were not available, the volume of ground water stored in the mound was computed numerically for comparison to other methods of computing recharge. The reference elevation of the water table surface for calculating the mound volume was taken to be that of the elevation of the water table just prior to the first flow of the season. The water table elevation fluctuates only about 1 meter seasonally. Just prior to the spring runoff, the water table surface declines very slowly, so no recession of this surface was accounted for.

To define the surface of the ground-water mound 15 monitor wells were installed within an area approximately 500 meters on each side parallel to the stream. A 40 x 50 grid was superimposed on the observation well field for computational purposes. Water level elevations at grid points were interpolated using the computer program PLOT 88 (PLOTWORKS, La Jolla, CA). A simple computer routine was written by this author to then calculate the volume of each individual vertical column (matrix element) as defined by the nodes of the grid. The volumes were then summed to give the total volume of the mound. When the edge of the ground-water mound had propagated beyond the edge of the computational grid, equation (2) was utilized to compute the volume of the mound beyond the grid. Ground-water mound volumes determined by the numerical method just described were used to check on the other methods because the resolution in determining the exact shape of the mound was very good.

3.4 Chemical Analysis

Water samples were obtained from surface waters, the vadose zone, and shallow and deep piezometers at varying distances from the stream. Surface water samples were collected in plastic bottles by submerging the bottle in the stream flow by hand. Samples from the vadose zone were collected using suction lysimeters. The samples collected were chemically analyzed for major ion concentrations and pH by the New Mexico Bureau of Mines and Mineral Resources laboratory, located on the campus of New Mexico Tech.

To evaluate the chemical evolution of the surface and infiltrated water, the computer program BALANCE (USGS, 1982) was utilized. BALANCE is a fortran computer program designed to define and quantify chemical reactions between ground water and minerals. Using (1) the chemical compositions of water samples from two points along a flow path and (2) a set of mineral phases hypothesized to be the reactive constituents in the system, the program calculates the mass transfer (amounts of the phases entering or leaving the aqueous phase) necessary to account for the observed changes in composition between the two water samples. Additional constraints can be included in the problem formulation to account for mixing of two end-member waters, redox reactions, and, in a simplified form, isotopic composition.

3.5 Geologic sampling

Geologic sampling was done in several areas at the Rio Puerco site. A hole was drilled to thirty meters using 8 inch (22 cm) hollow stem auger. Samples from this hole were obtained by split spoon. This deep sample hole was located approximately 30 m northwest of well P4 and about 120 m south of the channel. Samples were taken at all depths, and valley fill alluvium was encountered throughout the total depth of 30 m (appendix 1). Heath (1983) indicated that the Rio Puerco alluvium may be at least 40 m thick. Refer to Appendix 1 for additional details of subsurface geology from samples obtained during construction of monitor wells, neutron probe access tubes, and excavations. At the stream bank, a trench was dug fully into the bank and down to below the level of the thalweg. Split spoon shelby tubes were taken at all depths close to this trench. In the bottom of the channel, sampling was done down to the water table, at a depth of approximately 0.7 meters. The geology was also recorded during the installation of well P1, well P3, and neutron access tube PN3.

Geologic sampling data near the stream channel of the Rio Puerco consisted of logs of observation well P1, neutron tube PN2, split spoon shelby tubes at the edge of the stream bank, and a trench excavated fully into the bank and thalweg. All geological loging was done along a line approximately perpendicular to the channel to allow as high a degree as possible of correlation between sample points.

For the Rio Salado sites, geologic sampling was done with split spoon in the channel bed at the upper site. The geology of the sediments at the lower site was recorded from cuttings during installation of the observation wells.

4.0 SITE SELECTION AND DESCRIPTION

4.1 Rio Puerco.

The Rio Puerco was chosen as one of the ephemeral stream to study. In the next few sections the characteristics of the basin and the site are described.

4.1.1 Basin Characteristics.

The Rio Puerco drains the Albuquerque Basin and other subbasins as shown in Figure 2. The area drained is approximately 18,800 km^2 and comprises portions of the Colorado Plateau, Southern Rocky Mountains, and the Basin and Range physiographic provinces. The Albuquerque Basin is a structural basin that trends in a north-south direction for 125 to 150 km and varies in width from 30 to 50 km. Down-faulting on the western side of the basin appears to be less than 340 m in contrast to the east side where it could be as much as 6800-7000 m. The western boundary of the basin is formed by the Lucero and Ladron uplifts. The southern end of the basin is defined by an alluvial and structural divide at the entrance to the Socorro constriction near San Acacia, New Mexico. The Rio Grande drains the eastern and central portions of the basin while the Rio Puerco drains the western portion of the basin. Between the two rivers is a long and narrow tableland known as the Llano de Albuquerque.

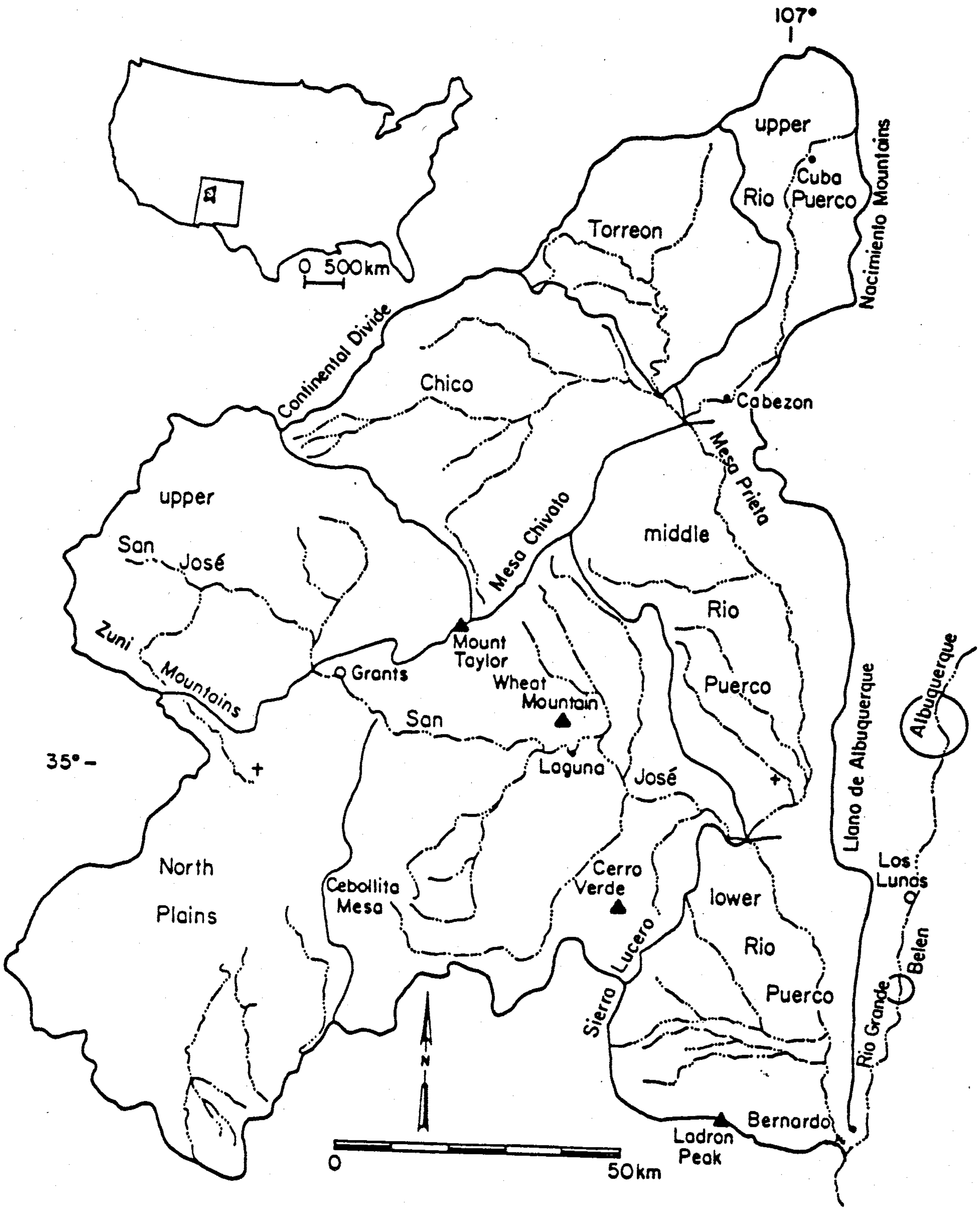

Figure 2. Rio Puerco Drainage Basin (after Love, 1983). (▲ — major mountain peaks; ○ — major metropolitan areas.)

Major tributaries entering the Rio Puerco are the Comanche Arroyo, the Rio San Jose, and Alamito Arroyo. Areas drained by these arroyos include the area west of Laguna including the northern flank of the Zuni Mountains west of the Continental Divide and the southern flank of Mount Taylor. The mainstream of the Rio Puerco flows southward along most of its reach and merges with the Rio Grande near Bernardo, New Mexico.

The valley floor sediments of the Rio Puerco are part of the Santa Fe Group, and two major alluvial facies are recognized. One is the meandering alluvial facies of the Rio Puerco floodplain and the other belongs to a number of braided alluvial systems entering the Rio Puerco floodplain at right angles. The main channel of the Rio Puerco and its tributaries cut through Mesozoic sandstone, siltstones and shales, including the Mancos and Chinle shales. Numerous other rock types are found in the basin as indicated in figure 3. According to Love (1986) basalts in the Mount Taylor-Mesa Chivato and North Plains areas contribute little surface runoff. Along the course of the channel, which parallels the west side of the Albuquerque Basin and Rio Grande Valley, the Rio Puerco is incised into unconsolidated to weakly indurated basin-fill sediments of the Santa Fe Group. The upper Santa Fe Group includes the Sierra Ladrones formation, principally a sand and gravel deposit. The Lower Santa Fe Group consists of less permeable

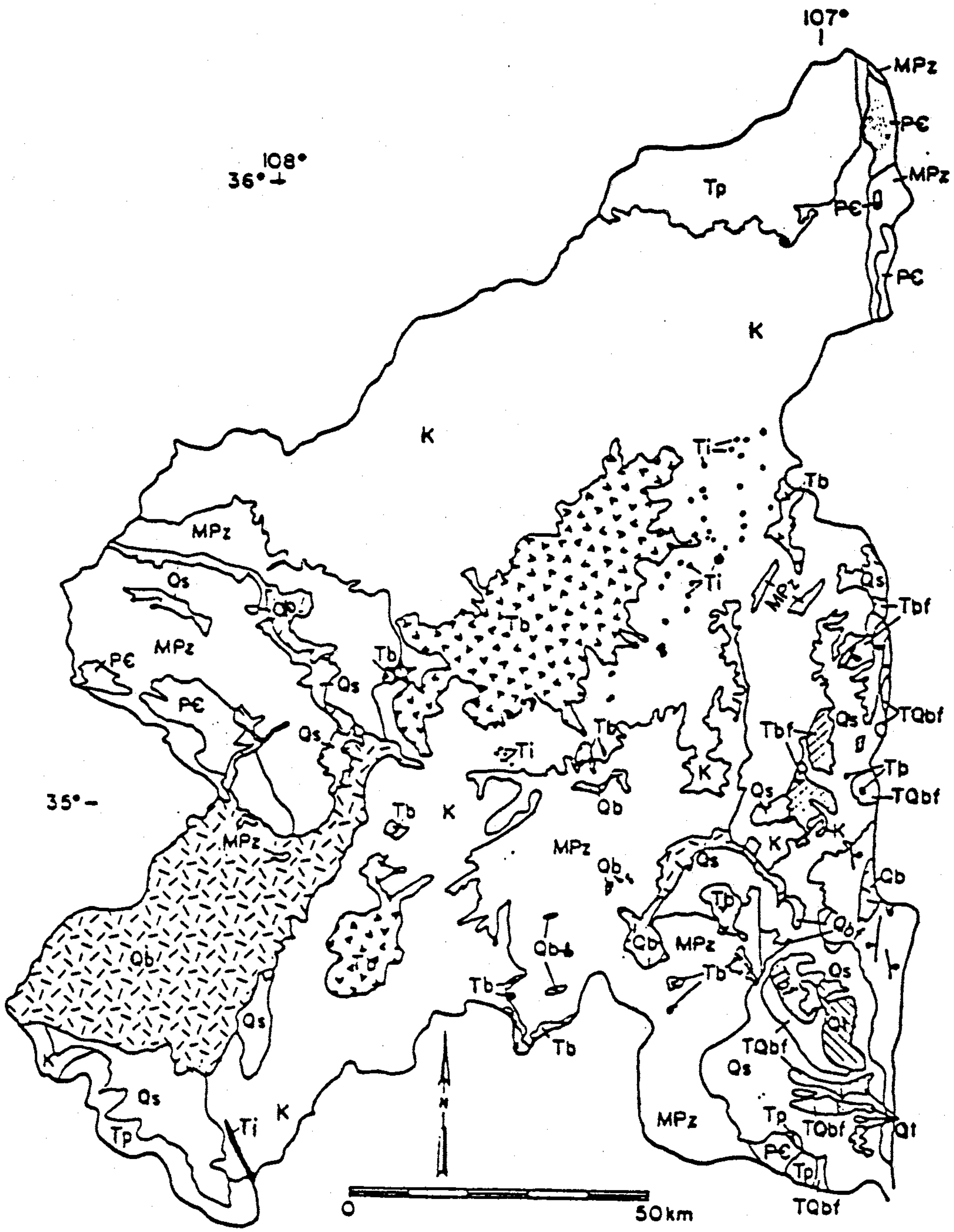

Figure 3. Generalized geologic map of Rio Puerco Drainage Basin (after Love, 1983). Symbols for rocks from oldest to youngest: Pε (gray stipple) = Precambrian metamorphic and igneous rocks; MPz = Paleozoic and lower Mesozoic sediments (mostly redbeds and limestone); K = Cretaceous sandstones and shales; Tp = Tertiary Paleogene sandstones and shales; Tbf = Tertiary (Miocene) basin.

fanglomerate and playa facies of the Popatosa Formation. Pleistocene and Holocene valley fill alluvial deposits occur along the course of the Rio Puerco. Love (1986) indicates that the Rio Puerco and its tributaries were aggrading until about 1 million years ago. The Llano de Albuquerque is a remnant of this period of maximum aggradation. Subsequently, there have been periods of erosion as well as aggradation. The present erosional episode began about 200 years ago. Refer to Love (1986) for additional details on the Quaternary geology and geomorphology of the Rio Puerco.

The Rio Puerco is dominated by a suspended particle load which produces gray to green fine-grained sediments. Tributaries to the Rio Puerco are predominantly bedload channels that contain coarse-grained, light brown to reddish sediments. Surficial sediments of the valley flat consist of pale brown, sticky (when wet), hard, clay loam. Vegetation on the floodplain is sparse and consists of scattered four-wing salt bush and grasses. The stratigraphy of the valley flat deposits is made up of alternating sequences of overbank clays and fine and medium, to coarse-grained channel sands. Scours are generally overlain by an upward-fining sequence that begins with a pebble sand. The stratigraphy indicates complex cycles of cut and fill. Overbank clays range in color from reddish brown to dark brown, and may include drab gray, green, or yellowish brown. Valley fill derived from the north is composed predominately of fine-grained material from Mesozoic sandstones and shales. The average gradient of the valley floor is 1.7 m/km.

The Rio Puerco is a typical example of the meandering stream which usually develops where gradients and discharge are relatively low compared to those of braided channel systems, such as the Rio Salado. In meandering systems, sandy deposition is normally restricted to the main channel, and deposition of fines occurs on levees and in flood basins. Outside the main channel, deposition takes place by the addition of material during flood stage in which sheets of fine sand, silt, and clay are deposited on the overbank areas. These deposits are sometimes laminated and ripple-marked.

4.1.2 Site Characteristics - General.

The instrumented site (figure 4) is located a few hundred meters west of I-25, near the USGS suspension cable used for discharge measurements. The old Highway 85 bridge is located only a few hundred meters upstream from the site. There is a USGS stream gage at the bridge that has been in continuous operation since 1939. The confluence of the Rio Puerco with the Rio Grande is located approximately 4 km downstream from the site.

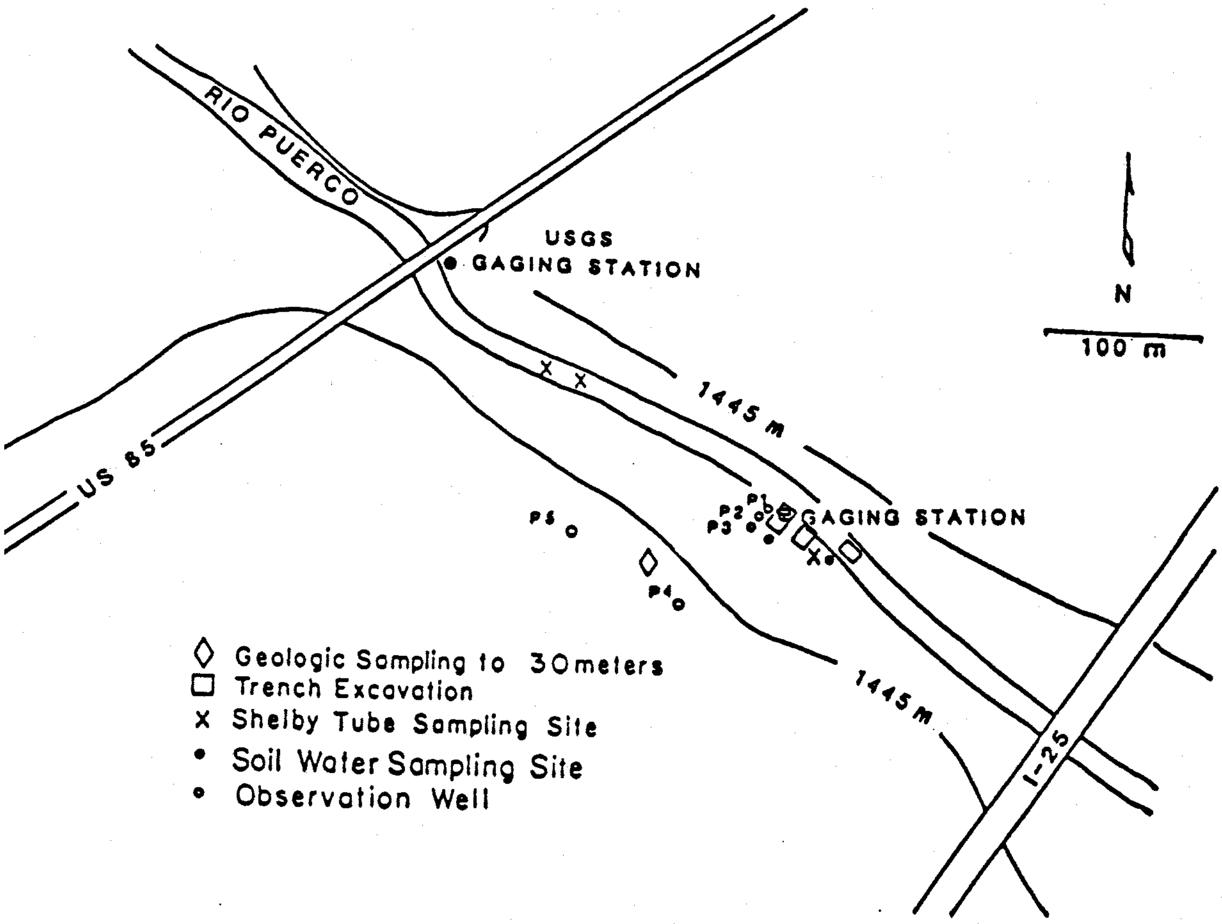

Figure 4. Site of field investigation on the Rio Puerco.

The channel and surrounding area at the instrumented site are typical of a meandering stream. The channel itself is approximately 10 m wide and 2 m deep. The depth to water under the channel for most of the year is approximately 1 m. The Rio Puerco near the site has a well developed inner flood plain adjacent to its channel. The inner floodplain is about 100 m wide and lies a few meters below the valley floor, a much broader and older surface which was cut into the valley fill of the Albuquerque Basin. Away from the inner floodplain the area is relatively flat, with the primary vegetative cover being four-wing saltbush and various grasses. This site was chosen because of its convenient access, the presence of the stream gaging station, and the generally typical channel characteristics.

The fine-textured sediments beneath the active channel of the Rio Puerco and the meandering character of the stream bed contrast sharply with the Rio Salado, a braided stream channel underlain by coarse-textured sediments. The difference between these two streams afford an excellent opportunity to analyze a wide range of recharge characteristics.

4.1.3 Site Characteristics - Geology

At the site on the Rio Puerco, channel bottom sediments observed during periods of no flow are comprised of silt and clay. These sediments usually desiccate into polygonal plates approximately 10 to 20 cm wide. Sediments beneath and adjacent to the channel consist mostly of medium sand with layers of silty clay. A geologic cross-section suggests that some of the clay layers in the valley fill are not laterally continuous (figure 5) over extensive areas.

In the geologic boring farthest from the channel (122m), the main water table was encountered at 6.71 meters. A zone of apparent saturation was encountered at 5 meters depth above a layer of tan sandy clay (see Appendix 1), indicating that perching conditions are present, and may occur in the sediments adjacent to the stream channel as well. The thickest unit in the sequence sampled occurred between 19.81 to 30.48 meters and consisted of a poorly sorted medium to coarse sand.

As may be noted from the cross section (figure 5), the deposition at this site generally alternated between layers of fine to medium sand and clays of varying color. The nature and orientation of the sediments suggest that the channel has migrated from right to left in figure 5.

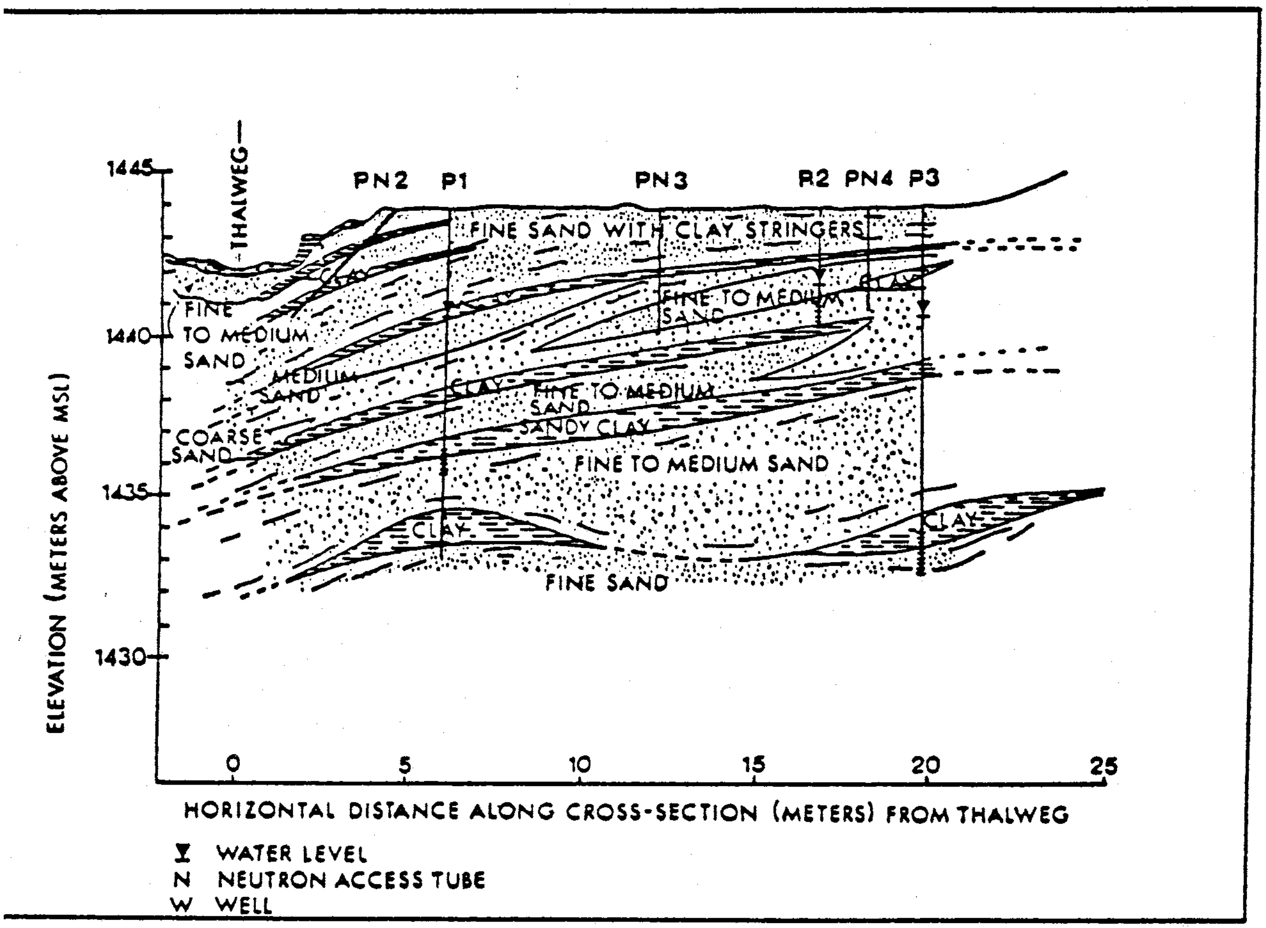

Figure 5. Cross-section of unconsolidated alluvial sediments at the Rio Puerco site.

4.1.4 Site Characteristics - Stream Discharge

A USGS gaging station is located on the bridge of former U.S. Highway 85, 0.3 km upstream from Interstate Highway 25, and 5 km upstream of the mouth. The period of record for this gage is from November 1939 to the current year. The gage itself is a water stage recorder of the mechanical type. The records from this gage are listed as poor, probably due to channel migration and gage isolation. Although the channel was extremely stable at the site chosen for the instrumentation to study infiltration, the site of the USGS gage at the bridge was subject to deposition around the inlet to the stilling well. On many occasions this author observed that the USGS gage stilling well was completely isolated, even though there was substantial flow in the channel. As a consequence, a new stage recorder was installed at the site.

Available records of the USGS gaging station at this site indicate that the average recorded discharge for the 45 years of record between 1939 to 1984 was about 1.28 m^3/s (45.2 f^3/s). The extremes of record are 532.88 m^3/s (18,800 f^3/s) on Sept. 23, 1941 and no flow for extended periods.
The Rio Puerco is an ephemeral stream that has a drainage area of approximately 18,816 km^2; however, at least 2700 km^2 do not contribute directly to surface runoff. Table 1 shows the wide variation in frequency and volume of runoff during

Table 1. Streamflow on the Rio Puerco at the Highway 85 bridge, 1941 through 1959. (From Flow Characteristics of NM Streams. New Mexico State Engineer Special Report, 1963)

Location.--Lat 34°24'30", long 106°51'10", in SE¼ sec. 8, T.2 N., R.1 E., at bridge on U. S. Highway 85, 1.2 miles southwest of Bernardo, 3 miles upstream from mouth, and 18 miles south of Belen.
Drainage area.--5,860 sq mi, approximately.
Average discharge.--19 years, 58.2 cfs.
Remarks.--Diversions for irrigation of about 11,500 acres above station, of which about 3,700 acres is irrigated from ground water sources.

CLASS	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	
YEAR														NUMBER OF DAYS IN CLASS																						CFS-DAYS
1941	117							12		4	8	5	14	5	14	6	19	11	41	14	11	10	14	13	20	8	4	9	1	3		1	1			62244.0
1942	236							12		3	3	4	4	5	8	5	7	3	23	20	14	4	2	3	1	2	1	1		2	2					23730.0
1943	263							7		10	3	3	7	6	11	3	11	5	9	4	2	2	4	6		4	2		1	2						15612.0
1944	279							7		15	6	5	5	3	7	3	5	3	4	4	3	2	1	4	1	2	4	1		1		1				15836.0
1945	231							27		14	2	8	6	4	10	9	9	4	11	5	11	3	1	3	1	2	1	3								10948.0
1946	260							12		6	3	5	2	3	8	6	13	4	9	4	9	2	4	3	3	4	2	2		1						15511.0
1947	281							11		1	4	1	4	5	5	6	3	1	6	3	2	7	3	1	3	5	4	3	1	3	1	1				32910.0
1948	244							11		5	8	4	11	9	7	13	15	12	11	3	2	4	4	1	1	1										5293.0
1949	238							11		4	6	5	4	9	13	8	14	3	13	3	9	4	4	5	4	5	2		1							14246.0
1950	313							4		3	1	3		7	4	5	3	2	7	3	3	1	1	1	1	1		1	1							6049.0
1951	319	2	1		1		1			3	1	1		1	2	2	1	2	7	3	4	2	3		2		3	3	1							11622.7
1952	270		4		2	3	1	12		4	5	5	5	1	9	2	6	3	6	7	7	4	3	1	5	1										6727.9
1953	306	1	1	1						2	2	1		4	2	4	7	2	7	3	3	3	3	1	1	1	3	5	1		1					17218.6
1954	259	5	2		4	2	1	5		5	3	2	3	6	6	1	6	7	6	3	3	6	4	3	3	4	3	6	1	3	2	1				39501.3
1955	279	1	1	1	1		3	1		2	3		1	1	2	3	4	3	2	7	7	1	6	4	4	11	6	3	3	2	1	2				42993.3
1956	335	2		1	3			2		1			3	2		2	1	2			3	1	4			1	1	1	1							6194.7
1957	275							4		2	3	1	3	2	5	5	5	8	4	5	8	4	4	3	3	3	3	4	4	3	3		1			44205.0
1958	218							7		5	7	5	10	9	7	4	11	7	15	11	21	15	2	1	1	1	3	2	1	1	1					22255.0
1959	310							1		4		2	2	3	5	5	3	4	2	5	3	2	3	2	2	1	3	3								10827.0

CLASS	CFS	TOTAL	ACCUM	PERCT	CLASS	CFS	TOTAL	ACCUM	PERCT	CLASS	CFS	TOTAL	ACCUM	PERCT	CLASS	CFS	TOTAL	ACCUM	PERCT
	.0	5033	6939	100.0	09	2.0	93	1715	24.7	18	40	183	879	12.7	27	1000	47	104	1.5
1	.1	11	1906	27.5	10	3.0	68	1622	23.4	19	70	107	696	10.0	28	1500	17	57	.8
2	.2	9	1895	27.3	11	4.0	60	1554	22.4	20	100	125	589	8.5	29	2000	21	40	.6
3	.3	3	1886	27.2	12	5.0	84	1494	21.5	21	150	77	464	6.7	30	3000	11	19	.3
4	.4	11	1883	27.1	13	7.0	85	1410	20.3	22	200	70	387	5.6	31	4000	6	8	.1
5	.5	5	1872	27.0	14	10.0	125	1325	19.1	23	300	55	317	4.6	32	5000	2	2	.0
6	.7	6	1867	26.9	15	15.0	92	1200	17.3	24	400	56	262	3.8	33				.0
7	1.0	146	1861	26.8	16	20.0	143	1108	16.0	25	500	57	206	3.0	34				.0
8	1.5		1715	24.7	17	30.0	86	965	13.9	26	700	45	149	2.1	35				

the period 1941-1959. According to the USGS records during 1941-1959 the Rio Puerco is dry approximately 264 days per year. Flow depends on conditions in the basin that may vary widely in space and time. Flow may occur at any time of the year although the months of November and December generally tend to be periods of little or no flow. Other periods of little or no flow are scattered throughout the summer months.

Suspended sediment load of the Rio Puerco is quite high. The total tonnage of sediment for the Rio Puerco for the water year 1985 was 3,398,587.3 tons (USGS discharge records, water year 1985). For the Rio Grande at Bernardo, New Mexico, just upstream from the confluence of the Rio Grande and Rio Puerco, the total load for that year was 680-,411.0 tons. The Rio Puerco, an ephemeral stream, carried 5 times the load for the same year as the Rio Grande. These data have implications for the interaction of the stream and the channel in which the flow is taking place. There may be wide ranges of the flow regime in which significant scour may occur as well as flow regimes where rapid deposition may occur. This in turn affects the interaction between the stream and the aquifer.

4.1.5 Site Characteristics - Hydraulic

The hydraulic characteristics of the channel bottom, channel banks, and underlying aquifer were determined by laboratory and field methods. Shelby tube samples were taken from the channel bottom and on the banks. The samples in these tubes were analyzed for saturated hydraulic conductivity by the constant head permeameter method. Aquifer hydraulic conductivity was obtained by pump test.

Thin-walled Shelby tube samples were taken at the Rio Puerco site on February 23, 1986. The shelby tubes used were 61 cm long length with an inside diameter of 7.3 cm. The sample tubes were driven in vertically in the stream bed using a B-30 Mobil drill rig. Samples were taken at two locations in the stream bed (Figure 4), half way between the old highway 85 bridge and the research site. Six shelby tubes were taken, to a depth of 102 cm in the first local and to 204 cm at the second. Samples were obtained to 40 cm below the water table. In addition, 3 tubes were driven into the banks by hand at three different levels.

To determine the saturated hydraulic conductivity of the samples in the Shelby tubes, manometers were inserted in each tube and, by means of special adapters for the ends of each tube, a constant head was applied. Data on flow rate, head levels, and temperature of the water were taken for a period of 5 days. Distilled water was used in a recirculating system that included two sediment filters. For the two shelby tubes taken at the surface, a comparison was made between using distilled water and distilled water with a flocculating agent, $CaCl_2$ added. There was no apparent difference in conductivity observed.

The results shown in Table 2 indicate that the hydraulic conductivity of sediments within 41 cm of the channel bottom ranges from about 6.8×10^{-7} to 1.2×10^{-5} cm/s. In contrast, the underlying sediments are much more permeable, having hydraulic conductivities ranging from about 2.1×10^{-5} to 1.2×10^{-2} cm/s. Similar results were obtained from thin-walled samples driven horizontally into the bank of the stream bed (Table 3). From this sampling and testing it appears that channel bottom sediments are significantly lower in permeability than sediments sampled further from the channel. This contrast in permeability may be attributed to suspended material which settles out during recession of flow and material which is filtered by the sand and accumulated during infiltration of runoff.

In a regional sense, ground water generally occurs under water table conditions in the Santa Fe Group and alluvium along the Rio Puerco. This may not be entirely the case on a local scale where the sands such as those shown in Figure 5 may be locally confined by clay layers. Because the clay layers may not be continuous over extensive areas, there probably is a reasonably good hydraulic connection between the sandy water-bearing horizons at a large scale.

TABLE 2

HYDRAULIC CONDUCTIVITY OF SEDIMENTS
BENEATH THE RIO PUERCO CHANNEL

Saturated Hydraulic Conductivity (cm/sec)

Depth Below Channel (cm)	Location #1	Location #2	Arithmetic Mean (cm/sec)
14	3.97E-05	4.75E-05	4.36E-05
27	3.81E-05	2.42E-05	3.12E-05
41	6.79E-07	1.35E-05	7.09E-06
75	9.55E-04	4.96E-04	7.26E-04
88	6.06E-03	1.17E-02	8.88E-03
102	8.82E-03	3.40E-03	6.11E-03
123	---	9.33E.04	9.33E-04
134	---	1.15E-03	1.15E-03
153	---	2.79E-03	2.79E-03
163	---	water table	---
177	---	2.08E-05	2.08E-05
182	water table	---	---
190	---	2.81E-03	2.81E-03
204	---	4.03E-03	4.03E-03

TABLE 3

HYDRAULIC CONDUCTIVITY OF SEDIMENTS
ALONG THE BANK OF THE RIO PUERCO

Horizontal Distance into Bank (cm)	Vertical Distance above Thalweg (cm)	Saturated Hydraulic Conductivity (cm/sec)
14	20	6.12E-04
14	30	2.03E-04
14	35	1.69E-03
27	20	7.14E-03
27	30	1.88E-04
27	35	1.52E-03
41	20	5.46E-03
41	30	2.38E-03
41	35	9.82E-03

Measurements taken in the monitor wells installed at the site indicate that the depth to ground water at the site is only about 1 meter below the channel bottom. There is a vertical hydraulic head difference of about 1 m over an 8 m depth interval between the shallow monitor and deep monitor wells (P2 and P5, respectively, see figure 4). This suggests a downward flow component that is probably driven by recharge from the stream channel. Since all monitor wells installed at the site were completed and screened at different depths, it is difficult to assess the regional direction of ground-water flow. However, the gradient is most likely southeast, following the topography.

An aquifer pumping test was conducted by pumping monitor well P1 (Figure 4, 5). Included in the site instrumentation were three monitor wells close to the channel (within 20 meters). These monitor wells were screened at different depths in fine to medium sand layers between clay layers (Figure 5). The annulus of each well was sealed with either commercial bentonite or clay cuttings to prevent communication with ground water from any other depth. Well P1 was pumped at a constant rate of 1.0×10^{-4} m^3/s (1.65 gal/min) for 6.2 hours, while water levels were measured in all monitor wells using a steel tape. The data from the pumped well were analyzed by the Hantush and Jacob (1955) method for leaky aquifers. The results indicate that the hydraulic conductivity of the sand adjacent to the screened interval in monitor well P1 was approximately 10^{-3}cm/s. The drawdown in P1 was about 430 cm. In comparison, 3.6 cm of drawdown was measured in monitor well P3, and virtually none was measured in well P2. Inference can be made that the shallow water-bearing sand represented by well P2 is separated from the deeper sand by a low-permeable clay layer.

The conceptualization of the system with respect to well P1 for purposes of analysis of the data by the Hantush and Jacob method was that of an aquifer overlain by a confining bed of low but finite permeability, which in turn is overlain by an unconfined aquifer. When discharge takes place from a well located in the confined aquifer, the change in the relative head between the confined and unconfined aquifer results in a change in the leakage rate through the confining bed separating the two aquifers. The two aquifers and confining bed are assumed to be infinite in areal extent for the purpose of the analysis, though this was <u>not</u> the case in the system under consideration. The clay layers in the actual profile were only assumed to behave like confining beds between a confined and unconfined aquifer over <u>short</u> time periods.

4.2 Rio Salado Sites

Two hydrologic research sites were established near the Rio Salado. The lower site was located at the former USGS gaging station, approximately 0.5 km west of the Interstate-25 bridge and 5 km upstream of the confluence of the Rio Salado with the Rio Grande. The upper site is about 4.8 km upstream from the lower site, at the location of several previous hydrologic field studies funded through the N.M. Water Resources Research Institute, U.S. Geological Survey, and U.S. Bureau of Reclamation.

4.2.1 Basin Characteristics

The Rio Salado originates along the Continental divide in Catron County, New Mexico, and discharges into the Rio Grande some 120 km east near San Acacia, New Mexico (Figure 6). The drainage basin encompasses approximately 3533 km^2. Elevations in the basin range from about 2500 m above sea level to approximately 1430 m. Alamocito Creek is a major tributary which drains the north side of the Datil Mountains. La Jencia Creek is a major tributary which drains the area in the vicinity of Magdalena, New Mexico. The Rio Salado cuts through the Lemitar and Ladron Mountains where it enters the Rio Grande Valley. From this point eastward, the Rio Salado lies within the Sevilleta National Wildlife Refuge. The confluence of the Rio Salado and Rio Grande is located just north of San Acacia, NM.

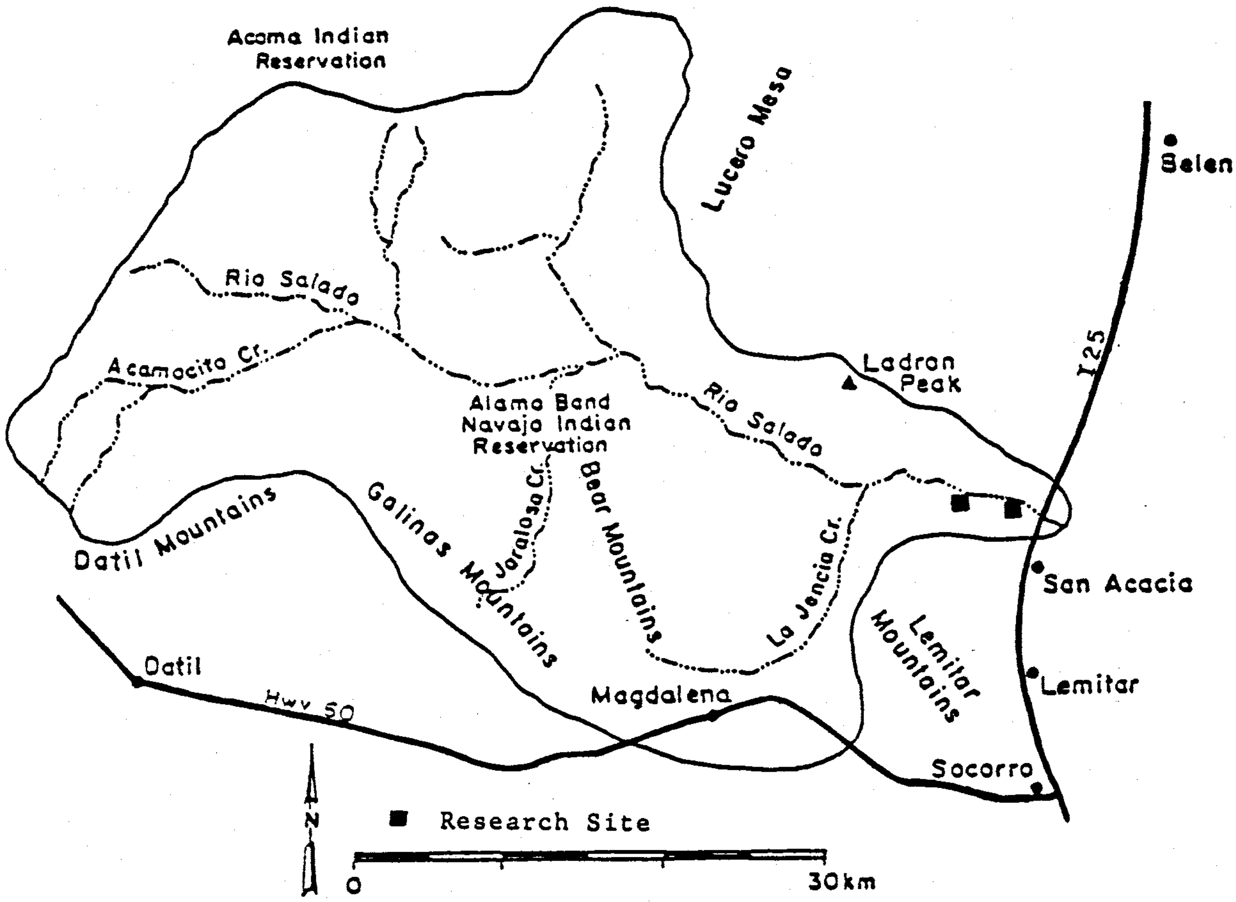

Figure 6. Rio Salado drainage basin.

Most of the drainage basin of the Rio Salado is underlain by Triassic to Tertiary clastic and volcanoclastic rocks as well as Mesozoic shale and sandstone. To the east, the Rio Salado drainage basin is underlain by Tertiary basin fill alluvial deposits of the Santa Fe Group. Where it cuts through the Sierra Ladrones roughly 15 km west of the upper research site, the Rio Salado is underlain by well indurated rocks which include Precambrian granite and Paleozoic limestone and shale. To the east of this mountain area, the Rio Salado flows across the well indurated conglomerates and mudstones of the Popotosa formation of the Santa Fe Group and then the Quaternary alluvium. Locally thick sequences of Quaternary alluvial fill cover the older consolidated units across wide sub-basins and along the course of the present drainage net. However, considerable exposures of bedrock occur along the flanks of mesas and hillslopes, and along the erosional scarps of the drainage network. Exposures of Precambrian rocks within the drainage basin are limited to the upper elevations of the Ladron and Magdalena Mountains. The combined effects of land surface slope, orographic precipitation, and the low permeability of these rocks may serve to make the Ladron Mountains an important source area for runoff within the lower reach of the Rio Salado where the instrumented sites were located. Detailed description of the basin geology may be found in Havlena (1988).

4.2.2 Lower Site Characteristics - General.

The lower site on the Rio Salado is located at the former bridge site of old Highway 85, 0.5 km west of the Interstate Highway 25 bridge near San Acacia and 5 km upstream of the confluence of the Rio Salado with the Rio Grande (Figure 7). The main channel at this site is approximately 200 meters wide and 1.5 meters deep, the confining banks being vertical in most places. The inner channel is intensely braided. There are few tributary arroyos, gullies and soil pipes along this reach, indicating little or no local runoff. Precipitation outside the channel is presumed either to be lost to the atmosphere as evapotranspiration or become recharge to the underlying aquifer.

The inner channels form a complex network which is frequently modified and adjusted in response to localized areas of deposition and scour. As a result, the flowing inner channels during a low to moderate flow event are commonly isolated some distance laterally from the main channel. During many low-flow events, discharge only occurs in a few well incised localized channels which meander through the sandy stream bottom sediments in the main channel. However, these channels tend to remain fixed near or in the vicinity of the instrumented site due to the presence of old bridge pilings. The channel bottom is

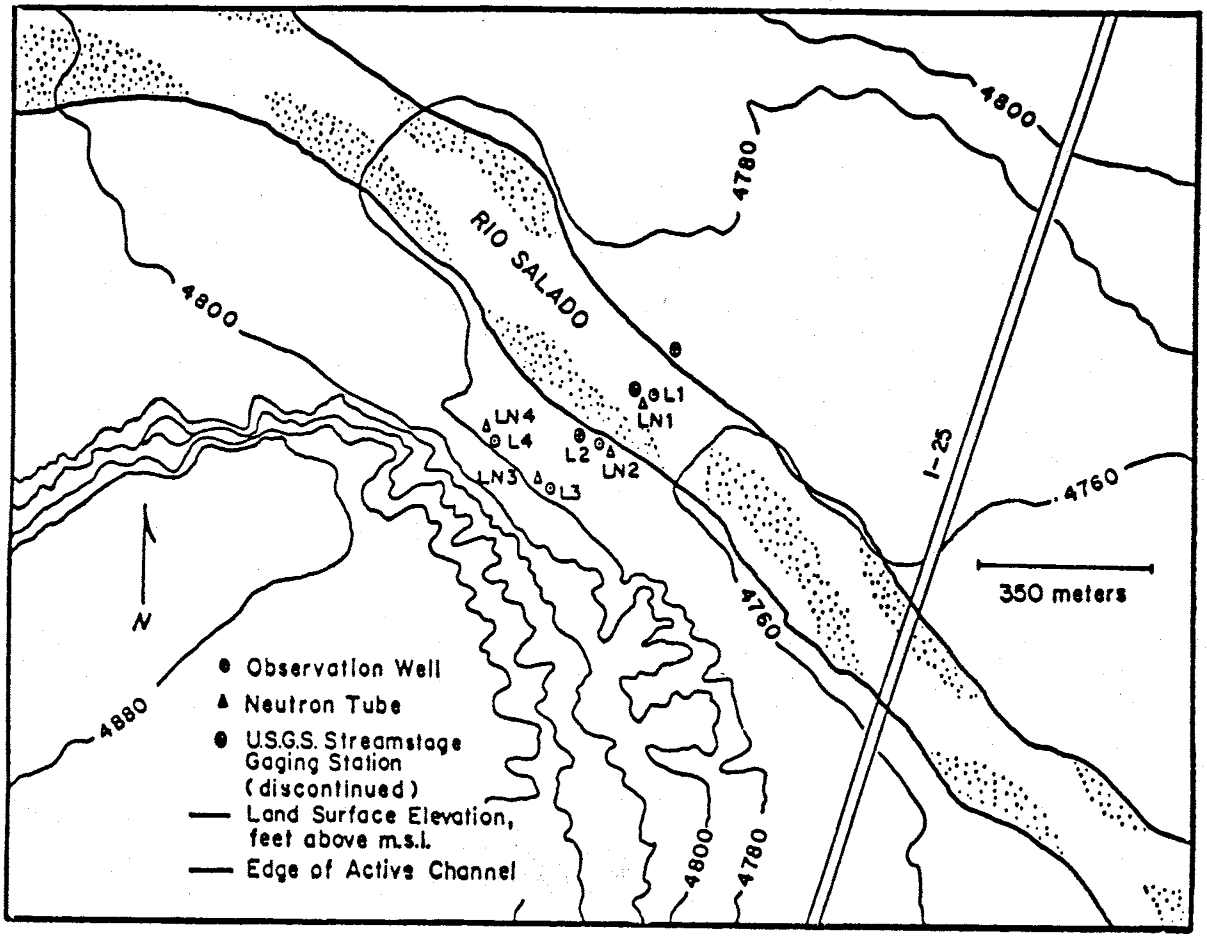

Figure 7. Monitoring locations at the Lower Rio Salado Site.

predominately well sorted, fine to medium quartz sand, with local concentrations of coarser material in longitudinal bars and as lag gravels. The channel gradient of approximately 6 m/km (31 ft/mi) is much greater than on the Rio Puerco. The presence of large cobbles in the bed material indicates a relatively high energy environment during peak flows.

The Rio Salado is a low sinuosity braided stream. Channels of braided streams such as the Rio Salado tend to be variable in their depth and consist of a network of interlaced low sinuosity channels. Material carried in the flows tends to choke previous channels and are deposited as bars. Alluvium of braided streams is most typically composed of sands and gravels. The banks of braided streams tend to be easily eroded and there are few clay plugs. Bedload is most commonly coarse material, whereas in meandering streams the load is carried in suspension.

4.2.3 Lower Site Characteristics - Geology.

Characteristics of the geologic materials underlying the stream channel was conducted during installation of the observation wells at the site. A plan view of the site and locations of these wells is shown in Figure 7. Below the middle of the channel, the profile consisted almost exclusively of medium to coarse grained material separated by thin interbedded layers of fine sands. The exception to this was between 2.3 to 3.0 m in depth where a zone of large cobbles was encountered. This zone could not be penetrated on the first two attempts with an 8" (20.3 cm) auger rig. Depth to ground water beneath the channel is approximately 12 meters. It is postulated that the base of the aquifer plunges in this area since approximately 2 km upstream from the USGS stream gages the water table intercepts the stream bed for most of the year.

At monitor well L3, approximately 120 meters from the channel, the sediments encountered in the upper portion of the profile were similar to those encountered in the middle of the channel. Below 12 m, most of the profile consisted of the same medium to coarse sand, but with more fines, indicating this area may have been one of overbank deposits. At 14.6 meters a layer of grey sandy clay was encountered that was 1 m thick. The nature of these sediments indicate that to a depth of at least 20 m the deposits at this site are recent alluvium.

A north-northeast trending normal fault, the Loma Blanca, has been mapped (Machette, 1978) in outcrops located between the upper and lower site and projects across the Rio Salado. Hydrogeologic data to be presented later will suggest that the fault displacement may cause the Santa Fe Group to be at a greater depth on the east side of the fault, causing in the unconsolidated permeable alluvium to be thicker at the lower site than at the upper site.

4.2.4 Lower Site Characteristics - Stream Discharge

At the lower Rio Salado site, discharge measurements at the gaging station near I-25 were recorded from about October 1947 to September 1984 by the US Geological Survey. The station consists of three separate stilling wells and stage recorders to measure flow in the major localized channels (Figure 7). The discharge records of the stations at this site show that the average recorded discharge for the 37 years of record is 0.4 m^3/s (14.3 ft^3/s). The extremes of record are 1026 m^3/s (36,200 ft^3/s) on July 31, 1965 and no flow for extended periods of time. The Rio Salado is dry on the average of 320 days per year. The variability in runoff on the Rio Salado for the period 1948 through 1959 is illustrated in Table 4. Because of the anastomizing nature of the Rio Salado during low-flow periods, the stream flow records are rated as poor. The gages have not been operated since 1984 due to lack of operating funds.

Flow in the Rio Salado is in response to precipitation in the basin. Maximum elevations in the basin are below levels at which heavy snowfall occurs and thus runoff is almost exclusively in response to rainfall. This results in runoff occurring almost exclusively in the summer months during the thunderstorm season.

Table 4. Streamflow in the Rio Salado at the Highway 85 bridge, 1948 through 1959. (From Flow Characteristics of NM Streams, New Mexico State Engineer Special Report, 1963)

Location.--Lat 34°16'55", long 106°52'50", in E½ sec.30, T.1 N., R.1 E., near right bank 1.0 mile downstream from bridge on U. S. Highway 85, 1.4 miles upstream from mouth, 2.0 miles northeast of San Acacia, and 15 miles north of Socorro.
Drainage area.--1,380 sq mi, approximately.
Average discharge.--12 years, 13.0 cfs.
Remarks.--Diversions for irrigation of about 100 acres above station.

CLASS	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	
YEAR															NUMBER OF DAYS IN CLASS																					CFS-DAYS
1948	319	2	1	1	3	5	1	7	3	4	3	1	1	2	4	2	1	2	2				1		1											832.4
1949	305							11		7	5	2	4	1	4	1	3	5		1	3	4	3	4		2										3561.0
1950	322							7		4	1	2	1	2	5	1	3	2	2		4	4	4			1										2264.0
1951	330							9		3	3	2	1		2		1	1		1	1		1	1	3	1	1	4								6096.0
1952	324					1		2		2	1	3	4	3	4		1	1	1	4	4	4	2	4		1										2967.5
1953	316		1	1		3	2	3		2	2	1	1	3	2	5	2		3	5	5		3	1	1	2			1							4044.6
1954	307		1		1		1	6		3	2		3	4	9	1	1	2	3		3	4	2	3		3		2	3	1						10112.4
1955	309		1		1	1	1	2		4	2			2	3	2	3	6		3	2	7		3	3	1	6	1		2						11223.8
1956	340	1			1					3	2	1	3		1	1	1	3	1			3	1	1	2		1									2144.5
1957	307							1		2	1		2	3	5	2	4	3	1	3	4	6	6	6	1	2	3	2	1							9777.0
1958	344							3		2			4		4	2	1	1		2	2															422.0
1959	321							1					10		10	1	2	4		2	3	4		3	2	1		1								3573.0

CLASS	CFS	TOTAL	ACCUM	PERCT	CLASS	CFS	TOTAL	ACCUM	PERCT	CLASS	CFS	TOTAL	ACCUM	PERCT	CLASS	CFS	TOTAL	ACCUM	PERCT
	.0	3844	4383	100.0	09	2.0	36	454	10.4	18	40	13	206	4.7	27	700	10	18	.4
1	.1	3	539	12.3	10	3.0	22	418	9.5	19	50	21	193	4.4	28	1000	5	8	.2
2	.2	4	536	12.2	11	4.0	12	396	9.0	20	70	31	172	3.9	29	1500	3	3	.1
3	.3	2	532	12.1	12	5.0	34	384	8.8	21	100	36	141	3.2	30				.0
4	.4	6	530	12.1	13	7.0	20	350	8.0	22	150	23	105	2.4	31				.0
5	.5	10	524	12.0	14	10.0	53	330	7.5	23	200	26	82	1.9	32				.0
6	.7	5	514	11.7	15	15.0	18	277	6.3	24	300	13	56	1.3	33				.0
7	1.0	52	509	11.6	16	20.0	23	259	5.9	25	400	14	43	1.0	34				.0
8	1.5	3	457	10.4	17	30.0	30	236	5.4	26	500	11	29	.7	35				

In order to obtain reliable stage data for this investigation, a site to construct a new stage recorder was selected upstream at the upper site. The site for the new stage recorder was selected based on surveying data, which indicated any flow along the selected reach of the channel would pass close to the south bank where the stage recorder was placed.

Suspended sediment load sampling is done infrequently on the Rio Salado, and thus the records are poor. Available data, though sparse, indicate that the suspended load is one-half to one-third that of the Rio Puerco.

4.2.5 Upper Site Characteristics - General.

The upper site (Figure 8) is located approximately 5.3 kilometers west of Interstate I-25. This upper site was previously instrumented with a complete weather station, 15 soil moisture monitoring stations and 7 monitor wells installed during research work conducted on areal recharge (Stephens, et al., 1984).

The surface features of the north and south bank at the upper site are quite different. The topography near the south bank of the stream is low and gently rolling. This low plain gives way to outcrops of sandstone upon which aeolian sand has accumulated. The north bank is characterized by a large dune field which stretches for

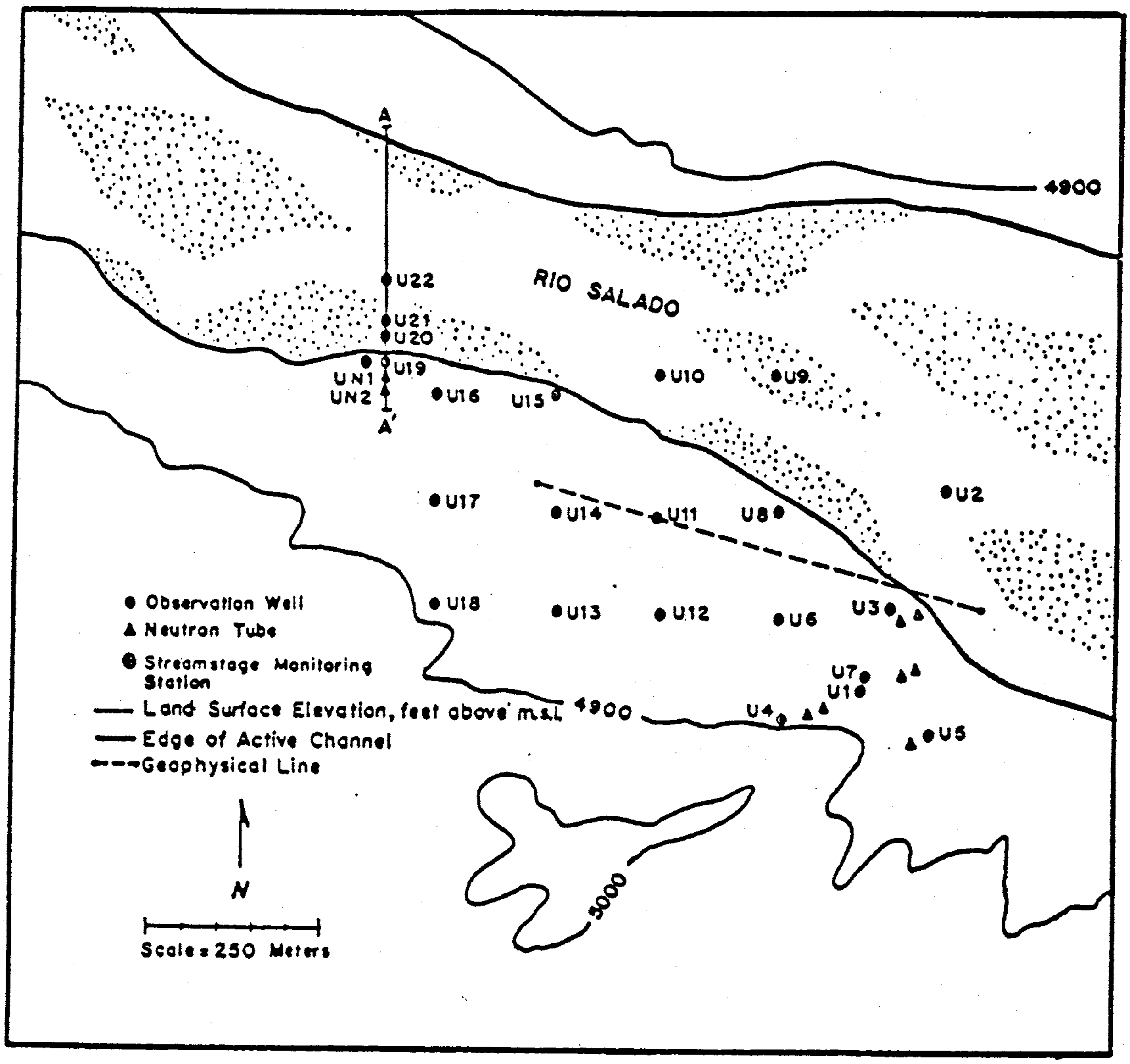

Figure 8. Monitoring locations at the Upper Rio Salado Site.

several kilometers along the course of the stream channel. This dune field is generally less than a kilometer wide and is the result of local wind and sediment conditions. There was no instrumentation installed on the north bank.

The stream bed at this site is approximately 220 meters wide and 1.0 meters deep. The general stream bed characteristics are the same as those of the lower site except that there were no well-incised channels due to structures, such as the old bridge pilings at the lower site. Depth to water in the channel and on the low plain south of the channel ranges between 1 to 6 m, depending on the season of the year and the location.

4.2.6 Upper Site Characteristics - Geology.

Two methods were employed to study the distribution and type of sediments underlying the stream bed and the floodplain. In the first method, geologic sampling of boreholes were done on two separate occasions. A borehole was drilled by power auger (Mobil B-30) in October of 1984 and represents the sediments in the profile down to 21 meters, at which depth a very dense layer was encountered. The borehole was located 12 meters east of observation well U1. Another borehole was drilled in the channel bottom in April, 1986 using an 8" (20.3 cm) auger and split spoon sampler (Mobil B-53). This second borehole was located approximately 10 meters northwest of observation well U21.

The logs describe a profile of relatively uniform medium to coarse sands with gravel. The base of the aquifer was located at approximately the same depth in both boreholes. Drilling logs of these wells are shown in Appendix 1.

The second method employed to describe the nature of the profile was electrical sounding. Using this geophysical technique, saturated unconsolidated sediments were found from about 3.6 to 18.5 m depths, and shale and clay layers were interpreted to occur from about 18.5 to about 196 m depths (W. Olsen, unpublished class report, New Mexico Tech, 1985). At this upper site, it is possible that the contact between the Rio Salado alluvium and Santa Fe Group (possibly the Popatosa Formation) is located at about 18.5 m below land surface. These results corroborate those obtained by boring.

4.2.7. Upper Site Characteristics - Stream Discharge

The characteristics of the flow at this site would generally be the same as those described for the lower Salado site. However, I observed various times that flow would occur at the upper site, while at the lower site no flow would be observed.

4.2.8 Upper Site Characteristic - Hydraulic Properties

An experiment was performed to determine the steady infiltration rate of the channel bottom and to observe the rise of the ground-water mound produced from the infiltration. The experiment was performed in April, 1986, and consisted of a plot measuring 3.048 meters on a side, constructed in a square around observation well U22. Berms of channel sand were constructed with shovels on each side of the plot, and the center of the plot was leveled. Water was applied to the plot from a line connected to a 55 gallon barrel. A valve in the line between the 55 gallon barrel and the infiltration plot was regulated so that the head in the plot was maintained as close to zero as permissible. Once the steady infiltration rate was achieved, The volume of water per unit of time applied to the plot was measured and recorded.

The final steady infiltration rate was determined to be 1.36×10^{-3} cm/sec. This value is lower than would be expected from the medium and coarse sands underlying the channel. This indicates that the infiltration rate may have been controlled by a layer of finer sediments near the surface. These fines sediments are believed to accumulate during recessions in the flow, and then are scoured away during the initial phase of a subsequent flow event. This value of the channel bottom saturated hydraulic conductivity may therefore be taken as a conservative figure, and the true infiltration rate during flow events is probably higher. Laboratory tests on soils similar to those in the channel bottom indicate this is a resonable assumption (Cox, 1985, unpublished laboratory results from measurements of saturated hydraulic conductivity of channel bed sediments).

4.2.9 Upper Site Characteristics - Aquifer.

The principal shallow aquifer is the Rio Salado alluvium. This water table aquifer is approximately 0.5 km wide and at least 15 m thick. The depth to ground water is quite variable between the upper site and the lower site. At the upper site, the water table lies about 1 m below the channel, whereas along the flood plain south of the channel the water table is about 3 to 6 meters below land surface. In contrast, at the lower site the water table is about 9 m below the channel, and depths to water in wells on the adjacent flood plain are about 10 to 12 meters. There are no wells located between these two sites, nor have there been any geophysical studies to help explain the substantial increase in the depth to water to the east. One explanation for the rapid change in the depth to water may be that the thickness of permeable alluvium is much greater on the east side of the Loma Blanca fault than on the west side.

The direction of ground-water flow is eastward, nearly parallel to the Rio Salado. The average hydraulic gradient between the upper site and the lower site is about 8 m/km.

To determine the hydraulic parameters of the aquifer, a pump test was performed in April, 1986. Monitor well U20 was used as the pumping well since it was located in the channel. It was expected that the pump test would provide information on aquifer properties at the same site where the infiltration experiment was carried out. Observation well U21 was installed 2 m from the pumped well in order to provide drawdown data. Well U20 was pumped at a rate of 1-.14 x 10^{-3} m^3/s (18 gal/min) for about 1240 minutes. Since this pumping rate was not sufficient to adequately stress the aquifer, the quality of the test data was judged to be too poor to attempt to compute the hydraulic conductivity. However, several previous investigations of sediments on the south bank of the upper site indicate that the saturated hydraulic conductivity of alluvium is on the order of 10^{-2} cm/s (Stephens et al., 1983, Byers and Stephens, 1983, Stephens and Knowlton, 1986).

5.0 SITE INSTRUMENTATION

5.1 Rio Puerco Site - Monitor Wells.

Five monitor wells were installed at the Rio Puerco site (Figure 4). A cross-sectional view of channel morphology and monitoring instrumentation is shown in Figure 9. The wells were laid out in an 'L' pattern so that the regional water table gradient could be determined. Wells closest to the channel were screened and sealed in different zones corresponding to fine to medium sand layers between impeding clay layers (Figure 5). Screening the wells at different depths allowed the piezometric head to be determined for each zone. Installation of all of the monitor wells was done using a Mobile B-30 drill rig with 20.3 cm (8 in.) hollow stem auger. A summary of monitor well construction details is given in Table 5.

5.2 Rio Puerco Site - Neutron Tubes.

Six neutron access tubes were installed at the Rio Puerco site (Figures 4 and 9). These tubes consisted of thin wall extruded aluminum 5 cm in diameter. The bottoms of the tubes were plugged with rubber stoppers. All of the tubes were installed by hand augering a 5 cm diameter hole

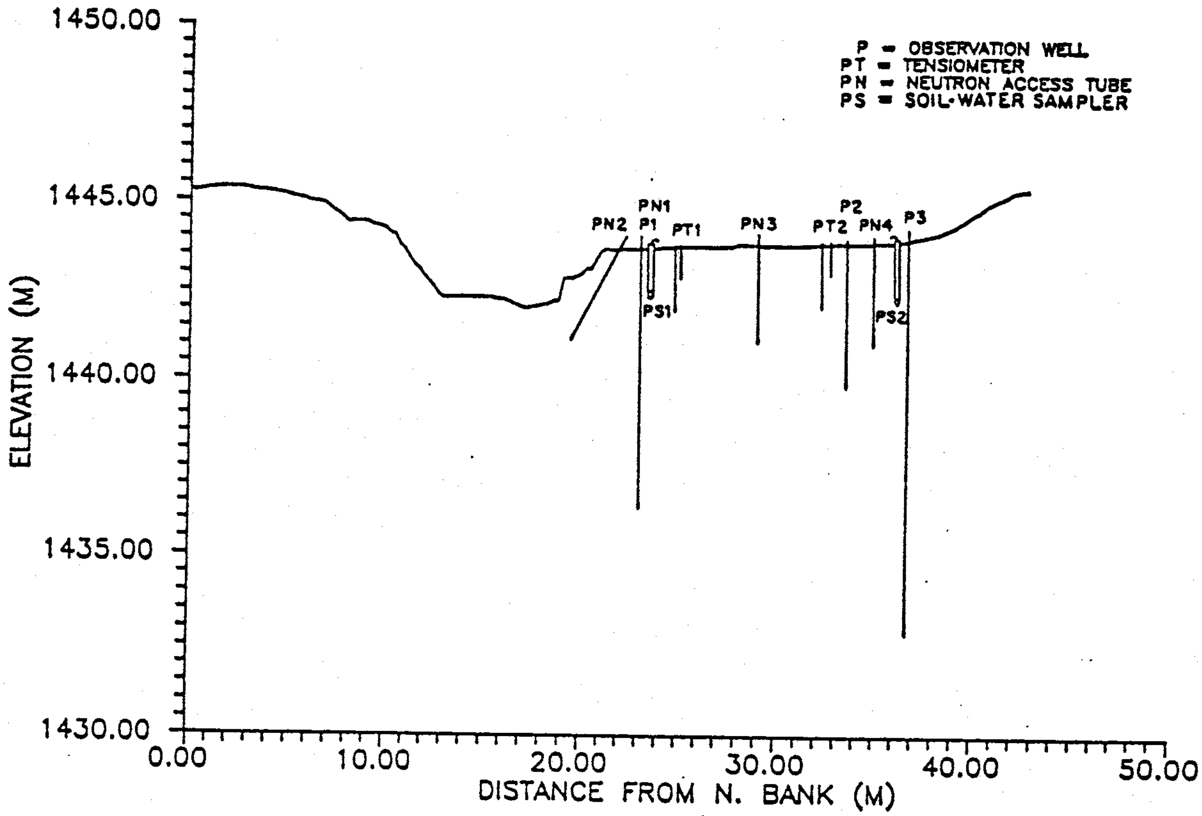

Figure 9. Cross-section of channel morphology and monitoring instrumentation locations at the Rio Puerco site.

TABLE 5

SUMMARY OF MONITOR WELL CONSTRUCTION DETAILS, RIO PUERCO SITE

Well	Meas Pt. Elev(TOC) (M above S.L.)	UTM Coord. (m)	Total Depth Below Top of Casing (m)	Average Height of Water in Well (m)	Case. Diam. (m)	Screen Length (m)	Date Installed
P1	1444.048	E 330000.0 N 3808723.0	8.42	5.3	0.05	1.37	8/15/85
P2	1443.951	E 329994.0 N 3808714.0	4.15	1.4	0.05	1.37	8/27/85
P3	1444.265	E 329992.0 N 3808712.0	11.40	8.2	0.05	1.37	8/15/85
P4	1446.048	E 329943.0 N 3808700.0	12.89	7.6	0.05	1.37	8/23/85
P5	1447.084	E 329863.0	15.09	8.8	0.05	1.37	8/30/85

Comments:

P1 - Formation caved in around casing when installed.

P2 - Gravel packed around screen; backfilled above screen with native material.

P3 - Gravel packed screen interval; sealed with bentonite 0.6 meters above screen at confining layer.

P4 - Gravel packed screen interval; backfilled above screen with native material.

P5 - Gravel packed screen interval; backfilled above screen with native material.

down to the water table. After the tube was put in the augered hole, native material was used as backfill around the tube. Care was taken to seal the annular space. Neutron tube PN2 was installed at a measured angle of 45 degrees to the horizontal as close to the bank as possible. The hole for this tube was augered into the saturated zone and the tube was forced as far down as possible. The base of this tube lies 90 cm below the lowest point in the channel. However, due to the configuration of the probe sensing unit and the position of the rubber stopper sealing the end of the tube, the lowest point of measurement is 30 cm below the lowest point in the channel. The base of this same tube lies 60 cm horizontally from the base of the inner bank above the channel bottom. Neutron tube PN1 was placed on line upstream from well P1 and is, therefore, in the same plane normal to the cross-section as well P1, and thus is not shown in figure 9. Neutron tube PN3 was placed approximately one-half the distance between well P1 and P3 to define the horizontal distribution of moisture away from the channel. Neutron tubes PN4, PN5 and PN6 were installed close to observation wells.

The neutron probe used on this project was a Campbell Pacific Nuclear, model 503, with a 50 millicurie americium-beryllium source. The probe was calibrated using gravimetric analyses of samples collected in situ from access tube core holes, as well as by collecting samples outside the access tubes in some instances.

5.3 Rio Puerco Site - Tensiometers.

Two nests of tensiometers were installed at the Rio Puerco site (Figure 4 and 9). Each nest consisted of two tensiometers, one with the porous cup at one meter in depth and the other with the cup at 2 meters depth. The tensiometers used were laboratory assembled using a design closely related to the tensiometers available commercially. Pressure in the tensiometer was determined by using a pressure transducer (Soil Measurements Systems, Las Cruces, NM) with access to the pressure environment through a hypodermic needle inserted through the septum stopper. The tensiometers were installed in a 1.27 cm diameter hole containing a slurry of locally derived clays. Native material taken from the hole was used to complete the backfill above the porous cup. The locations of the two stations were designed to provide measurement of both horizontal and vertical gradients in the vadose zone within the area of influence of the channel.

5.4 Rio Puerco Site - Stream Stage Recorder.

A stream stage recording system was devised and installed which was closely patterned on the traditional stilling well float recorder system of the USGS gages (figure 10). Early in the project, I observed that the inlet to the stilling well of the USGS gage was often silted in. The nature of the stream sediments and the monitoring schedule dictated that a system be devised which could record the stage in the stream with good inherent mechanical and structural reliability and a high degree of resolution. To accomplish these goals, The stilling well and inlet were made from 11 cm diameter PVC pipe, connected together in an 'L' shape with a sump at the bottom to trap sediment. To provide a hydraulic connection between the stilling well and the stream, PVC 20 slot well screen was attached to the inlet and anchored in the channel bottom by using galvanized pipes driven into the stream bed. A trench was cut into the bank and the entire unit, stilling well, riser pipe and inlet with screen attached was installed and covered over. The fill material was compacted to prevent washing away during streamflow. A water level recorder (Stevens type F40) was fit inside a specially designed housing and placed on a stand next to the riser of the stilling well. The chart was clock driven with a recording period of 8 days.

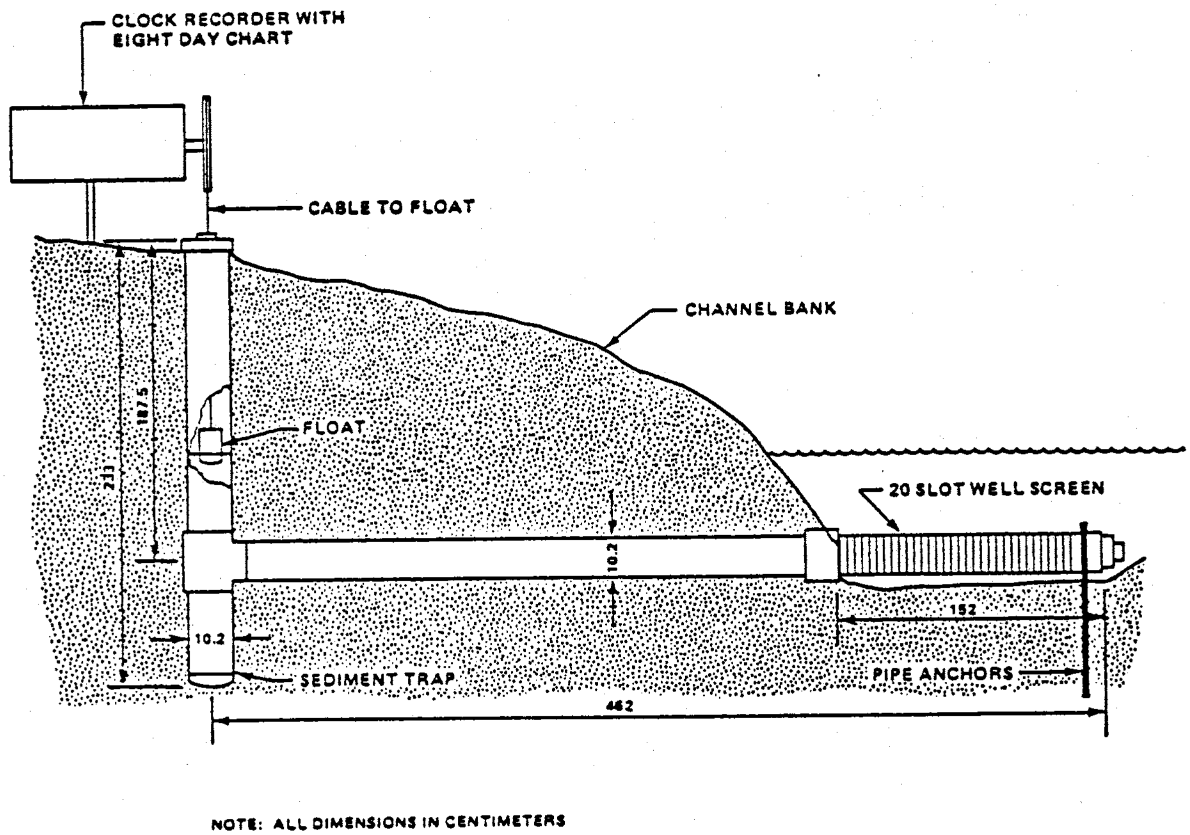

Figure 10. Stage recording gage on the Rio Puerco.

5.5 Rio Puerco Site - Soil Water Samplers.

Soil water samplers were buried in the vadose zone near the channel and 16 meters away from the channel (Figure 9). The samplers used were Soil Moisture model 1920 of a pressure vacuum type. Boreholes of 5 cm in diameter were augered vertically to just above the water table (approximately 1.5 meters). The samplers were placed in the holes and backfilled. A vacuum was then established in the sampler using a hand pump. These samplers were left for a period of approximately one week under vacuum, a time period during which close to a liter of soil solution was obtained. Chemical analyses was performed on the soil water retrieved from these samplers for major cations and anions, conductivity, and pH.

5.6 Rio Salado Sites

5.6.1 Lower Site - Monitor Wells.

Four monitor wells were installed at the lower Salado site (figure 7). A cross-sectional view of the channel morphology and the location of the monitoring instrumentation is shown in Figure 11. Installation of all of these wells was done in the same manner as those on the Rio Puerco. A summary of the monitor well construction details is given in Table 6.

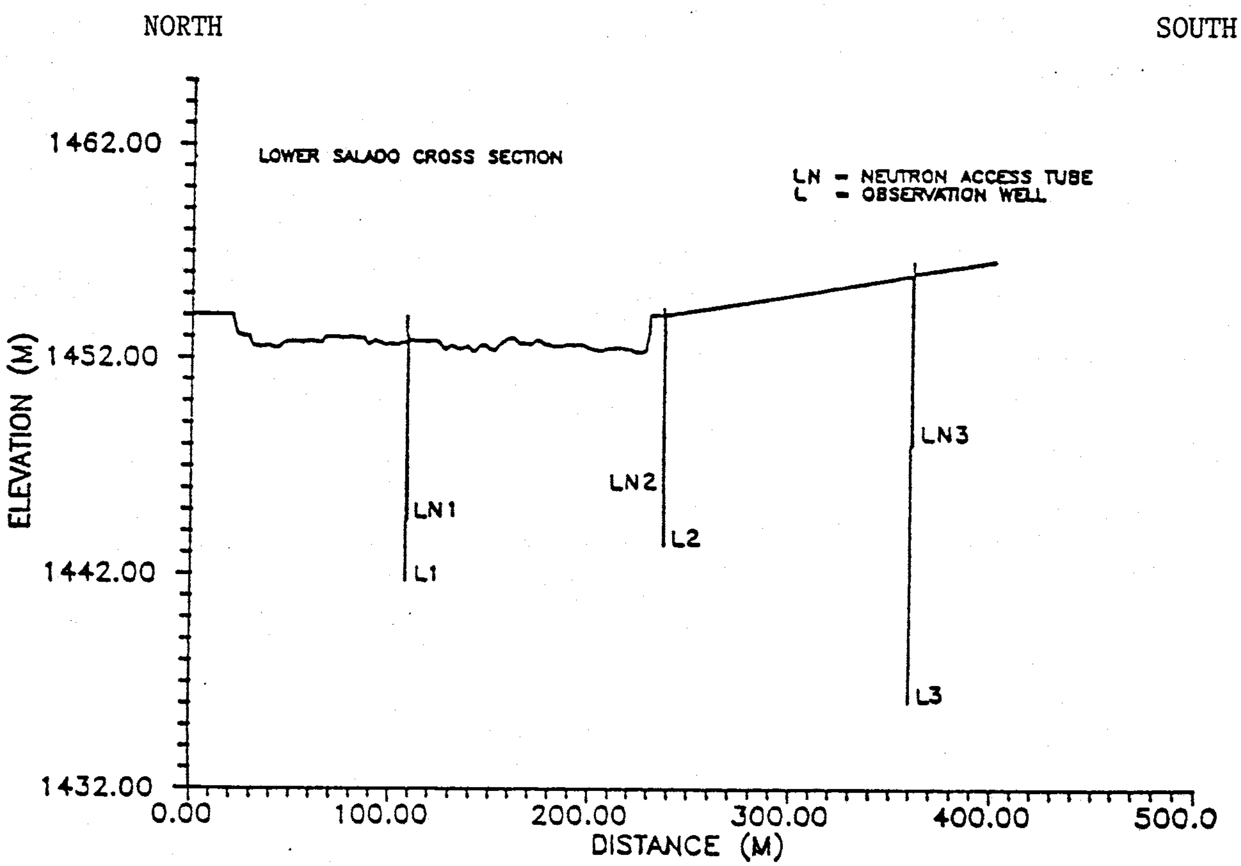

Figure 11. Cross-section of channel morphology and selected monitoring locations at the Lower Rio Salado Site.

TABLE 6

SUMMARY OF MONITOR WELL CONSTRUCTION DETAILS
LOWER RIO SALADO SITE

Well	Meas Pt. Elev(TOC) (M above S.L.)	UTM Coord. (m)	Total Depth Below Top of Casing (m)	Average Height of Water in Well (m)	Case. Diam. (m)	Screen Length (m)	Date Installed
L1	1453.934	E 325186.6 N 3796537.5	12.28	2.41	0.05	1.37	9/3/85
L2	1454.027	E 325092.6 N 3796448.4	10.67	0.80	0.05	1.37	9/5/85
L3	1455.895	E 325003.8 N 3796364.3	19.81	8.10	0.05	1.37	9/7/85
L4	1455.767	E 324917.5 N 3796452.9	16.76	6.78	0.05	1.37	9/10/85

Comments:

L1 - Backfilled with native material, coarse sand. Cemented at base, chained to old gaging station.

L2 - Backfilled with native material, coarse sand.

L3 - Screened interval packed with gravel, backfilled with native material, coarse sand.

L4 - Backfilled with native material, coarse sand.

The well fields at both Rio Salado sites are larger in areal extent and spread farther away from the channel than the wells established at the Rio Puerco site due to the higher transmissivities present in the Rio Salado system. No automatic water level recorders were installed at either Salado site, so the depth to water was determined using steel tape.

5.6.2 Lower Site - Neutron Access Tubes.

Four neutron access tubes were installed at the site, one near each observation well (Figures 7 and 11). All of these tubes at this site were installed in boreholes made using a hollow stem auger rig since it was not possible to hand auger due to the large cobbles in the profile. The water table at this site was encountered at greater than 11 meters beneath the base of the channel, making it possible to use the maximum length tubing of 9.87 meters. Each tube was 5 cm in diameter, the same size as those installed at the Rio Puerco site. After the tube was emplaced, native material taken from the augered hole was used to backfill around the tube, taking care to ensure that the soil was replaced in the proper order and that the annular space around the tube was properly packed to prevent channeling down next to the tube. This was essential since neutron tube LN1, in the middle of the channel, was at risk during flows. Twice the stage in the channel was high enough to submerge tube LN1, but no channeling down next to the tube was observed in subsequent monitoring.

5.6.3 Lower Site - Stream Stage Recorders.

No stage recorders were available or installed to record stage data at this site. At the onset of the project it was believed that the gaging stations present at this lower site, could be put back into service by project personnel and utilized to obtain stage data. However, after surveying the channel and observing flow in relation to the recorders, it was determined that the gages would not be able to record the majority of the events that would occur without major modifications to the instruments. After studying various reaches of the channel, a location was found at the upper site for the installation of a gage of virtually the same design as had been installed on the Rio Puerco, except a Stevens Type A model 71 recorder with a 30 day clock was used instead of an 8 day clock. The station began operation on May 30, 1986. However, a large runoff event in October of 1986 eroded the stream bank and washed away the station.

5.6.4 Upper Site - Monitor Wells.

Fifteen additional monitor wells (U8-U22) were installed at the upper site (Figure 8). Ten of these wells were installed by Mr. William Olsen (U8-U18) in conjunction with a numerical model study, uncompleted as of this writing. The details of the monitor well construction are given in Table 7. Seven monitor wells were already in place as a result of the previous work done on areal recharge (Stephens and Knowlton, 1986).

Wells U8 through U18 were in a regularly pattern over an area approximately 500 meters on a side. This array of wells was designed to form a integral part of the wellfield already established at the site. The larger wellfield formed by the addition of the new wells measured approximately 1000 meters long stretching beside the stream channel and 500 meters deep going away from the channel. Well U19 was placed on the bank at the west end of the grid where the stage recorder was established. Wells U20 and U21 were established in the stream channel 6 m from U19, primarily to obtain pump test data, and to monitor water levels in the aquifer subsequent to the pump test. Well U22 was established in the middle of the channel for the sole purpose of observing the rise of the ground-water mound during an infiltration experiment.

TABLE 7

SUMMARY OF MONITOR WELL CONSTRUCTION DETAILS
UPPER RIO SALADO SITE

Well	Meas Pt. Elev(TOC) (M above S.L.)	UTM Coord. (m)	Total Depth Below Top of Casing (m)	Average Height of Water in Well (m)	Case. Diam. (m)	Screen Length (m)	Date Installed
U1	1480.078	E 321075.25 N 3797954.28	-----	----	0.10	----	9/28/83
U2	1497.408	E 321220.96 N 3798232.53	-----	----	0.05	----	9/30/83
U3	1497.042	E 321175.38 N 3798088.37	-----	----	0.10	----	9/28/83
U4	1480.566	E 320948.67 N 3797876.46	-----	----	0.10	----	10/4/83
U5	1482.181	E 321191.67 N 3797859.04	-----	----	0.044	----	1/13/84
U6	1480.200	E 320941.29 N 3798051.13	-----	----	0.044	----	1/12/84
U7	1480.139	E 321076.57 N 3797956.24	-----	----	0.044	----	3/2/84
U8	1480.590	E 320939.57 N 3798221.55	5.85	3.72	0.05	1.37	10/85
U9	1481.365	E 320956.57 N 3798387.90	7.88	5.29	0.05	1.37	10/85
U10	1482.825	E 320789.06 N 3798423.26	7.55	4.65	0.05	1.37	10/85
U11	1481.526	E 320766.60 N 3798225.65	7.51	5.22	0.05	1.37	10/85
U12	1481.526	E 320760.50 N 3798051.18	8.74	6.51	0.05	1.37	10/85
U13	1482.934	E 320607.49 N 3798060.54	7.47	4.27	0.05	1.37	10/85
U14	1482.462	E 320609.12 N 3798225.94	7.05	4.67	0.05	1.37	10/85

TABLE 7 (con't)

SUMMARY OF MONITOR WELL CONSTRUCTION DETAILS
UPPER RIO SALADO SITE

Well	Meas Pt. Elev(TOC) (M above S.L.)	UTM Coord. (m)	Depth Below Top of Casing (m)	Total Average Height of Water in Well (m)	Case. Diam. (m)	Screen Length (m)	Date Installed
U15	1482.895	E 320607.62 N 3798384.16	7.62	5.36	0.05	1.37	10/85
U16	1484.324	E 320449.20 N 3798408.80	7.92	5.02	0.05	1.37	10/85
U17	1485.946	E 320439.60 N 3798223.90	10.61	5.64	0.05	1.37	10/85
U18	1489.265	E 320443.21 N 3798064.56	10.67	2.01	0.05	1.37	10/85
U19	1484.781	E 320340.84 N 3798552.45	5.49	----	0.05	1.37	2/7/86
U20	1483.600	E 320345.04 N 3798558.05	10.67	----	0.05	1.37	4/86
U21	1483.600		5.18	----	0.05	1.37	4/86
U22	1483.500		3.05	----	0.05	0.91	4/86

Comments:

U1 through U7 - No construction details available

U8 through U19 - Backfilled with native materials.

5.6.5 Upper Site - Neutron Access Tubes.

Two neutron access tubes were installed orthogonal to the channel near well U19 (figure 24). The first tube, UN1, was placed 1 m away from well U19. The second tube, UN2, was placed 6 m south and approximately normal to the longitudinal axis of the channel. Both tubes were installed by hand augering a 5 cm diameter hole to just below the level of the channel. Backfilling around the annulus was done with the material excavated from the hole.

5.6.6 Upper Site - Stream Stage Recorder.

A stream stage recording system was installed at this site on the south bank, 1.5 meters from well U19. The overall design was the same as that of the gage established at the Rio Puerco site with the exception of the water level recorder. For this gage, a Stevens recorder type A model 71 was used. The recorder was uniquely suited for this site due to its unlimited range in stage, a case sealed against moisture and long term stand alone capability (Figure 10). The stage recorder, along with the stilling well and inlet was washed away in the flow event of early October, 1986, but the recorder was retrieved from the channel downstream with the interior still dry and sealed.

6.0 MONITORING PROCEDURES - RIO PUERCO AND RIO SALADO

The instrumentation at the three study sites (Rio Puerco, Upper Rio Salado, Lower Rio Salado) was monitored either continuously, via recording charts and cassettes, or weekly (and bi-weekly) through manual observations.

Observation wells at the three sites were monitored on a weekly basis through the first year of the project (1985-86) and more frequently during times of continuous flow. During periods of no flow in the second year, monitoring was done bi-weekly. Determination of depth to water in all wells was done using a steel tape. One continuous recording well equiped with a Stevens 30-day clock was located at the upper site on the Rio Salado (U4).

Tensiometers at the Rio Puerco site were monitored at the same frequency as the observation wells. Failure rates of the tensiometers increased markedly during the second year due to overbank flows which completely submerged and stressed the tensiometers. In addition, increased traffic from cattle in the area was suspected in the breakage of the tensiometers and loosening of them in the ground. The tensiometers were filled with a 50% etheylene-glycol mixture during the winter so no freezing occurred.

Neutron moisture loging was done on a weekly and bi-weekly basis, except for the site on the lower Salado which was logged on a monthly basis during the second year. In

October of the second year access tube LN1 at the lower site was destroyed in a flow event and could not be salvaged.

The stream stage recorder on the Rio Puerco was monitored on a weekly basis. In the spring of 1986 the stilling well began losing water and it was suspected that a crack had developed in the PVC or at a joint possibly due to freezing conditions encountered during the winter. The leak apparently sealed itself and the stilling well and sediment trap continued to function properly.

The stream stage recorder on the Rio Salado needed to be maintained often in order to keep the screen open to the channel. At times hours of shovel work were performed to dig the inlet out of the sediment which had deposited on top of it. For some flows, when the channel had migrated away from the stilling well inlet, the channel was intentionally diverted to pass by the stage recorder inlet to get a record of the event. It became impossible to catch every flow on the recorder and notes were taken whenever a flow was observed, though these observations occurred on a chance basis. In early October, 1986 the recorder along with the stilling well and inlet were carried away in a large flow event. The gage was not re-installed after that time since the flow season on the Rio Salado had passed.

7.0 RESULTS

7.1 Stream Stage - Rio Puerco.

The flow events in the Rio Puerco during the period of record for this study show wide variability in duration and amplitude (figure 12). Between flow events, the channel was often completely dry. In early spring, snowmelt is the primary source of runoff, while thunderstorms tend to be the major source during summer. Winter precipitation is generally longer in duration but lower in intensity, resulting in longer periods of discharge in the channel. In late June of 1986 to late July of 1986, the stream flowed continuously at approximately the same stage. This relatively long period of nearly constant flow is used in subsequent calculations of recharge by various methods (Section 7.6). Beginning in late August 1986 through November 1986, flow occurred in response to precipitation in the basin. During this period, large fluctuations in the stream stage were recorded. Two of the flow events, in early October and November of 1986, were of sufficient discharge for the stream to overflow its banks. Stream stage data were not recorded for short periods of time during these overbank events, but the stream stage data base was supplemented with field observations of high water marks on the support stand of the stage recorder and the neutron access tubing. From mid November 1986 to February 1987, low

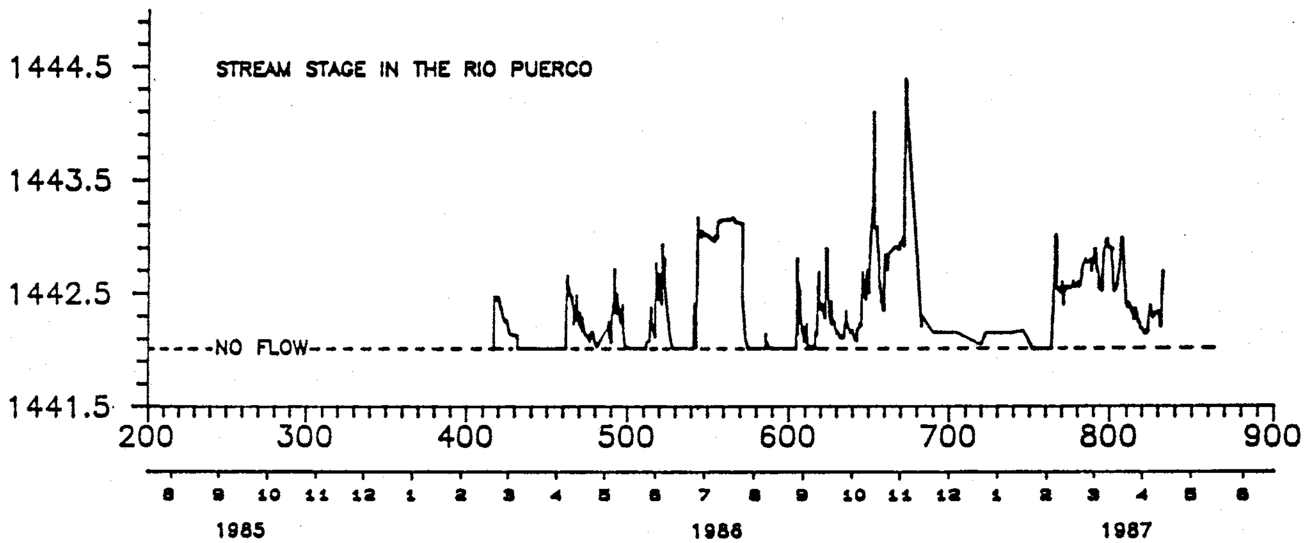

Figure 12. Stream stage in the Rio Puerco.

but almost continuous flow was observed in the channel. From February to May of 1987 there was continuous flow in the channel at a relatively high stage. There were more flow events during 1986-87 than during 1985-86.

7.2 Soil Moisture - Rio Puerco.

Soil moisture was measured using a number of neutron access tubes placed at several different distances from the channel. The locations of these neutron tubes in cross-section near the channel are shown in Figure 5. Neutron access tubes PN5 and PN6 are located approximately 100 m away from the channel near well P5 and P6 respectively and are not shown in Figure 5. For the near channel, neutron access tube PN1 lies in the same plane normal to the cross section as well P1 so it is superimposed in figure 5. Neutron access tube PN2 is located nearest the channel and is angled at 45 degrees to the horizontal. The neutron access tubes are placed in the same "L" pattern as the wells. Soil moisture data from neutron access tubes PN1 and PN3 through PN6 are tabulated in Appendix 5. For all soil moisture data, depths are referenced to land surface which, for neutron access tubes PN1 through PN4, is very nearly the same elevation for each one.

Data from tube PN1 indicates that for depths 0.3 and 0.6 m, the effects of the surface process of evaporation is evident. The moisture contents are relatively low, with additional drying in the profile taking place as the warm months of the year approach. The two flow events that resulted in the stream overflowing its banks in October and November of 1986 produced rapid and significant increases in moisture content at the surface. The stream stage for both overbank events was high enough to submerge all neutron access tubes. The tubes were capped with rubber stoppers and covered with PVC sleeves. None of the tubes had water in them after the flow events. Some channeling down next to the tubes could have occurred, although I could not detect any obvious breach of the annular seals around them.

Moisture content changes in the profile surrounding neutron access tube PN2 are dependent on flow in the channel, type of sediment and atmospheric conditions (figure 13). At the 0.86 and 1.29 m depths there is a contrast in the type of sediments present, as seen in the difference in steady-state moisture contents in the first portion of the period of record. At the 0.86 m depth a finer grained material is present with higher water contents. The increase in moisture contents for the flow event of late June and August of 1986 at these two depths show that the water was infiltrating horizontally from the channel, as opposed to increases in saturation propagating from beneath. The moisture content changes at the 0.86 m depth are not delayed in time to the response at the 1.29 m depth and the magnitude of positive change in moisture contents is greater

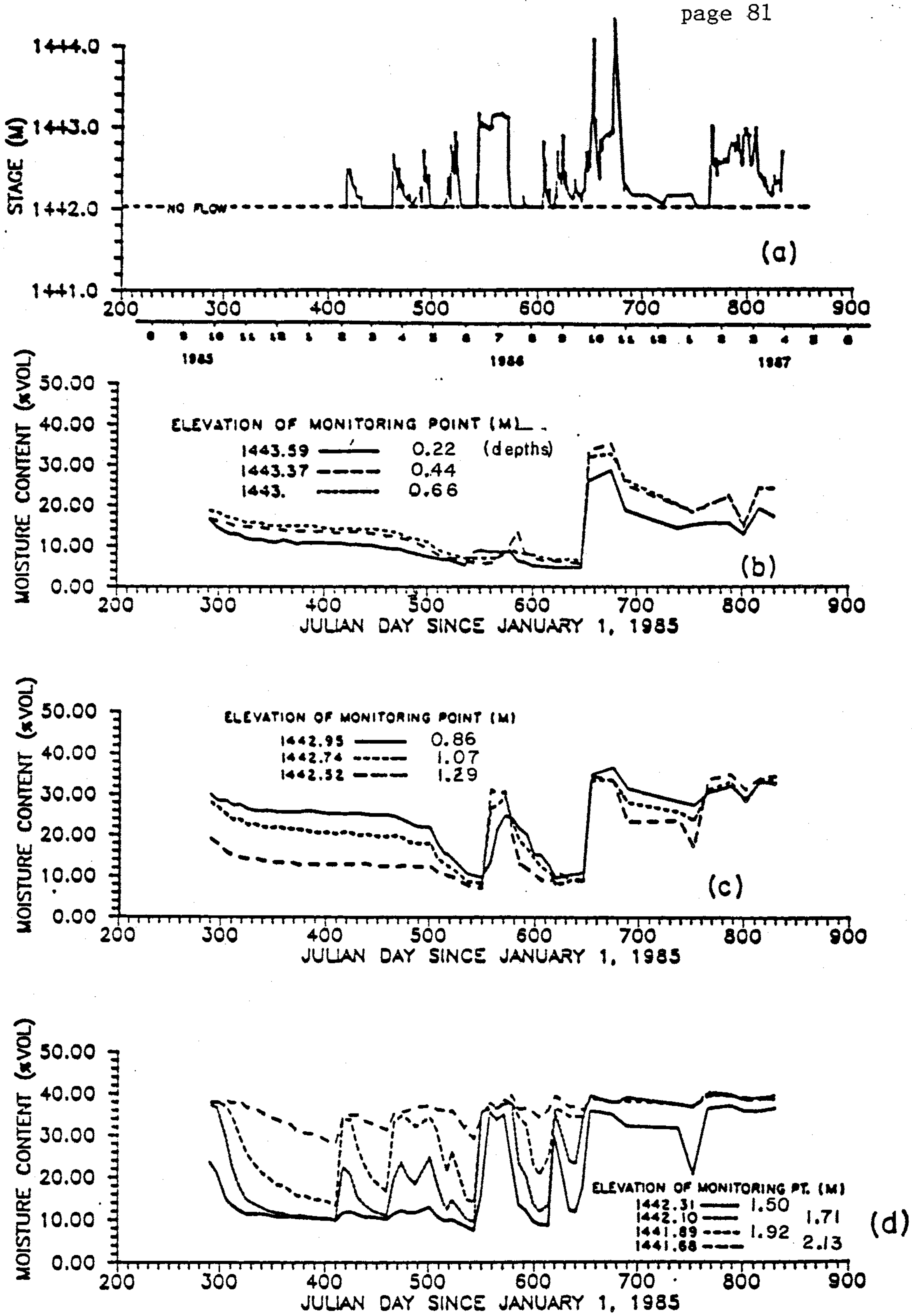

Figure 13. Moisture content in neutron probe access tube PN2 at selected elevations adjacent to the Rio Puerco channel.

for the 1.29 m depths. These two depths, 1.29 m and 0.86 m, lie at 1442.52 m and 1442.95 m, respectively. The channel bottom elevation is 1442.009 m and the stage in the stream for the flow event corresponding to these increases in moisture content was approximately 1 m above the base of the channel on average, so that the 1.29 and 0.86 m depths lay below the level of the stage in the stream. The response to the first few flow events of record begin to show at the 1.7 m depth, which lies at 1442.10 m, nearly the elevation of the channel bottom. Moisture contents remain elevated following November of 1986. Note, from the data for the 2-.13 m depth, that saturated moisture contents appear to be about 40% and for the period after November of 1986 the depths below 1.5 m are tension-saturated until February of 1987. This may have been above the air-entry pressure, thus not reducing the hydraulic conductivity below the value at saturation.

The data for neutron tube PN2 (Figure 13) also indicate that the depths from 1.7 m to the surface respond to conditions at the soil-atmosphere boundary since the tube follows the slope of the bank. This response to surface conditions is manifested at these depths in the rapid drying of the soil during the warm months of the year. The response at the 1.5 and 1.7 m depths is shown in Figure 13. These depths correspond to elevations of 1442.31 and 1442.10 m, respectively. These are elevations just above and at the level of the bottom of the channel. The low moisture contents at these depths, as well as the rapid drainage that occurs indicate that these are fine to medium sandy grained sediments. The interval between these two levels is the depth in the profile where the water table fluctuates the most, and imbibition and drainage occur most often. The moisture contents for the 2.13 m depth (1441.68 m) remain at or near saturation for the period of record indicating this is the elevation at which the ground-water table exists for most of the year.

Data from neutron tube PN3 (Appendix 5) indicate that at the 0.22 m depth there was response to surface infiltration during late June and into July. The overbank events appear to have caused deep percolation at this point and channeling down next to the tube may have occurred. Infiltration of precipitation also occurred in the area during this time is indicated in the record of moisture contents for neutron access tube PN4 (Appendix 5), which is located approximately 120 meters from the channel. Soil moisture increased at all depths and remained high after November of 1986 near PN3. The upper portions of the profile responded to precipitation events and the lowest depths responded to a general rise of the water table.

Soil moisture changes in the profile at neutron access tube PN4, located approximately 18 m from the channel, are similar to soil moisture changes in the profile at the location of tube PN3. The exception to this is at the lowest two depths of 2.7 and 3.0 m. These depths extended below the deepest depth for tube PN3 of 2.4 m. The depths of 2.7 and 3.0 m showed moisture contents of approximately 40% for most of the period of record.

Data from neutron access tubes PN5 and PN6, located approximately 100 meters from the channel, indicate that response to surface events such as precipitation and evaporation is attenuated rapidly. A stable profile of moisture contents has developed at the location of these tubes with no indication that the flow in the channel has any effect at this distance other than raising the regional water table. Small peaks in the data around the middle of August and again in October are believed to be erroneous and related to data entry error.

To illustrate the response of the vadose zone near the channel to infiltration, Figures 14 and 15 show three-dimensional surface mesh plots of the moisture content distribution in the profile near the channel versus the depth and distance from the channel before and during a flow event. Figure 14 shows the profile before flow. The water table lies just below the 3 m depth, so a portion of the capillary fringe creates the elevated moisture contents at

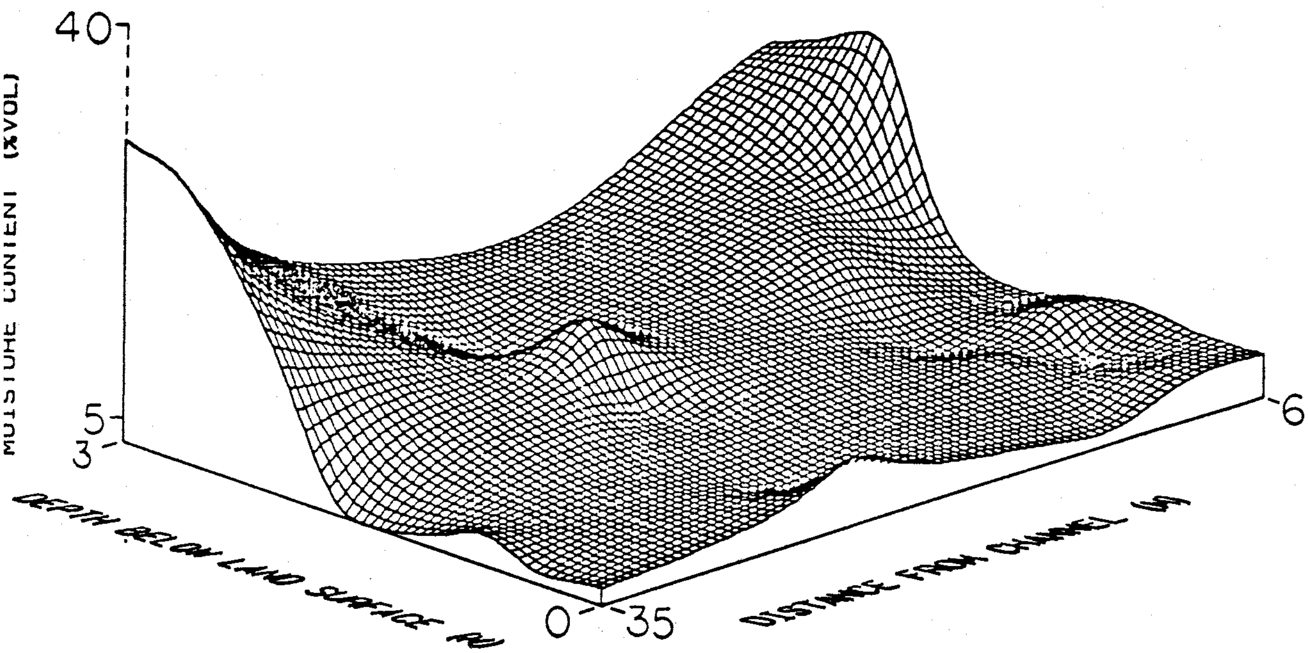

Figure 14. Moisture contents beneath the floodplain adjacent to the Rio Puerco prior to flow in the channel.

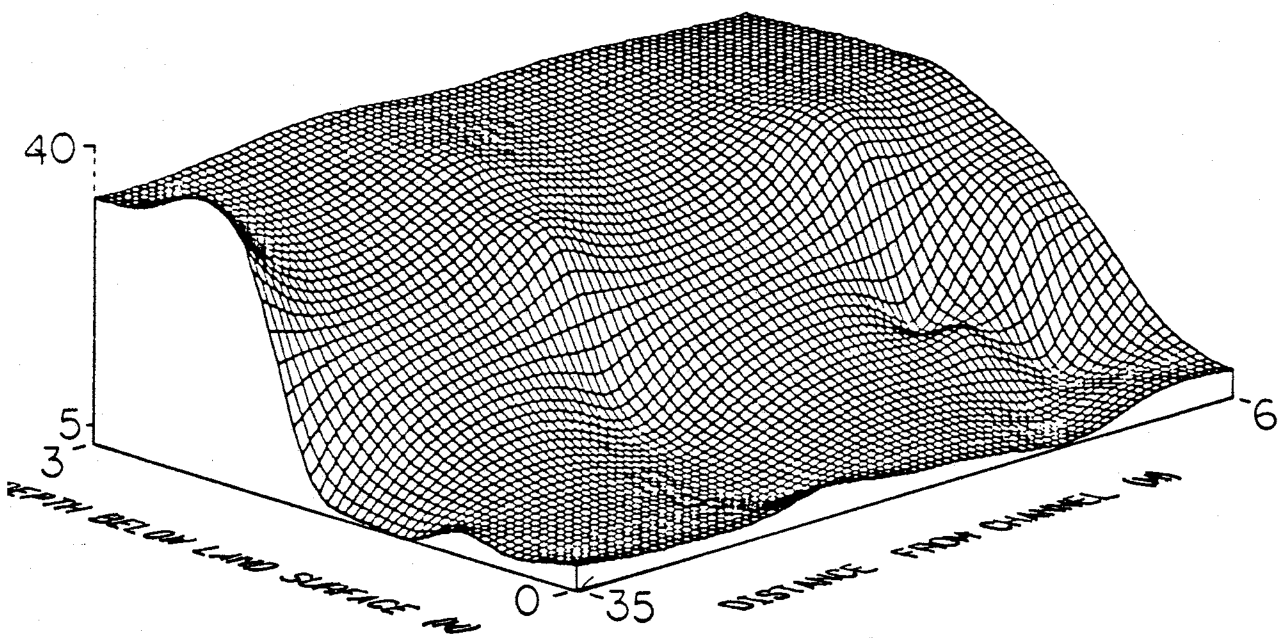

Figure 15. Moisture contents beneath the floodplain adjacent to the Rio Puerco channel after 21 days of flow.

this depth. Figure 15 shows the profile after infiltration, and the shape of the mounding near the channel.

7.3 Hydraulic Head - Rio Puerco.

The stream stage in the Rio Puerco is shown in figure 16a plotted superior to the water level hydrographs and represents the data obtained from the stream stage recorder installed at the site. This stage recorder was not installed until February of 1986, so data on stream stage for the period prior to that time was taken from the records of the USGS gaging station at Bernardo. These records indicate that the Rio Puerco flowed twice, once in late September and another time in the first part of October.

The time series of hydraulic head measurements in wells P1-P5 at the Rio Puerco site can be seen in figure 16b. All the observation wells at the site were installed in mid to late August of 1985. Remember from the geologic cross-section (Figure 5) that well P1 is screened at an intermediate depth, well P2 is screened at a shallow depth, well P3 is screened at the greatest depth interval of the profile of the three wells close to the river, and wells P4 and P5, located farthest from the channel, are screened at 12.89 m and 15.09 m respectively (see Table 5 for complete details).

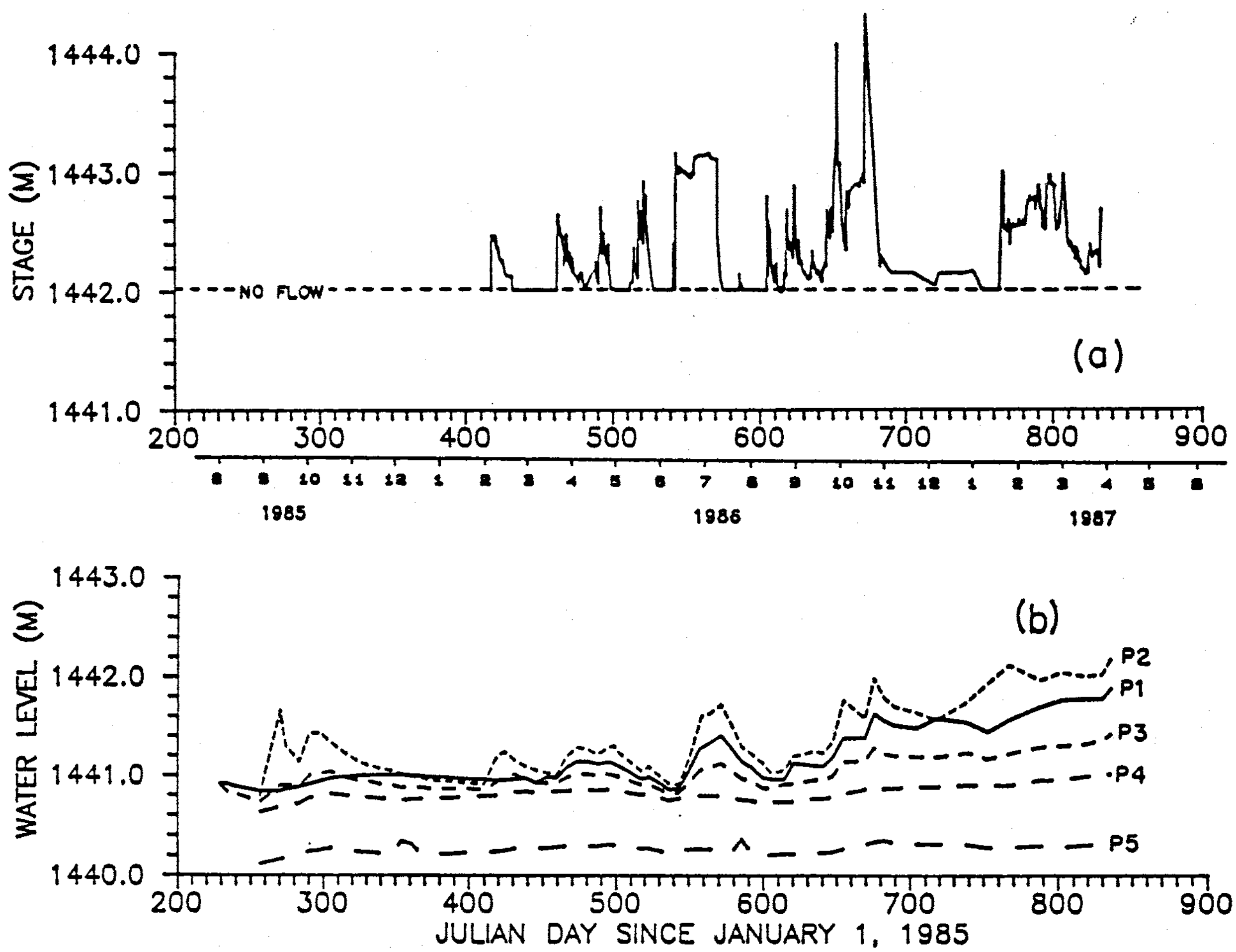

Figure 16. a) Stream stage, and b) Water level elevations in monitor wells at the Rio Puerco Site. (Wells P1, P2, P3, P4, and P5 are screened at depths of 8, 4, 11, 12.5 and 14.7 meters respectively)

The water level elevations in the wells indicate that there is a downward component of the hydraulic gradient in the aquifer. The difference in water level elevations between well P4 and P5 would be expected to be the background regional horizontal component. However, the gradient between wells P4 and P5 is away from the Rio Grande, exactly opposite to what would be expected. The conclusion seems clear that the vertical hydraulic head gradient predominates in the area of this site (remember that wells P4 and P5 are screened at different depths). The downward gradient near the channel fluctuates between near 0.0 and 0.1.

Water levels in the monitor wells fluctuate in response to changing stream stage. Changes of the water levels in the monitor wells in response to flow in the channel follows a trend from the highest level in the profile to the lowest, particularly for those wells closest to the channel. Response of the water level in a particular well to flow in the channel is more correlated to the depth at which the well is screened than to the distance the well was placed from the channel, at least for the wells closest to the channel. This behavior indicates that lateral components of flow away from the channel play a major role during infiltration in the system of the Rio Puerco where interbedded layers of low permeable material are present.

Changes of the water level in the aquifer in response to flow in the channel are quite rapid for all of the monitor wells near the channel (P1, P2, P3). This indicates that saturated conditions probably develop quickly beneath the channel and full hydraulic connection is established. Exceptions to this were discovered and are discussed in detail under the results section on stream-aquifer interconnection. The response to streamflow is attenuated in the aquifer with increasing depth; that is, water level fluctuations in the wells screened highest in the profile have the largest amplitude. The head in well P1 (Figure 16b) only responded slowly to the first three flow events. Poor aquifer communication was believed to have been due to plugging of the screen which may have occurred during well installation. In March, 1986, the well was developed by surging and pumping to clean the well screen. After development, the response of this well followed the response trends of the other wells near the channel.

The responses of the wells appear to be in phase with each other except where there may be errors in the data base. The first anomalous water level response was on December 18, 1986 when the head in well P1 was rising while the head in well P2 was dropping. This could be a phenomenon related to the geology under the channel at that level of the head in the aquifer, or it may be an error in one data point. The second occurrence was on the 22nd of

January, 1987. The hydrograph of well P2 shows that the water level in the aquifer was rising on that date while the water level in well P1 indicated a lowering of the water table. This anomaly was due to the fact that the data on water level for well P2 was not taken on that date because the wellhead cap was frozen on. Missing this data point makes it appear that the water level in well P2 was rising throughout the month of January, 1987, when it probably was following a trend similar to that indicated by the hydrograph of well P1 for that same period. The third occurrence was in mid-March of 1987, when the head in well P2 was declining while the head in well P1 was rising. This may have been due to transient flow and profile responses. What appear to be brief fluctuations in well P5 during December 1985 and August 1986 are believed to be errors in the data in recording of the water levels in the well, since there was no like response in the other wells.

Seasonal trends in water level fluctuations cannot be determined from the two-year data base. Water levels in the aquifer are lowest at the beginning of this study and increase throughout the period of record for all wells monitored. At the end of the study period (May, 1987) the water levels in wells P2 and P1 are just below the level of the channel bottom. At this time ground-water elevations were at a maximum for the two year period.

Changes in soil moisture and hydraulic head in the vadose zone and the aquifer due to flow in the channel was found to be dependent on the condition of the channel bottom prior to any given event. During periods of no flow and relatively warm weather, the channel bottom would dry and desiccation cracks would form, exposing the fine to medium sands underlying the clays which form the channel lining. A flow event subsequent to such drying of the channel bottom would infiltrate quite rapidly as evidenced by the rapid rise in water levels in the monitor wells. If the channel lining remained wet enough to prevent desiccation cracks from forming, water levels in the wells would not rise as rapidly or with the same magnitude.

Total hydraulic head data in the vadose zone as measured by tensiometers indicate a downward total head gradient during the winter and an upward gradient during the warmest months of the year. The data are shown in Figure 17b and 17c. No records of precipitation at the site were obtained, and therefore fluctuations in the total head in the vadose zone could not be correlated with surface events away from the channel. However, the total head data is correlated at a depth of 1.8 m with the fluctuations in the water table after approximately day 570 (Figures 18b and 18c). The tensiometers at the 1.8 m depth were above the capillary fringe at the beginning of the study, but aquifer levels rose more than expected through the period of

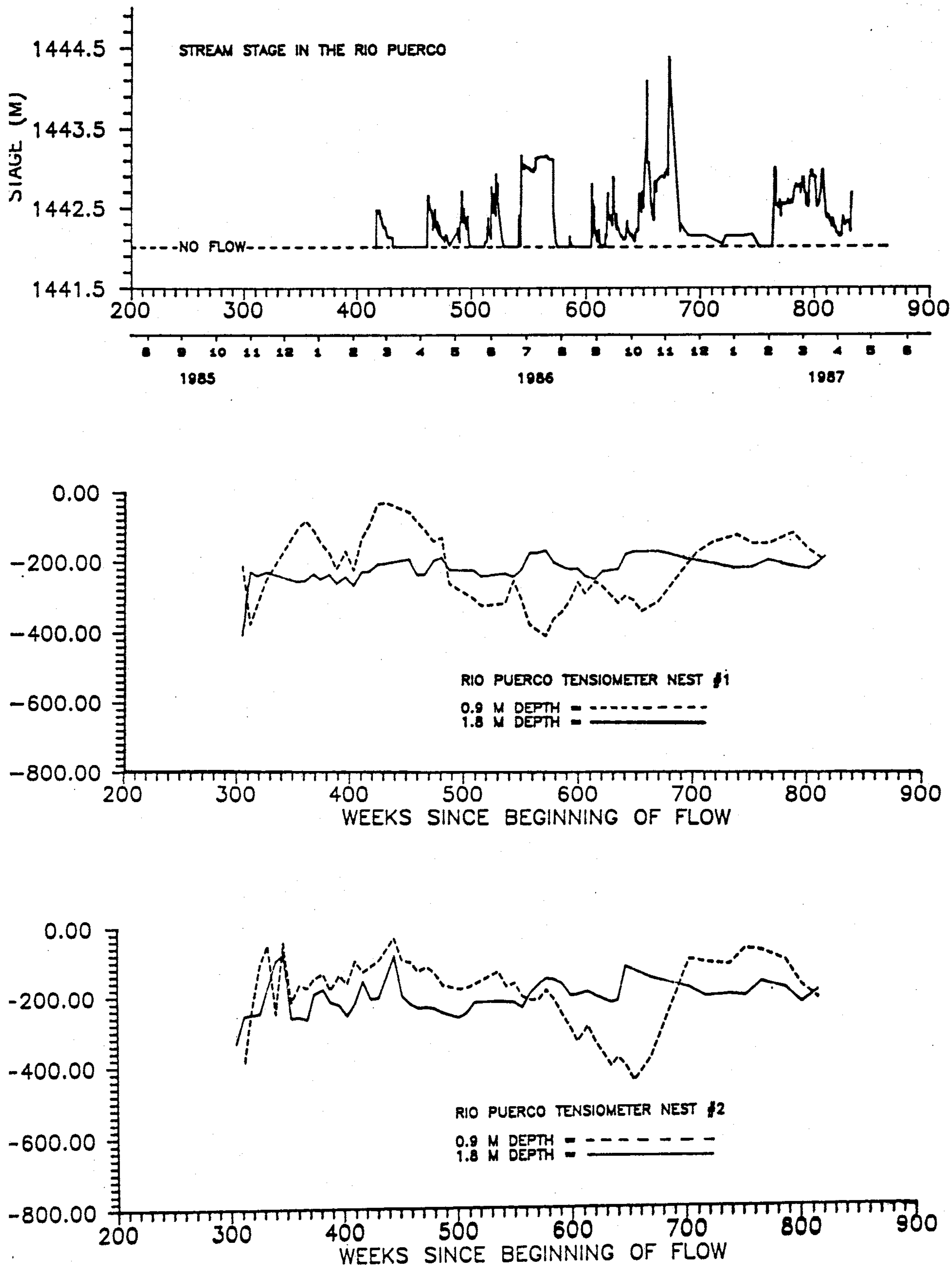

Figure 17. Total head distribution in the vadose zone at the Rio Puerco site. (Tensiometer nest #1 is located 6 m from the channel, nest #2 is 13 m from the channel)

monitoring. This resulted in the tensiometer cups being within the capillary fringe for the later period of this record.

7.4 <u>Stream-Aquifer Connection - Rio Puerco.</u>

To determine whether the stream and aquifer are in full hydraulic connection, an examination of the response of water levels in the monitor wells near the channel to stream stage fluctuations is done. The degree of saturation in the vadose zone near the channel affords a means by which to determine whether a full or only partial hydraulic connection exists.

Stream stage fluctuated widely during the period covered by this study (figure 16a). From the beginning of the period of record, February 1986, the channel was virtually dry until about March 1986. This was followed by a sequence of runoff events which lasted from 2 to 4 weeks each. A period of continuous flow began about August 1986 and extended until field operations were discontinued in May 1987. Within this period of sustained flow, the stage fluctuated by more than 2 m; in fact, over-bank flow occurred within the inner floodplain in October and November 1986.

Water level elevations in the monitor wells responded rapidly to stream stage fluctuations as indicated in Figures 16a and 16b. There appears to be excellent hydraulic communication between the stream and the sandy aquifer as shown by the water level fluctuations in well P2. The amplitude of the response in monitor well P2, located 16 m from the thalweg and screened to about 3 m below the channel (Figures 4 and 5), was greater than in monitor well P1 located only 6m from the thalweg. The smaller water level amplitude in monitor well P1 is attributed to the presence of relatively low-permeable clay layers within the 7 m depth interval between the screen of monitor well P1 and the channel bottom. The water level response in monitor well P3 is in phase with the water level fluctuations in the stream. However, the amplitude is dampened relative to the response in monitor wells P1 and P2, owing to its greater distance from the stream and greater depth (Figure 5).

During the period of measurement, water level elevations in the monitor wells were lower than the stream stage elevation (Figures 16a and 16b), with one brief exception which will be described subsequently. This observation suggests that, in general, the Rio Puerco is a losing or influent stream at this site, and that there is potential for unsaturated flow phenomena to be significant. The exception mentioned above occurs approximately between days 750 and 760, when the water level in monitor well P2 exceeded the elevation of the stream free surface. From this, it is inferred that during this time ground water, or bank storage, flowed into the stream during a recession period. For this same period, the slope of the recession curve is less than that for other flow events. This provides further evidence that baseflow was occurring. Because ground-water levels generally rose due to continuous runoff from about day 600, there was potential for bank storage contributions to the stream discharge to occur when the stage decreased rapidly and ground-water levels exceeded the stage elevation. Suprisingly, there did not appear to be contributions from bank storage following the short periods of overland flow on about days 655 and 680. It is possible that the duration of over-bank flow was too brief to allow significant infiltration or bank storage to occur. However, the interpretations from the water level data are weakened because the frequency of monitoring was only about weekly.

Stream stage and water level elevation measurements, along with water content measurements beneath the channel also reveal evidence for variability in the degree of hydraulic communication between the stream and aquifer. For example, the stream stage and aquifer responses between days 460 and 530 (Figures 16a and 16b). During this time there were three runoff events; the latter was separated from the first two by approximately a 10 day period of no flow. In general terms, the three flow events appear to be quite similar. However, the magnitude of the aquifer response in monitor wells P1, P2, and P3 to the first two runoff events is much greater than the response to the third event. In fact, there is a general recession in ground-water levels during the third period of increasing stream stage. The water content beneath the channel averaged approximately 37% and tended to increase during days 460-500. However, during the third event the water content decreased to about 34 % (Figure 13). For all three events, soil water content beneath the channel was less than saturation. From this, the inference can be made that the stream and aquifer were not fully hydraulically connected during this discharge sequence.

There is no conclusive evidence for the development of a clogging layer during the first two flow events in this flow sequence (days 460 to 530), even though the sediments are not fully saturated. It is possible that a local zone of saturation developed beneath the channel even in the absence of a clogging layer, owing strictly to capillary effects and the two-dimensional geometry of the source. (Figure 18; condition 1B). The zone of saturation would tend to be more limited in vertical extent in fine rather than in coarse textured sediments, owing to capillary effects (Stephens and Neuman, 1982), and its size would vary proportionally to the stream stage. The zone between the water-table aquifer and the saturated trough beneath the channel would be expected to be just below saturation, such as was observed during the final two flow events described

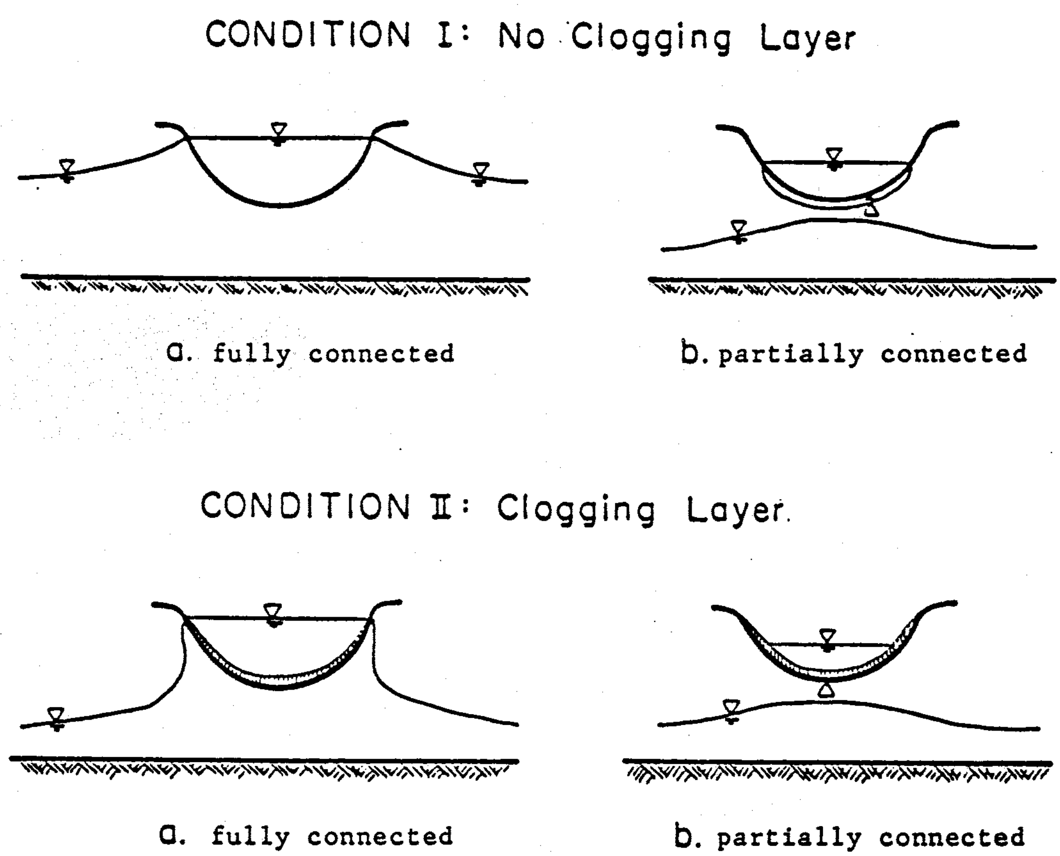

Figure 18. Conceptual models of stream-aquifer interaction.

above. If the stream stage remained unchanged, the degree of saturation in this interval would be expected to increase from below as the ground-water table mound rises. Additional data would be needed to determine whether these processes occurred at the Rio Puerco site.

There is more convincing evidence for the existence of a clogging layer during the third flow event. During the third event (days 515-530) water level elevations decreased in the monitor wells (Figure 16), and water content decreased beneath the channel (Figure 13). This information suggests that the rate of infiltration through the channel bottom decreased in comparison to the rate during the previous flow events. Inasmuch as the peak stream stage for the third event was slightly greater than that in the previous two events, the hydraulic conductivity of the channel bottom sediments probably decreased by comparison to previous conditions, most likely due to the development of the clogging layer.

Soil moisture evidence for a clogging layer also is indicated during other periods, such as for days 615-650. During this time, there is runoff in the channel (Figure 16), yet the soil beneath the channel is at a water content which is less than saturation (Figure 13). Prior and subsequent to this period, the stream stage was considerably greater; however, at these times the sediments beneath the channel were saturated. These changes in stream stage and soil moisture response suggest that there may be a relatively low permeable clogging layer present during the entire period (days 615-650) which allows infiltration at a rate sufficient to saturate underlying sediments only when the fluid head above the clogging layer (stream stage) is relatively large (Figure 18; condition IIA). The conceptual model of stream-aquifer interaction presented by Spiegel (1955), showing a ground-water mound intercepting the stream, most probably would be applicable only after sustained flow. This would apply where there are shallow initial depths to the water table, and where the soils have rather low permeability.

7.5 Recharge - Rio Puerco.

At the Rio Puerco site recharge from stream infiltration was calculated by three methods: channel seepage rate determined from hydraulic data, the convolution integral applied to a ground-water level time series, and the flux rates of recharge based on a previous study of channel losses between gaging stations (Heath 1983). In the first approach, recharge was calculated using the method of Bouwer (1969).

$$I_s = \frac{K_a}{W_s L_a} \left\{ (H_w - h_{cr}) W_b + (H_w - 2h_{cr}) \frac{H_w}{\sin\alpha} \right\} \qquad (9)$$

where

K_a = saturated hydraulic conductivity of clogging layer (L/T^{-1})

W_s = water surface width (L)

L_a = thickness of clogging layer (L)

H_w = depth of water in channel (L)

W_b = width of bottom of channel (L)

α = stream bank angle from horizontal (degrees)

h_{cr} = pressure head of soil beneath clogging layer (L).

In this method, a clogging layer is presumed to exist with unsaturated soil beneath it. To perform the analysis, a period of record from day 543 to 570 (July 1986) was selected because the stage of the stream, H_w, was rather constant, at about 1.09 m. The width of the water surface of the stream w_s, was about 8 m; the width of the base of the channel, w_b, was about 6.4 m; the slope of the channel sides, α, was about 33°; and the pressure head beneath the channel was estimated to be -0.2 m. The moisture content beneath the channel increased from about 30 to 37% during this period and continued to increase to as much as 41% following the period; it can be inferred that the sediments beneath the channel in fact were unsaturated during the time period of interest for the analysis. Hydraulic conductivity and clogging layer thickness are critical parameters in the analysis. The harmonic mean hydraulic conductivity of sediments sampled within 41 cm of the channel bottom and sides is about 4.6×10^{-6} cm/s (Table 2). If it is assumed that the clogging layer is 41 cm thick, then the steady infiltration rate from the trapezoidal channel, I_s, is calculated to be 1.58×10^{-5} cm/s. By this approach total recharge for the period averaged 2,949 m^3/km. This analysis assumes that the water table is sufficiently deep so that gravity flow occurs in unsaturated sediments below the clogging layer (Figure 18; Condition IIB). The uncertainty in hydraulic conductivity and thickness of the clogging layer are the principle sources of error.

If it is assumed that the system, alternatively, had no clogging layer present, so the stream and aquifer are actually fully connected, as in condition IA in Figure 18, recharge can be computed using Bouwer's (1969;pg. 125) graphical approach. For the same flow period as before, the depth to static ground water below the channel surface, D_w, was estimated at 2.3 m; the depth to an impermeable layer, D_i, was assumed to correspond to the clay layer at about the 5.0 m depth (Figure 5); saturated hydraulic conductivity was estimated to be 10^{-3} cm/s; and the width of the channel base was 6.4 m. This approach resulted in a calculated recharge rate of 6.4 x 10^{-5} cm/s. The total recharge from this event (day 543 to 570; July 1986) would be 11,944 m^3/km. In this second analysis, the increased infiltration rate, compared to the previous case, is due to the absence of the clogging layer. The presence of the assumed lower impermeable boundary at 5 m below the channel tends to limit the infiltration rate. Inasmuch as deep monitor wells below the 5 m depth actually did respond slightly to runoff and infiltration, the assumed lower boundary either is moderately permeable or is laterally discontinuous. Thus, if the stream and aquifer were fully connected and a clogging layer was absent, then the actual infiltration rate may exceed the value calculated above.

Next, the convolution method was used to calculate recharge. This method presumes that as infiltration occurs a ground-water mound grows beneath the channel. In response to this, water levels increase in wells adjacent to the channel. Based on available data, the specific yield of the aquifer is assumed to be 20%, and the width of the recharge source is 4 m (width of the source is arbitrary, as it cancels out in the computation of total recharge). Based on the water level hydrograph in monitor well P2 for the same period as before, the convolution method indicates that the infiltration rate is about 5.75×10^{-5} cm/s, and the total recharge is about 10,730 m^3/km. By all these methods, therefore, it is estimated that the total recharge for the period (day 543-570) ranges from about 2,949 to 11,944 m^3/km.

Over the entire 82 week period of monitoring water levels (Sept. 27, 1985 to April 29, 1987), the average weekly infiltration was also calculated using the convolution approach. The cumulative input function F(T) is shown in Figure 19, based on water level data of monitor well P2. If it is assumed that the specific yield is 20%, then the total recharge would be about 103,772 m^3/km. If the wetted perimeter averages 1000 cm, then the infiltration rate averaged over the 82 week period would be 2.09×10^{-5} cm/s. However, this average includes periods of no flow. During the 82 week period, flow in the channel occurred approximately 60% of the time. Therefore, the average weekly infiltration rate during the periods of runoff would be about 3.35×10^{-5} cm/s. On an annual basis the total recharge rate would be approximately 69,800 m^3/km-yr.

The channel losses from the Rio Puerco, between the gaging station on US Highway 6 and the one just west of the site, was previously computed to be about 30,000 m^3/km-yr by Heath (1983). The length of this segment of the channel is about 78 km. This channel loss would comprise about 32% of the mean annual runoff at the US Highway 6 gaging

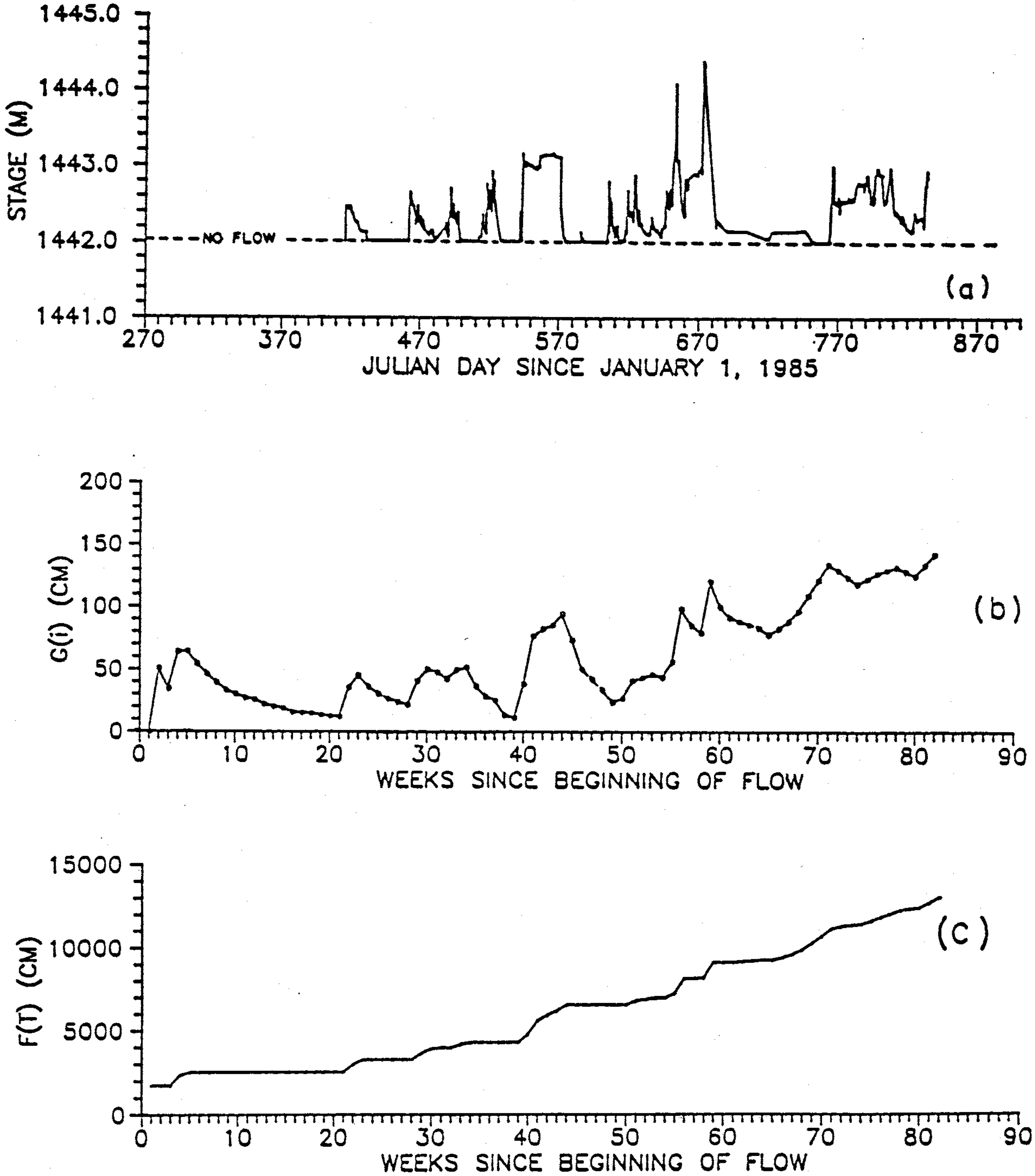

Figure 19. a) Stream stage, b) Observed water levels in well P2 and c) Cumulative input function for the Rio Puerco.

station. If it is assumed that the average length of the wetted perimeter is 1000 cm and flow occurs 40% of the time in this reach (Heath, 1983), then the average infiltration rate would be 1.52×10^{-5} cm/s. This estimate includes errors associated with the stream gaging data base; it also does not account for transmission losses due to direct evaporation from the water surface, although these losses are probably less than a few percent of the infiltrated volume. Not all transmission losses occur in the inner channel, some of the losses occur when overbank flow infiltrates the flood plain sediments.

A comparison of the infiltration rates computed by the various methods and for different time periods is shown in Table 8. The values agree to within the same order of magnitude, ranging from about 1.5×10^{-5} to 6.4×10^{-5} cm/s. This is surprisingly good agreement considering the numerous sources of uncertainty regarding conceptual models, numerical techniques, and hydraulic properties. Some variability in infiltration rates is to be expected. For example, based on field observations, it is likely that the development of a clogging layer is a dynamic process that may be influenced by variability in sediment load characteristics, stream velocity, and periods of drying between runoff events. In addition, there is uncertainty in the hydraulic properties, which are utilized in some of the

TABLE 8

COMPARISON OF INFILTRATION RATE ESTIMATES ON THE RIO PUERCO USING HYDRAULIC CHARACTERISTICS, CONVOLUTION, AND STREAM FLOW GAGING

Period of Record	Infiltration Rate ($x10^{-5}$ cm/s) Hydraulic Characteristics (Clogging Layer)	Hydraulic Characteristics (No Clogging)	Convolution	Stream Gaging
June 28, 1986 to July 25, 1986	1.6	6.4	14.4	n/a
82 week period (9/26/85 - 4/15/87)	n/a	n/a	3.6	n/a
long term (water years 1940 through 1976)	n/a	n/a	n/a	1.5

analytical models due to temporal changes in the permeability and thickness of the clogging layer. The presence or absence of a clogging layer determines, in part, the particular analytical model used for developing the recharge prediction.

7.6 <u>Water Chemistry - Rio Puerco.</u>

Water samples were collected from surface runoff in the channel, the vadose zone and aquifer then analyzed for major ion concentrations and pH. The results of the chemical analyses are shown in Table 9. These water samples represented points along the path of infiltration from channel or surface through the vadose zone to the aquifer. In general, the water would be classified as a sodium-sulfate type.

Surface water samples collected during the winter show lower total concentrations of all species compared to spring runoff (Figure 20). Winter runoff is primarily generated from precipitation of low intensity in the lower portions of the basin, whereas spring runoff is derived from snowmelt. The relative distance of channel travel is greater for the spring runoff, thus increasing its total concentration of dissolved constituents.

The chemical characteristics of the ground water near the Rio Puerco are similar to the average of those of the stream (Figures 20 and 21). The evolution of water that

Table 9. Summary of water chemistry data for the Rio Puerco

<u>Saturated and Vadose Zone</u>

Chemical Constituents in ppm

Sample Source	Ca	Mg	Na	K	HCO3	CO3
Well P1	78.00	17.80	155.00	4.20	111.00	0.00
Well P2	220.00	61.30	313.00	5.80	230.00	0.00
Well P3	367.00	126.80	600.00	7.20	321.00	0.00
Vadose Zone Near Channel (PS1)	154.00	52.00	230.00	6.20	92.00	0.00
Vadose Zone Away From Channel (PS2)	181.00	38.00	320.00	8.00	360.00	0.00

Chemical Constituents in ppm

Sample Source	SO4	Cl	NO3	PO4	Si	Fe
WELL P1	438.00	L39.00	5.80	0.00	0.00	0.00
WELL P2	1092.00	102.00	1.90	0.00	0.00	0.00
WELL P3	1722.00	483.00	1.00	0.00	0.00	0.00
Vadose Zone Near Channel (PS1)	875.00	62.00	1.40	0.00	0.00	0.00
Vadose Zone Away From Channel (PS2)	864.00	87.00	0.01	0.00	0.00	0.00

Table 9 Continued:

Percent Reacting Values

Sample	%Ca	%Mg	%(Na+K)	%Cl	%SO4	%HCO3	TDS, meq/l	%error
Well P1	31.89	12.00	56.12	9.84	75.16	15.00	24.34	0.30
Well P2	36.86	16.93	46.21	9.89	77.30	12.82	59.20	0.63
Well P3	33.28	18.96	47.76	24.91	65.48	9.61	109.78	0.25
Vadose Zone Near Channel (PS1)	34.73	19.33	45.94	8.24	84.74	7.01	43.62	1.44
Vadose Zone Away From Channel (PS2)	34.36	11.89	53.74	9.32	68.28	22.40	52.63	0.12

Surface Water

Chemical Constituents in ppm

Sample Source	Date Collected	Ca	Mg	Na	K	HCO3	CO3
Sample 1	11/06/86	85.00	19.50	165.00	5.40	151.00	0.00
Sample 2	12/20/85	80.00	19.00	162.00	8.10	164.00	0.00
Sample 3	4/18/86	162.00	68.00	500.00	16.00	298.00	0.00
Sample 4	3/11/86	162.00	49.00	302.00	29.50	173.00	0.00

Chemical Constituents in ppm

Sample Source	Date Collected	SO4	Cl	NO3	PO4	Si	Fe
Sample 1	11/06/86	453.00	39.00	11.00	0.00	0.00	0.00
Sample 2	12/20/85	344.00	58.00	0.00	0.00	0.00	0.00
Sample 3	4/18/86	1141.00	223.00	3.54	0.00	0.00	0.00
Sample 4	3/11/86	564.00	409.00	0.00	0.00	0.00	0.00

Percent Reacting Values

Sample Source	%Ca	%Mg	%Na+K	%Cl	%SO4	%HCO3	TDS, ppm	%error
Sample 1	9.20	2.10	18.34	4.20	48.77	16.26	843.0	0.48
Sample 2	9.58	2.28	20.37	6.95	41.20	19.64	753.0	1.20
Sample 3	6.72	2.81	21.40	9.25	47.31	12.36	1602.0	0.42
Sample 4	9.59	2.90	19.63	24.20	33.40	10.25	2263.0	2.40

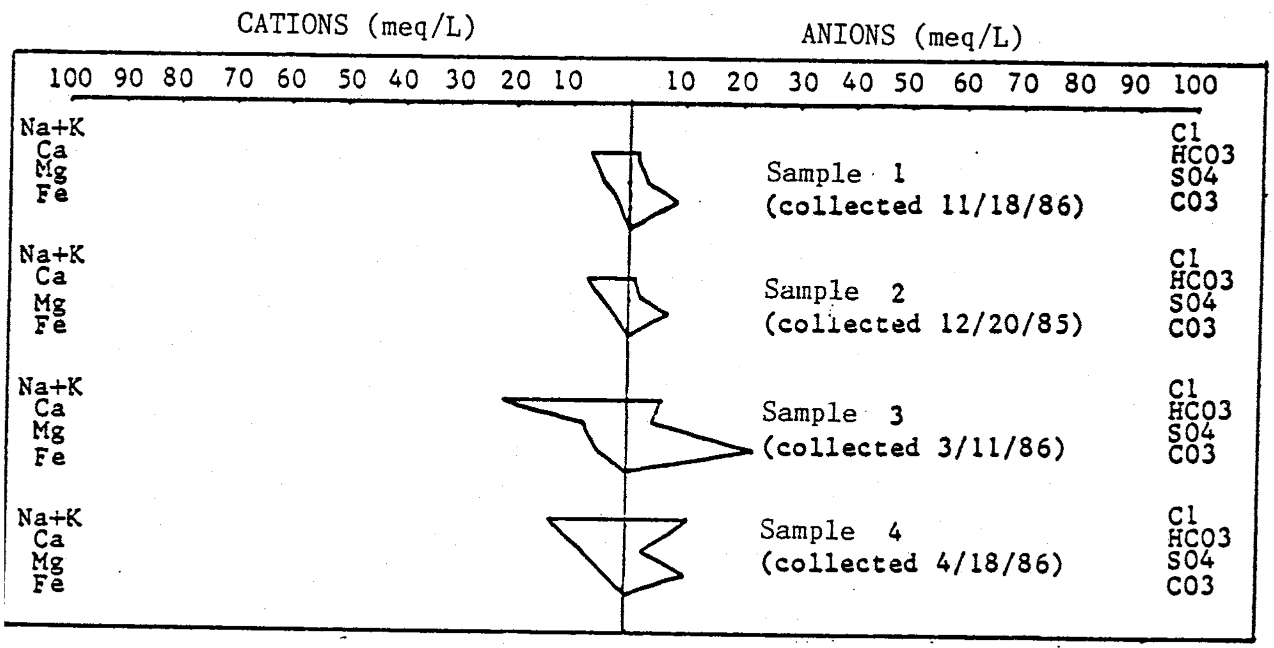

Figure 20. Stiff plot of major cation and anion concentrations in surface waters of the Rio Puerco.

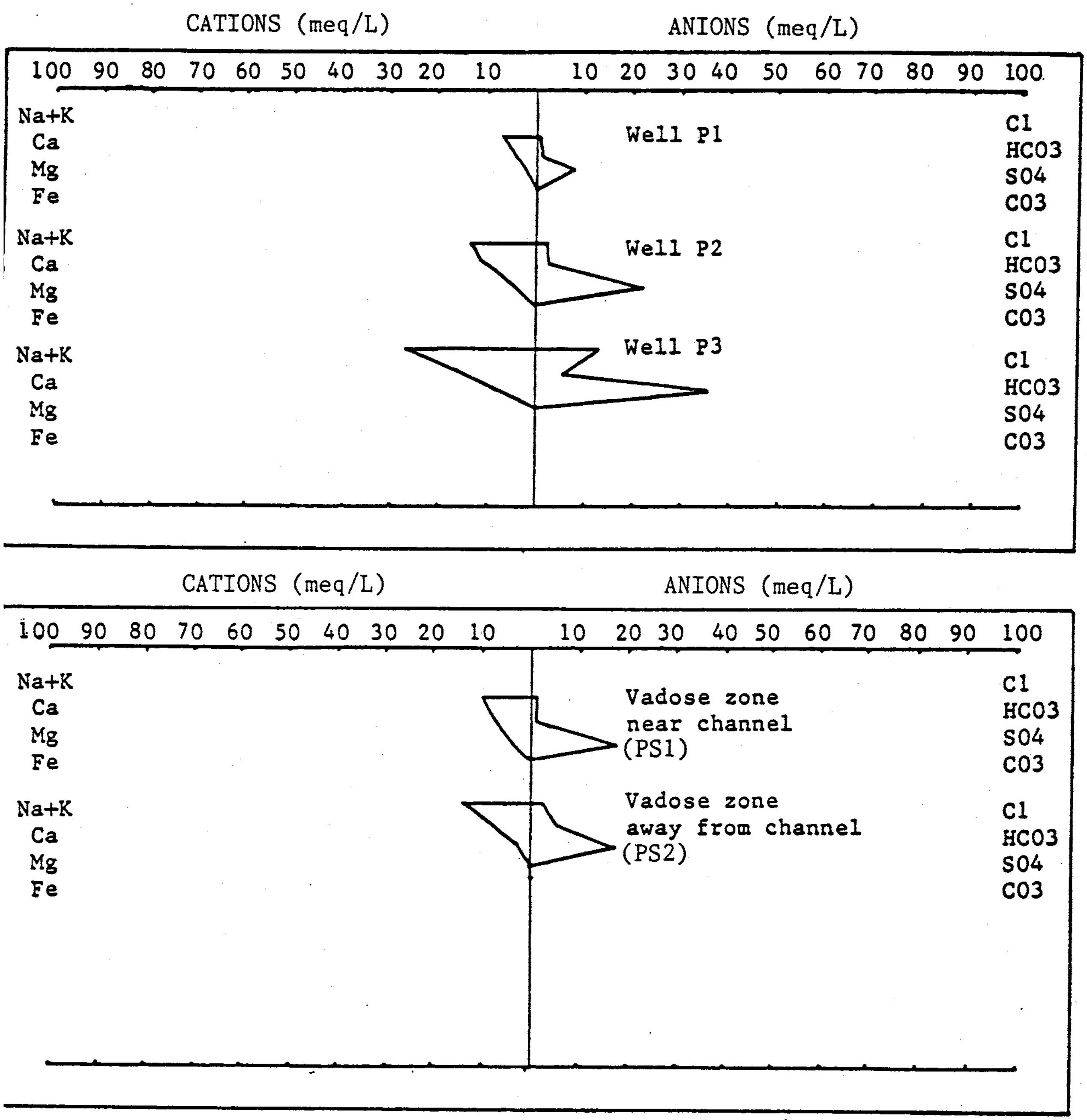

Figure 21. Stiff plot of major cation and anion concentrations in saturated and unsaturated zone waters at the Rio Puerco site.

infiltrates the stream bed depends primarily on the minerals in the soil which may dissolve in the ground water or the species in the ground water which may combine and precipitate to form solids along the pathway of infiltration. From previous data presented in this report, it can be concluded that the ground water is derived from the stream infiltration. The ground water in well P1 is very close in composition to that of winter runoff. Ground water in monitor well P2, which is screened at the shallowest depth, is higher in total concentration of salts than P1, probably due to the longer flow path from the stream and evaporation effects. The total dissolved solids concentration for well P3 is higher than that for P1 of P2, for the same reason. In general, TDS is highly dependent on path length from infiltration point to sampling point.

The chemical characteristics of samples taken of the vadose zone water are similar to the characteristics of well P2 which would imply that the water obtained with the vacuum samplers may have come from a fluctuating shallow groundwater table. However, there is no conclusive evidence for this. Alternatively, shallow ground water may also be recharged by water movement through the vadose zone.

If the water from the channel becomes recharge to the aquifer, chemical evolution will take place as the water moves through the sediments. For species at saturation, precipitation will occur. For species present in the infiltrating water which are at concentrations less than saturation, dissolution of minerals composed of these species from the soil matrix will occur. From the general chemical characteristics of the samples (Table 9), some likely phases may be present that are acting as sources or sinks in the Rio Puerco sediments. Phases are defined here to be a set of minerals, organic substances or gases which may act as reactants or products in the system. Some of these phases may be CO_2 gas, NaCl, $CaSo_4$, NO_3, CaF_2, KCl, $CaMg(CO_3)_2$, $CaCO_3$, or $CaCl_2$. In addition, the nitrate ion may be present as it is stable in both basic and acidic solutions.

To model the chemical evolution of the infiltrating water the computer program BALANCE (Parkhurst et. al, 1982) was used. This computer code takes as input the chemical makeup of water samples at two points along a flowpath along with a list of possible phases which act as reactants or products in the system. The program calculates the mass transfer (amounts of phases entering or leaving the aqueous phase) necessary to account for the observed changes in composition between the two solutions. BALANCE is based on reactions of the form:

$$\text{Initial solution + reactant phases} > \text{final solution + product phases} \quad (10)$$

A set of chemical phases is postulated for the system under consideration which the reaction model of the program then uses to calculate the amount of each phases necessary to satisfy equation (10). The selection of phases operable in the system is a matter of judgement by the user based on actual data or experience. Many reaction models can account for an observed change in water chemistry, and BALANCE cannot determine in any one of the postulated set of phases uniquely governs the reactions in the system. Additionally, BALANCE is not constrained by any thermodynamic criteria, so the user must independently verify whether a reaction is possible.

The data of Table 9 was utilized for the computer runs along with the phases postulated. The results of computer runs are given in Table 10. This table shows the chemical evolution with distance from the channel. Values in Table 10 are changes in the particular phase in units of mmol/kg. Precipitation of a phase is indicated by a minus sign, positive values are dissolution of that phase into the soil solution (Parkhurst et. al, 1982).

Dissolution or precipitation of a mineral phase proceeds in the absence of a chemical equilibria between the aqueous constituents and that mineral phase. The chemical equilibrium concentrations may shift depending upon the concentrations of the mineral phases present and the ratios

TABLE 10 Results of program BALANCE

PHASE	WELL P1 (mmol/kg)	WELL P2 (mmol/kg)	WELL P3 (mmol/kg)
CO_2 GAS	-0.2231	-2.0664	-2.0747
NaCl	-7.3950	-0.5224	11.9610
$CaSO_4$	-3.1540	1.3690	7.9270
NO_3^-	0.0350	-0.0271	-0.4140
CaF_2	-0.0032	0.0000	0.0079
KCl	-0.0972	-0.0563	1.6368
$CaMg(CO_3)_2$	-0.8926	0.8970	3.5920
$CaCO_3$	-1.5478	-1.7518	-5.6313
$CaCl_2$	3.3016	0.7335	-0.9809

Values are calculated on the basis of the equation:

Initial solution + reactant phases >

final solution + product phases

"product phases" are the computed values appearing in this table. Initial solution and final solutions are known from chemical analysis of water samples at two points along the flow path. Reactant phases are postulated for the under consideration based on the general chemical characteristics of the water samples.

of common ions such as Ca^{++} and Mg^{++}. Ion exchange reactions occur along the flow path as Ca^{++} and Mg^{++} are adsorbed and Na^{+} is released.

The data of Table 10 indicate that the surface water is supersaturated with respect to the soil solution for NaCl, $CaSO_4$, $CaCO_3$, and $CaMg(CO_3)_2$. This is because some precipitation of these phases has been calculated to have occurred between the channel and wells P1 and P2. However, it would be expected that along the flow path dissolution would occur into an initially dilute surface water. Therefore, the initial concentrations used for surface waters appear not to represent the true concentrations and have been "corrected" by the program by precipitating these phases between the channel and well P1 and P2.

Further along the flow path (well P3) Ca^{++} and Mg^{++} exchange with Na^{+} has taken place, dolomite has gone into solution, thus altering the equilibrium of calcite and anhydrite, resulting in the dissolution of anhydrite and the precipitation of calcite. Minor changes result in the phases of other minerals. Changes in CO_2 gas concentrations are directly related to the changes in concentrations of calcite and dolomite.

The pH of the surface water is variable depending on the source area of the channel water and the degree to which the local precipitation has added to the flow. Generally, however, the water in the channel is basic with a pH around 8.

On just the basis of the chemical evolution analysis, no strict conclusions can be drawn as to whether the water in the aquifer is wholly derived from infiltration through the channel bed. The sources and sinks postulated may not be those actually operating in the system under consideration, nor can it be shown conclusively that the flowpath is from the channel to well P2 then to well P3.

7.7 Stream Stage - Rio Salado.

Flow in the channel was recorded on the gage during late June and July of 1986 and in October of 1986 (Figure 22). The gage was initially sited based on surveying data of the lowest point in the channel along a reach of the south bank. However, rapid deposition and migration of the channel isolated the gage after July of 1986. The flow event of October 1986 scoured away they deposition around the stilling well inlet and the stage was recorded until the gage was washed away. For other time periods during the study the gage was either isolated or not in service any longer.

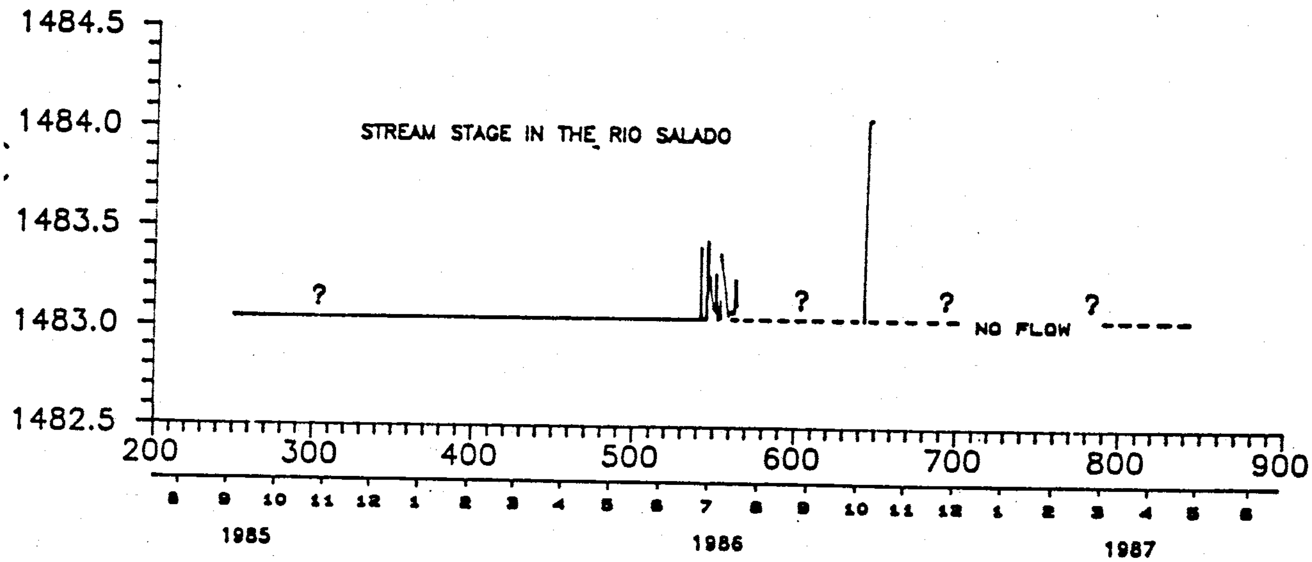

Figure 22. Stream stage in the Rio Salado at the upper site.

Water level data from the wells and field observations show that the Rio Salado flowed intermittently from June 1986 through February 1987. Flow occurred with much higher frequency in this period than in the same period for the year previous. This was in response to greater precipitation in the basin.

7.8 Soil Moisture - Rio Salado Upper Site.

Soil moisture data from the two neutron access tubes (figure 23) indicate rapid response at all depths to flow in the channel though the maximum water content of 30% is below saturation. (figure 24). This may have been due to entrapment of air during the rapid rise of the water table. During the flow event of October 1986 these tubes were swept away.

7.9 Soil Moisture - Rio Salado Lower Site.

The moisture contents for all depths are generally less than 10% by volume (Appendix 5, tube LN1-LN4). The sediments at this site are coarse grained, and depth to water is approximately 9 m. Only in tube LN3, below 5.5 m (figure 11), are moisture contents greater than 10% by volume. Observation of drill cuttings during the installation of well L3 nearby confirm the existence of finer grained silty sand with clay for these depths. The areal extent of such sediments is not known.

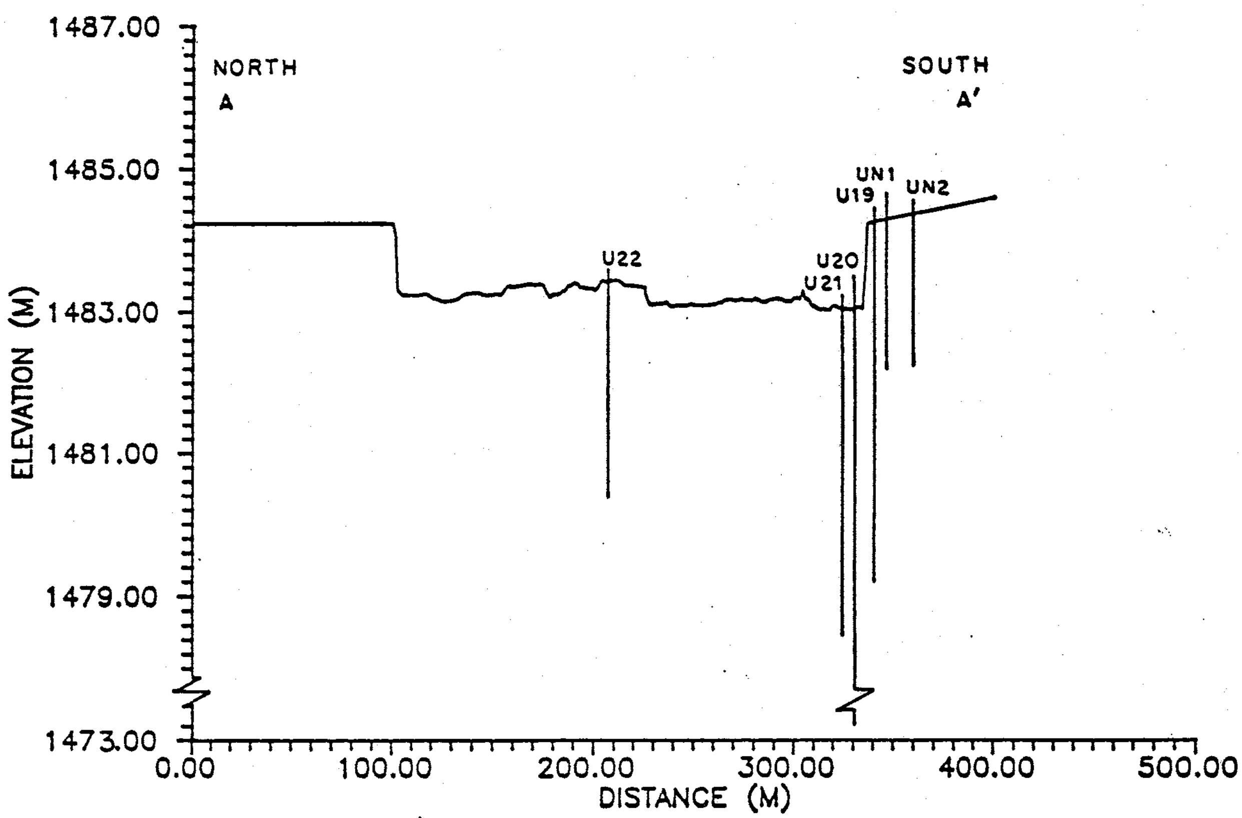

Figure 23. Cross-section of channel morphology and selected monitoring instrumentation at the Upper Rio Salado Site. (Note: Horizontal to vertical scale is 38:1)

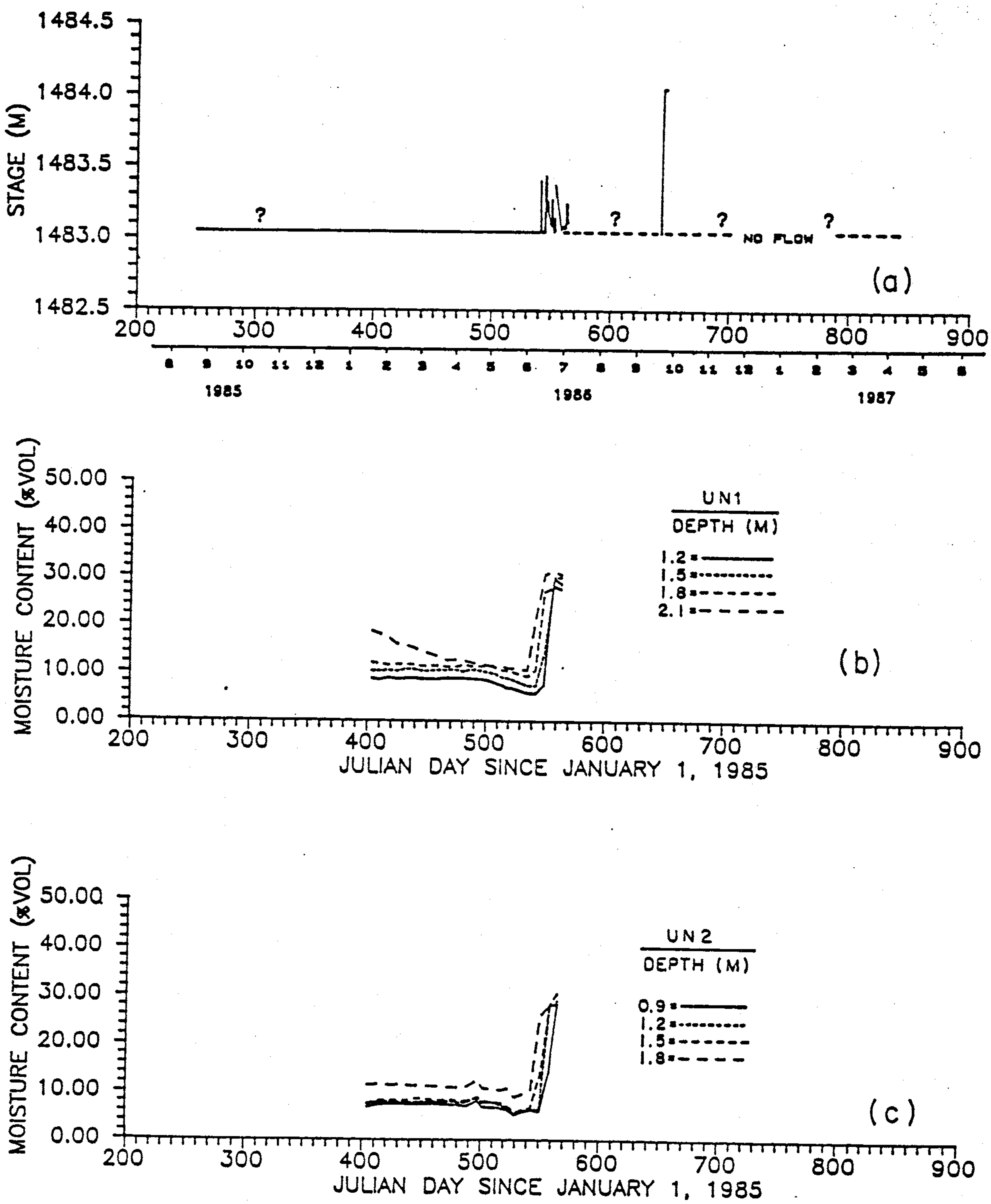

Figure 24. a) Stream stage and moisture content at b) UN1, and c) UN2.

The moisture contents in the profile for all locations at this site remain very stable through time. For tubes LN2, LN3, and LN4 there is very little change in the moisture content profile except at the bottom near the water table. Here the moisture content changes are related to the rise and fall of the water table and the capillary fringe above it.

The data from tube LN1 contrasts that of the other data sets in two respects. First, the profile in the channel appears to dry until just prior to the time it was destroyed in the flow of July 1986. Evaporation appears to be the mechanism for the decrease in moisture content in the upper levels of the profile, since the decrease in moisture content through time propagates from the surface down. For the deeper depths in the profile, drainage is taking place. Second, response of the profile to flow in the channel is quite different for tube LN1 than for the other tubes. Between days 185 and 193 of 1986, the moisture contents throughout the profile increase in tube LN1. The greatest changes in moisture contents occur near the surface. The moisture contents for the profile correspond to unsaturated conditions, averaging for all depths about 0.13. At the same time, mounding of the water table was occurring. Neutron tube LN1 was placed in the middle of the stream bed near a channel at old bridge pilings and when the Rio Salado flowed, the tube was within 2 m of the flow for all events.

The channels around the old bridge pilings did not change materially during the period of this study. However, these channels were 1 to 2 meters wide and 0.3 m deep, and have a lower width to depth ratio than where the channel was not controlled by structures.

7.10 Hydraulic Head - Rio Salado Sites.

The hydraulic head data from the upper site on the Rio Salado consist of the time series of water levels in well numbers 8-22 along a reach of the Rio Salado. Water level hydrographs of selected monitor wells are shown in Figure 25. The upper part of the figure shows water level hydrographs stream stage.

During flow events saturated conditions quickly develop beneath the channel and a ground-water mound develops. Figure 26 shows the shape of the mound at julian day 557 (julian day = 0 corresponds to January 1, 1985). The mound shown in figure 26 is not symmetric with respect to the longitudinal axis of the stream bed. This can be attributed to the fact that the mound initially propagates down stream as well as perpendicular to the channel. The depth to water in the channel at this site is approximately 2 m for most of the year.

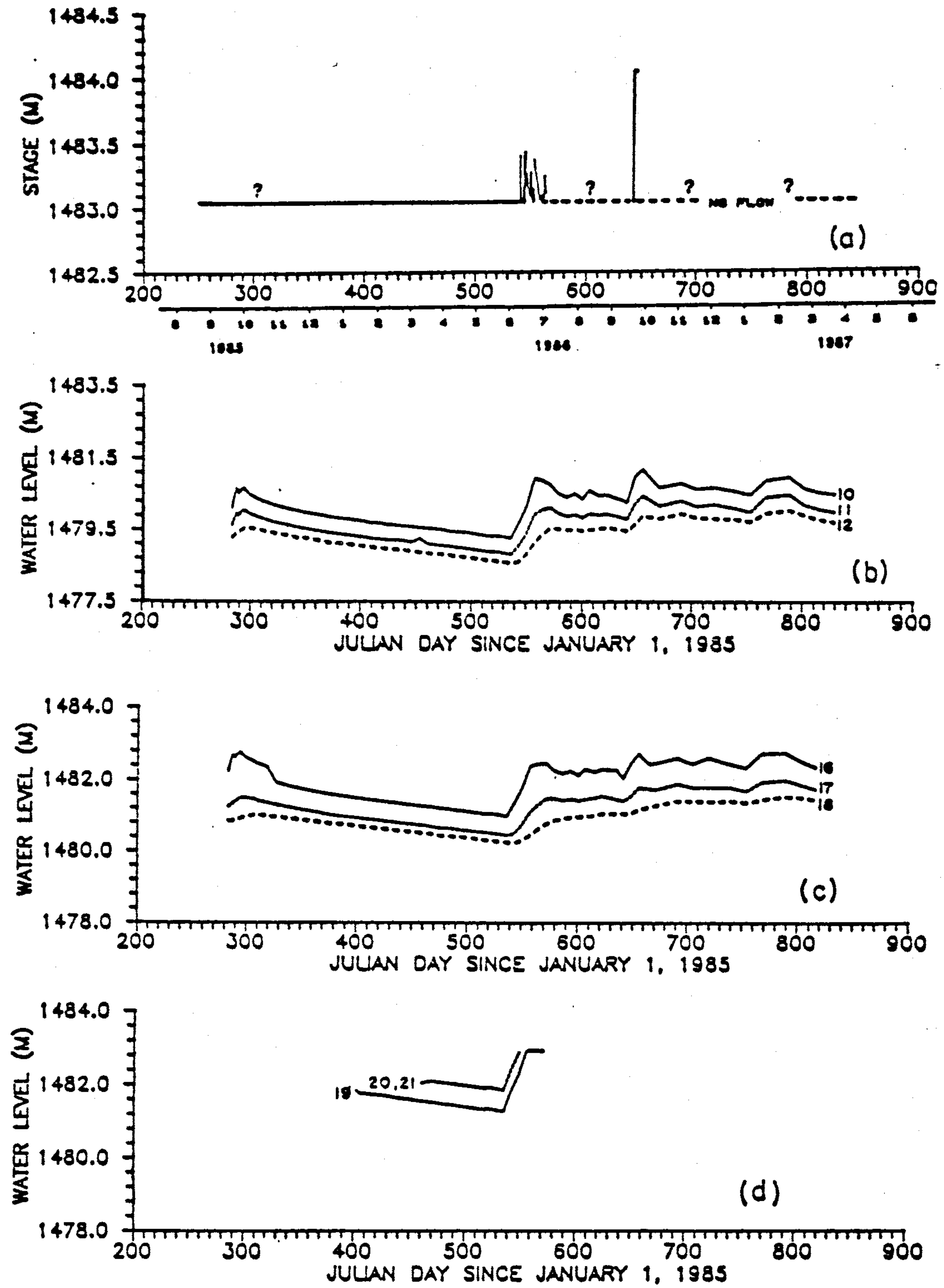

Figure 25. Stream stage and selected monitor well hydrographs at the Upper Rio Salado Site.

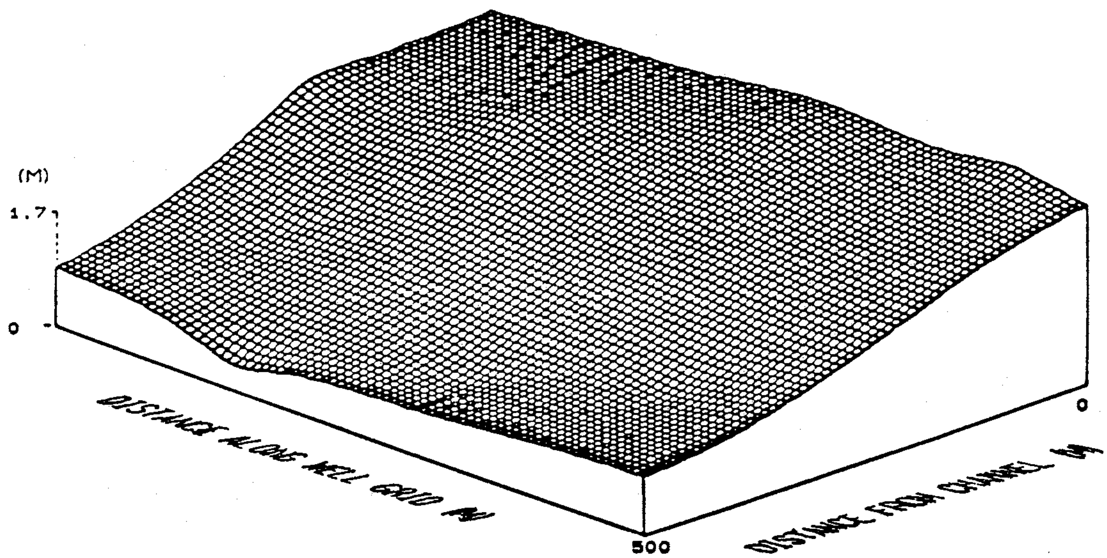

Figure 26. Water table mound beneath the Rio Salado during runoff. (Referenced to the water table surface on julian day 171, before any flow had occurred.)

The hydraulic head data from the lower site consist of observations of water levels in four wells placed perpendicular to and along the channel. (Figure 7). Water level hydrographs for the lower site are shown in Figure 27.

The hydrographs for the lower site monitor wells show that the water levels in wells L1, L2 and L3 had almost the same elevation during the period of record (Figure 27). These wells were placed in a line perpendicular to the channel bed. Therefore, the regional gradient in the area is in the direction of the channel bed of the Rio Salado itself. Water level elevation in well L4, located approximately 120 meters away from the channel and 120 meters upstream, was higher throughout the period of record. These water level elevations differences result in a water table gradient of 3 m/km for most of the period of record. The gradient of the channel bed is approximately 7 m/km at the same location.

The response of the water levels at the lower site indicate there were at least four major flow events which produced infiltration that reached the water table. Interestingly, the amplitude of the water level changes in the wells at the lower Rio Salado site is much greater for the same flow events as compared to the amplitude of the changes at the upper site. The most likely reason for this is shallow depth to water beneath the channel at the upper site.

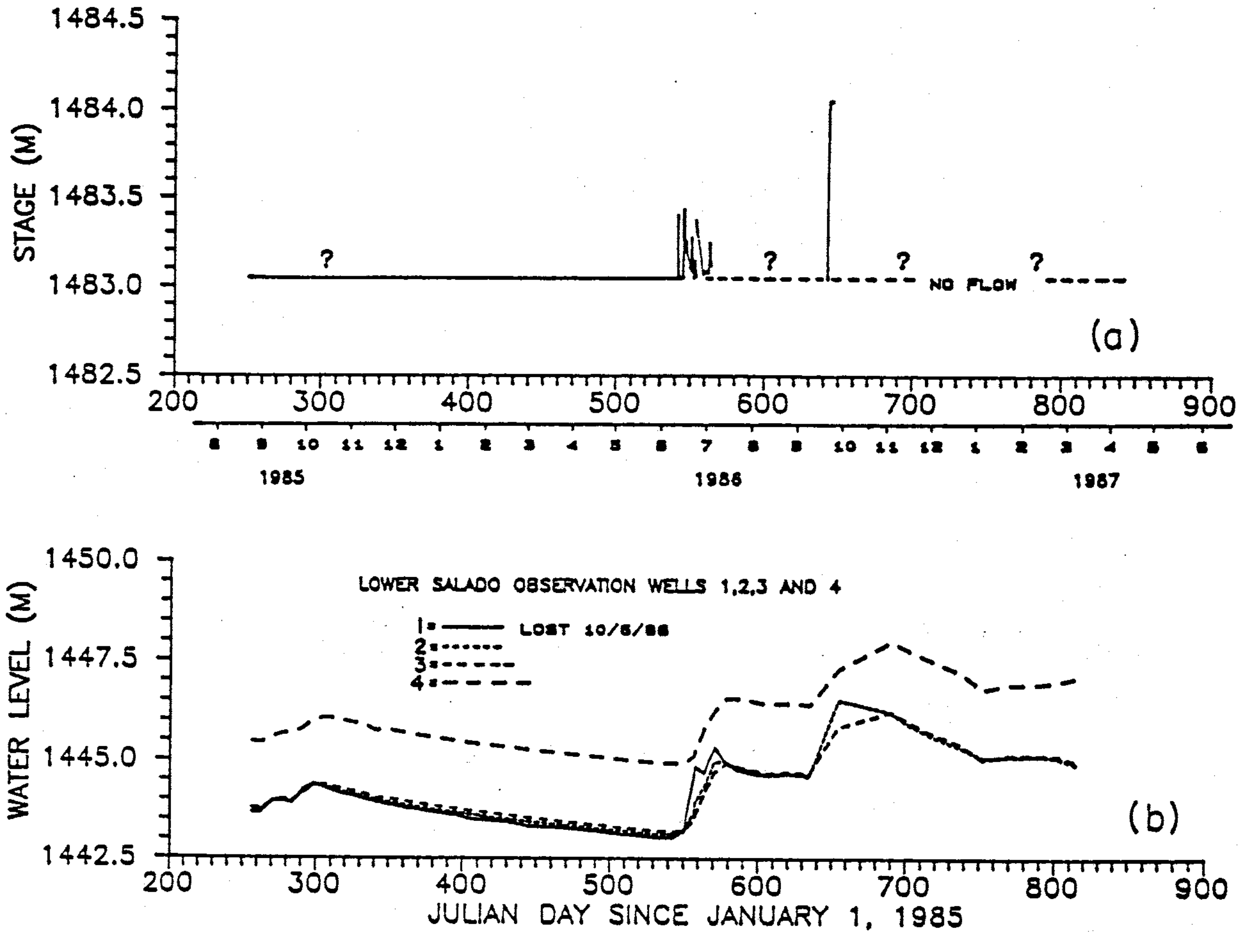

Figure 27. a) Stream stage at the upper Rio Salado site, and b) Water level hydrographs in monitor wells at the Lower Rio Salado Site.

Figure 27 shows that the amplitude of the water level response in the wells decreases with increasing distance from the channel. Note from Figure 26 that well L1, located in the middle of the channel was destroyed during the major flow event of October 6, 1986.

A comparison of small scale fluctuations in the water level hydrographs of the lower site wells (Figure 27) to those of wells U8 and U9 of the upper site (Figure 25), suggests that more flow events occurred at the upper site than did at the lower site. On several occasions I observed flow at the upper site that did not reach the lower site. Infiltration capacity of the bed of the Rio Salado appears to be high enough to cause a reduction in the amount of flow in the channel between these two sites which are located approximately 4.3 km apart.

The water table beneath the Rio Salado declines during most of the year when there is no recharge from stream infiltration (discharge of ground water to the Rio Grande exceeds recharge in the basin). Water levels in the aquifer during 1986 were higher than for the same period in 1985, due to more frequent flow events in the channel during 1986.

7.11 Stream-Aquifer Connection - Rio Salado.

Soil moisture data for the upper Rio Salado site indicates that water content increased sharply after runoff. The maximum water content, about 30 %, indicates the pore space was not completely saturated (figure 24). Full hydraulic connection appears to be established rapidly beneath the channel.

The water level hydrographs for the upper Rio Salado site show a rapid response to the two recorded runoff events in July and October 1986 (approximately days 540 and 645 , respectively). Subsequent to the destruction of the gaging station, the hydrographs indicate that runoff also occurred during February 1987. Throughout this period there is no evidence of bank storage contributions to runoff recession. This may be explained by the very shallow channel depth and shallow depth to ground water.

For the runoff event in July 1986, water level elevations in monitor wells U19, U20, and U21 near the gaging station were only slightly lower than the elevation of the base of the stream channel. The initial depth to the water table was shallow, and during this event water level elevations increased by only about 1 m (Figure 25). Water levels in and adjacent to the channel are just below the stream bed during runoff. At well U19 the water level on day 540 is nearly equal to the elevation of the base of the stream bed (Figures 25a and d). This suggests that the stream and aquifer are interconnected, in spite of the fact that the water content in the access tubes UN1 and UN2 adjacent to the channel was less than saturation (Figure 24). The apparent incomplete saturation may be attributed to air entrapped during a rapidly rising water table and possibly to errors inherent in the calibration of the neutron probe.

The available hydrogeologic data indicate that the interconnection between stream and aquifer are to be expected here, because of the shallow depth to ground water and because the coarse bedload of the stream is not likely to contribute sufficient fines to form a clogging layer. Also, owing to the very wide channel geometry, capillary effects are not likely to induce unsaturated flow conditions when there is bank-full discharge. The nature of stream-aquifer interaction at the upper site apparently follows the conceptual model identified as Condition IA in figure 18.

Soil moisture data from the lower Rio Salado site indicate that the maximum water content beneath the center of the channel was only about 17% during the runoff of July 1986 (Figure 28). At this time, roughly 30% of the channel was conveying water in several localized rivulets. During runoff, the sediments beneath the channel at this location appear to be unsaturated to a depth of about 8.5 m, even though the neutron probe access tube was located on a sand bar in the center of the main channel within about 2 m of the edge of a water-filled, local channel. Following runoff, there was only a slight increase in the water content in the neutron probe access tube LN2 located at the

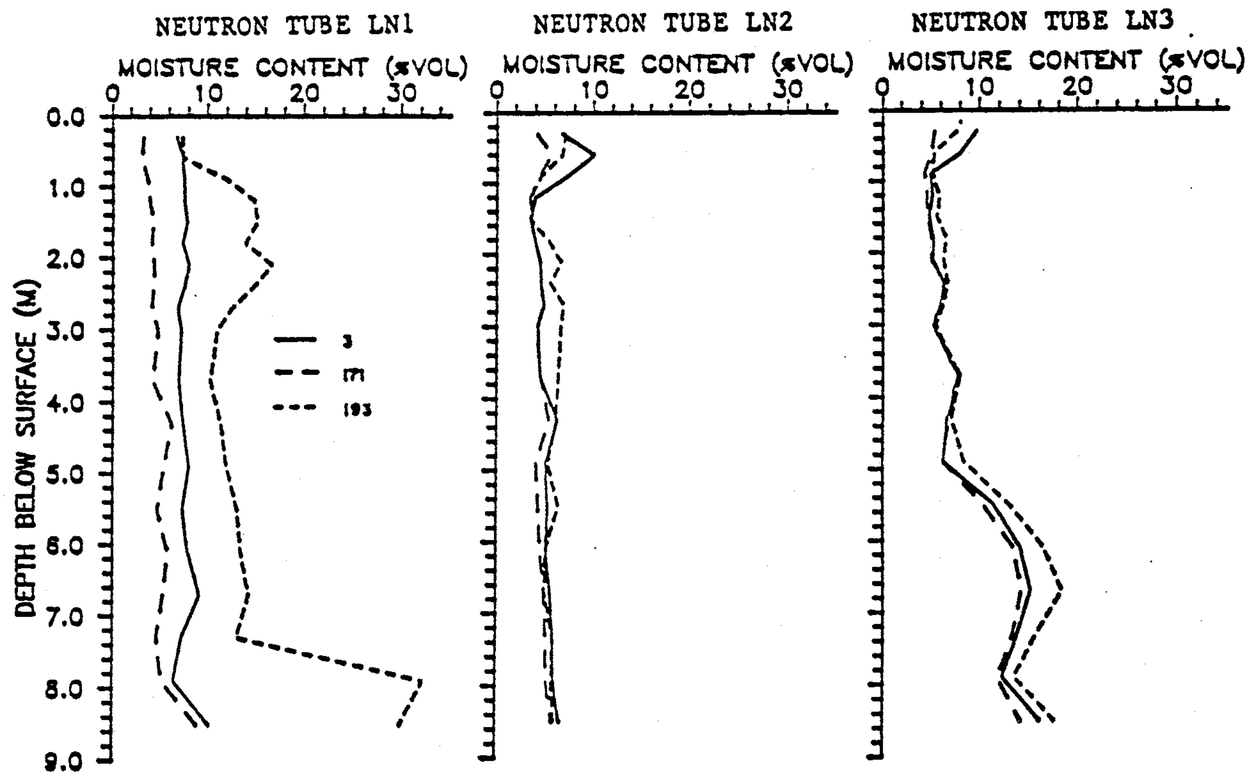

Figure 28. Moisture content profiles at the lower Rio Salado site. (Numbers are Julian Dates in 1986).

edge of the main channel, and virtually no significant change was detected in access tubes LN3 and LN4 on the floodplain (Figure 28).

Ground-water elevations in monitor wells L1 and L2 reflect the development of a small ground-water mound (Figure 29). However, the mound is about 8.5 m below the base of the channel (Figure 29). The water table does not intersect the stream and there is unsaturated flow beneath the channel during runoff. There was no geological evidence for a low-permeable clogging layer in the small channels during the late stages of recession. During the period of record water levels increased only by about 3.5 m (Figure 27). Because of the significant depth to groundwater, there is an opportunity for capillary effects to induce unsaturated flow conditions beneath the channel, especially when discharge occurs in localized rivulets. It can be concluded that the stream and aquifer were partially disconnected at the lower Rio Salado site during the period of record, as illustrated by condition 1B in Figure 18.

In comparing the relationships between surface and ground water at the two locations on the Rio Salado, it is apparent that the initial depth to ground water below the channel is a major factor in predicting whether a stream will be fully or partially connected. Local geology may have a significant influence on controlling depth to ground water. Previously it was noted that the alluvium at

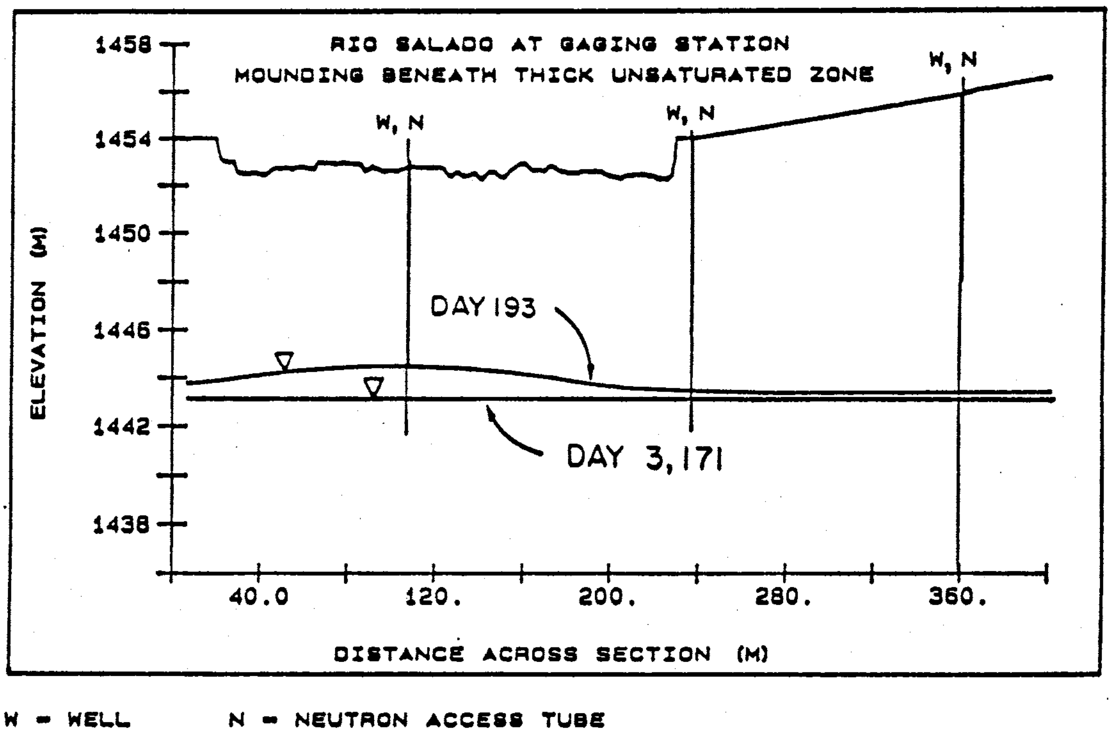

Figure 29. Ground-water mound developed at the lower Rio Salado site during the discharge events of July 1986.

the lower site east of the Loma Blanca fault may be thicker than at the upper site on the west side of the fault. Additional site characterization work is necessary to verify the importance of the geologic controls on stream-aquifer interaction on the Rio Salado.

7.12 Recharge - Rio Salado.

Ground-water recharge on the upper Rio Salado research site was determined by the convolution method. Before applying the convolution procedure, however, the hydraulic diffusivity of the aquifer was determined by a trial and error approach. This was accomplished by using equation 3 to predict the observed water level response to a brief period of runoff. For this analysis, water level data were chosen from monitor wells U10, U11, and U12 on julian day 286 of 1986, after about three days of discharge in the channel. Based on a reasonable fit of observed and predicted water levels, the diffusivity was estimated to be 823 cm^2/s. If it is assumed that specific yield is 20% and the aquifer thickness is about 18.3 m, then the hydraulic conductivity would have to be 9×10^{-2} cm/s in order to justify the estimated diffusivity. Such a value is larger than expected, but it is not unusual for coarse sand and gravel. A lower value of conductivity, which is in closer agreement with previous work, would be obtained if the aquifer were thicker and/or had a greater specific yield than that which was assumed in our analysis. Although the value of diffusivity may be approximate, Moench and Kisiel (1970) note that recharge is not highly sensitive to uncertainty in diffusivity.

An estimate of diffusivity having been obtained, the water level response in monitor well U14 was used as input to the convolution procedure. The period of record for the analysis began with the stream flow that commenced on approximately day 543 (about June 27, 1986). The recharge analysis was carried out on the next 40 weeks of water level data (Appendix 4). Figure 30 shows the stream stage, the well hydrograph for U14, and the cumulative input (recharge) function F(T). Recall that channel recharge is calculated from the input function using equation 4. Over the 40 week period, recharge from the channel totaled 1.04×10^{6} m^3/km. This amount would equal the annual recharge, if it is assumed that no other flow and recharge occurred during the year. The recharge flux would be approximately 3.2×10^{-3} cm/s, based upon a channel width of 50 m and flow in the channel occurring 14% of the year.

The recharge calculated by the convolution approach is compared to the results obtained by computing the volume of water stored in the ground-water mound beneath and adjacent to the channel. This was accomplished by first contouring

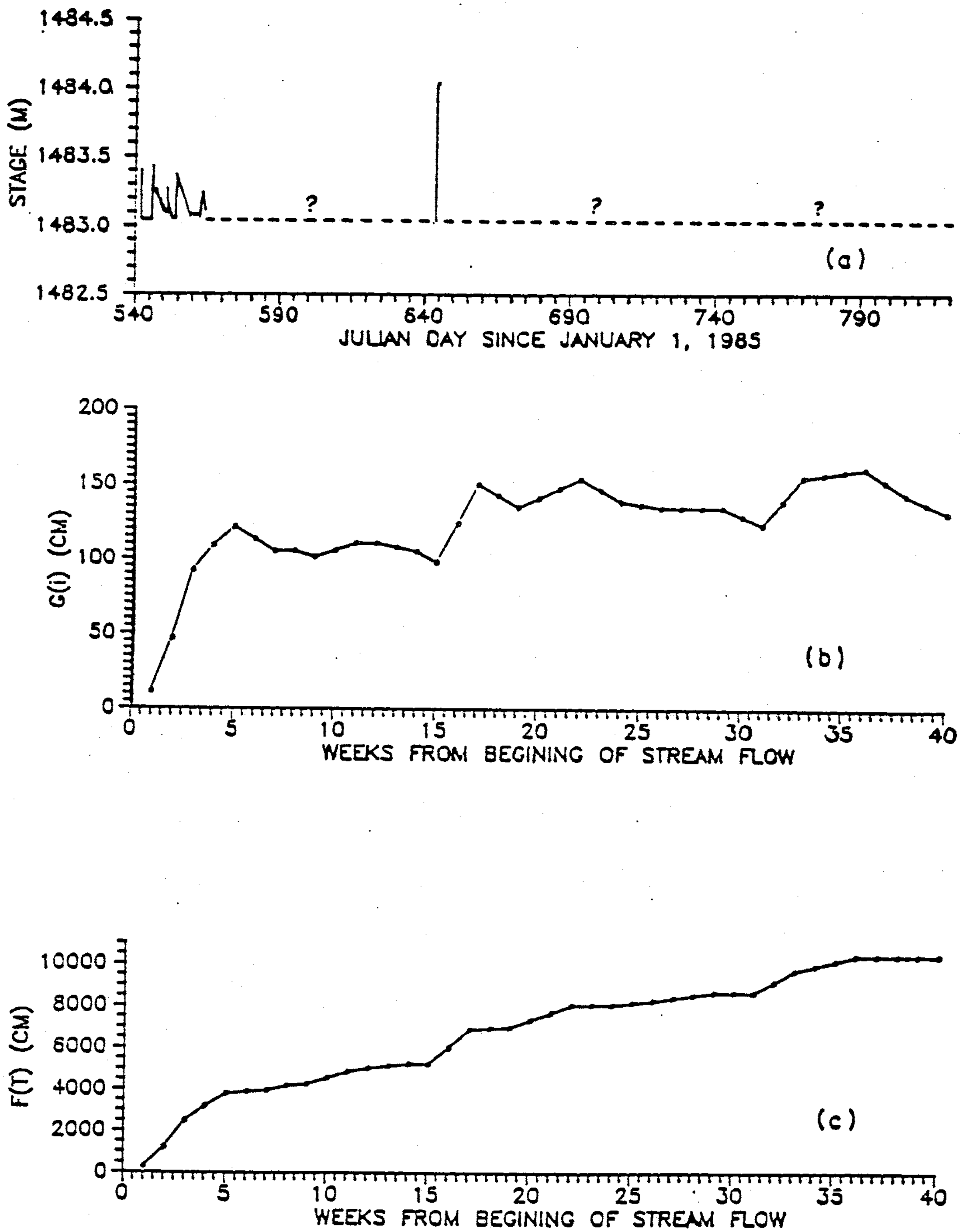

Figure 30 a) Stream stage at the Upper Rio Salado Site, b) Water level hydrograph for well U14, c) Cumulative input function, F(T).

the water level data from wells U8 through U18 using a Laplacian and spline interpolation scheme (Plot 88, Plotworks, Inc., La Jolla, CA). Next, differences in water level measurements were used in conjunction with Simpson's rule and an aquifer specific yield of 20% for integration to compute the increase in the volume of ground-water storage due to infiltration along a 520 m reach of the channel. For comparison, water level data during only the first three weeks after the flow began are used, because, thereafter the mound propagated beyond our most distant monitor wells. It is assumed that the ground-water mound propagates equally on both sides of the channel, although data are only available for the south-side of the Rio Salado. To obtain the results shown in Table 11, the stream reach length was set equal to the length of the monitor well network, 519 m. Table 11 illustrates that there is excellent agreement between both methods after the first week.

Recharge on the lower Rio Salado site was not calculated in this study. However, it is likely that recharge may be even greater than at the upper site. This is because the initial depth to ground water and the hydraulic gradient beneath the channel are much greater at the lower site.

Table 11. Ground Water Recharge at the Upper Rio Salado Site, June 27 to July 18, 1986 using the Convolution and Ground Water Mound Storage Methods.

Week	Recharge (m^3)		
	Convolution	Mound Storage	Percent Difference
1	14,791	23,996	61.5
2	63,121	69,264	9.7
3	129,879	137,288	5.4

8.0 COMPARISON OF THE RIO PUERCO AND RIO SALADO

The physical parameters of each stream are quite different even though both are ephemeral (Table 12). The Rio Puerco is a meandering stream flowing in an incised channel of low width to depth ratio and low gradient, whereas the Rio Salado is a braided system with high width to depth ratio and a steeper channel gradient. The Rio Puerco Basin drains an area approximately five times larger than that which drains drained by the Rio Salado. In addition, the Rio Puerco drains areas of higher elevation than the Rio Salado.

Sediments carried by the Rio Puerco are primarily silt and clay, whereas sediments carried by the Rio Salado include large fractions of sand and gravel. Not surprisingly, the hydraulic conductivity of the Rio Puerco channel bottom is about three orders of magnitude less than that of the Rio Salado in the vicinity of the sites. A consequence of theses factors is that the Rio Puerco flows more than twice as often as the Rio Salado. Mean annual discharge is greater for the Rio Puerco, yet for any single event, the Rio Salado discharge rate often exceeds that of the Rio Puerco.

Although the Rio Puerco flows more than twice as often as the Rio Salado (Table 12), recharge from the Rio Puerco on an annual basis is only about 5% of that for the Rio

Table 12. Physical Parameters of the Rio Puerco and Rio Salado

hysical Parameter	Rio Puerco (near Bernardo, NM)			Rio Salado (near San Acacia, NM)	
hannel Morphology	Meandering			Braided	
idth to Depth Ratio	20:1			200:1	
rainage Area (km^2)	18,816 Km^2			3,533 Km^2	
ischarge (ft^3/sec)					
period of record	1939-1985	1984	1985	1947-1984	1984
Mean	45.2	28.3	48.3	14.3	10.6
Extreme	18,800	1,690	14,000	36,200	14,000
ays of Flow (days/yr)					
period of record	1941-1959	1984	1985	1948-1959	1984
Mean	100	174	227	43	18
radient (m/km)	1			6	
uspended Sediment ischarge					
period of record (water years)	1984	1985		1984	
total load (tons)	2,678,574	3,398,587		N.A.	
T.D.S. (mg/l.)	1,800	N.A.		480	
daily mean load (tons/day)	7,339	9,311		N.A.	
epth to Ground ater (m)	1			1-9	

Salado. This is due to the area over which infiltration can occur in the channel and the permeability of the channel bottom sediments. For any prescribed discharge in the Rio Puerco and Rio Salado, the wetted perimeter of the Rio Salado is much greater than that of the Rio Puerco, as a consequence of the differences in the width to depth ratios. During the 40 week period June 27, 1986 to April2, 1987, the total recharge on the Rio Salado was about 1.0×10^6 m^3/km and the total recharge on the Rio Puerco was about 5.5×10^4 m^3/km.

9.0 CONCLUSIONS

Ground-water recharge from ephemeral streams may be a complex, dynamic process. Instrumentation installed on the Rio Puerco and Rio Salado and monitored from September 1985 through April 1987 indicates that recharge occurs through both saturated and unsaturated media beneath these streams.

On the Rio Puerco, unsaturated flow is caused apparently by a clogging layer on the channel bottom and sides; however, the clogging layer may be scoured and removed periodically. Another favorable condition for unsaturated flow is relatively low stream stage; when stage increases there may be a transition from unsaturated to saturated flow beneath the channel, even in the presence of a clogging layer. For most of the period of record, however, when there was a period of sustained flow, the Rio Puerco and the alluvial aquifer were fully hydraulically connected at the research site.

On the Rio Salado two sites were instrumented. At the upper site where the depth to water beneath the channel is about 1 m prior to runoff, the stream and aquifer appear to be fully hydraulically connected. The channel sediments are very sandy at both sites. There was no evidence of a fine-textured clogging layer. However, at the lower site, where the depth to the water table prior to runoff was about 12m, unsaturated flow occurred beneath the channel during runoff.

The unsaturated flow was probably a result of the combined influence of the significant depth to the water table, capillary forces, and the braided nature of the stream. At the lower site the stream and the aquifer were partially hydraulically disconnected.

Both the Rio Salado and Rio Puerco are influent streams. Results of analyses for recharge indicate that the recharge rate on the Rio Salado is about 3.2×10^{-3} cm/s and is about 3.76×10^{-5} cm/s on the Rio Puerco. Much more recharge occurs per kilometer along the Rio Salado, in spite of the much less frequent runoff periods, compared with the Rio Puerco. On an annual basis, recharge on the Rio Salado is about 10^6 m^3/km-yr. The Rio Salado is considerably more effective in inducing ground-water recharge.

10.0 RECOMMENDATIONS FOR FUTURE RESEARCH

This study helped answer questions of how ephemeral systems behave. In particular, evidence has been presented to confirm the existence of a clogging layer. Often the clogging layer will induce unsaturated flow beneath the stream. In ephemeral systems where there is a large depth to water and flow is localized in channels, unsaturated flow may occur. Ground water mounds may develop beneath thick unsaturated zones.

This study has also raised further questions about processes that influence the behavior of ephemeral systems. One aspect that deserves further study is the role that sediment load plays in establishing or removing a clogging layer. Also, what parameters such as type of sediment, pH, distribution of sediment load grain size or stream stage, to name a few, most influence the development of a clogging layer? Another question of interest is how does the antecedent condition of an ephemeral channel prior to flow influence the development of a clogging layer?

In this study recharge was determined for two different ephemeral streams. The methods utilized to compute recharge for the Rio Puerco each produced calculated flux rates to within an order of magnitude. For the Rio Salado the task has only been partially completed; recharge at the lower site has yet to be determined. Of particular interest would be the comparison of recharge estimates between the lower and upper sites.

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APPENDIX 1

GEOLOGIC LOG OF BORING NEAR P4 AT THE RIO PUERCO SITE

Depth (m) From	To	Sediment
0.0	1.52	fine sand - tan
1.52	3.05	fine sand - tan
3.05	4.27	fine sand - tan
4.27	4.57	alternating brown clay and fine sand in 1.75 cm to 5 cm distinct layers
4.57	5.03	Alternating brown clay and fine sand but with fine sand predominating
5.03	5.33	tan sandy clay - perched water at approximately 5 meters depth
5.33	6.10	fine to medium tan sand - dry
6.10	6.71	fine to medium tan sand
6.71	7.32	fine to medium tan sand - water at 6.71 meters
7.32	7.47	grey clay
7.47	7.62	coarse to very coarse sand
7.62	7.92	fine to medium tan sand
7.92	8.23	grey clay
8.23	9.14	fine to medium tan sand
9.14	9.75	grey sandy clay
9.75	10.36	medium angular sand
10.36	10.67	grey sandy clay
10.67	11.28	medium to coarse angular sand
11.28	11.89	grey silty sand with organic debris
11.89	12.19	brown clay
12.19	12.34	silty sand with clay
12.34	12.50	sticky grey clay
12.50	12.80	brown clay
12.80	12.95	silty sandy clay with organic matter
12.95	13.72	medium sand
13.72	14.94	sandy clay
14.94	15.24	sand and gravel < 2cm
15.24	16.76	medium grey sand
16.76	18.29	medium grey sand - coarse with pebbles near 18 meters
18.29	19.81	medium to coarse sand, poorly sorted with a few pebbles
19.81	30.48	medium to coarse sand, poorly sorted

GEOLOGIC LOG OF TRENCH INTO STREAM BANK AT THE RIO PUERCO SITE

Depth (cm)		Sediment
From	To	
0.0	7.62	fine sand - yellow
7.62	8.25	dark grey clay layer
8.25	17.78	fine tan sand
17.78	18.42	dark grey clay layer; minor fine roots
18.42	25.40	fine tan sand
25.40	26.67	red sandy clay
26.67	30.48	root horizon - live
30.48	53.34	fine tan sand
53.34	60.96	clay, grading from sandy red clay near the top into massive grey clay at 58 cm. Some organic matter at 58 cm. Thickness highly variable. Sloping of layer toward channel. Roots common in the red clay. Lower contact gradational into sandy clay.
60.96	86.36	fine tan sand
86.36	90.17	grey clay. Variable thickness. Some live roots on top of clay. Slopes towards channel
90.17	124.46	fine tan sand
124.46	132.08	fine tan sand interbedded with dark silt
132.08	134.62	grey to red sandy clay
134.62	139.70	fine tan sand
139.70	144.78	2 clay layers with interbedded sand. Top clay is grey, bottom clay is red. Lower clay contains some organic material. Minor root horizons on surfaces of the clays
144.78	146.05	sandy red clay
146.05	149.86	fine tan sand
149.86	151.13	solid grey clay with minor roots
151.13	152.40	fine tan sand
152.40	162.56	interbedded sand and silt. Major live root horizon at 162 cm.
162.56	198.12	medium tan sand - clean

GEOLOGIC LOG OF SHELBY TUBE SAMPLES TAKEN NEAR
THE STREAM CHANNEL AT THE RIO PUERCO SITE

Depth (cm) From	To	Description
0.0	45.72	fine sand - yellow with silty stringers
45.72	48.26	red silty sand
48.26	53.34	dark brown silty sand
53.34	101.60	fine to medium tan sand fine silt stringers
101.60	106.68	fine interbeds of sandy silt and silty sand
106.68	111.76	clean yellow - tan sand
111.76	114.30	clean yellow sand, but with interbedded grey clay
114.30	116.84	fine to medium yellow sand interbedded with red silty sand
116.84	144.78	fine sand with stringers of brown silty sand
144.78	162.56	fine sand with stringers of brown silty sand and very finely layered silt
162.56	187.96	fine sand with stringers of brown silty sand but with carbonized wood debris
187.96	193.04	fine to medium coarse tan sand. Upward fining, with brown clay lenses
193.04	203.20	massive brown clay with occasional pockets of clean coarse to very coarse quartz sand

GEOLOGICAL LOG OF NEUTRON ACCESSS TUBE PN3 AT THE RIO PUERCO SITE

Depth (cm) From	To	Sediment
0.0	30.48	fine yellow sand
30.48	60.96	fine yellow sand, with interbedded clays
60.96	121.80	fine tan sand
121.80	152.40	fine tan sand with interbedded clays and roots
152.40	213.36	medium to coarse sand
213.36	243.84	sticky, dirty coarse sand
243.84	304.80	poorly sorted fine to coarse sand

GEOLOGIC LOG OF WELL P1 AT THE RIO PUERCO SITE

Depth (m) From	To	Sediment
0.0	1.22	fine silty sand - yellow-green
1.22	1.83	fine silty sand, but with namy thin sandy clay layers
1.83	2.13	fine silty sand - yellow-green
2.13	2.74	fine to medium tan sand with some sandy clay stringers
2.74	3.66	fine to medium tan sand
3.66	4.27	medium to very coarse sub angular to subrounded sand
4.27	4.57	medium to coarse sand with sandy clay stringers
4.57	5.18	tan to grey massive clay
5.18	5.79	fine tan sand with silty clay stringers
5.79	6.10	fine to medium tan sand
6.10	6.71	red and tan massive clay
6.71	7.32	red-tan fine to medium, clean sand
7.32	7.62	fine to medium tan sand with minor fines
7.62	8.84	fine to medium tan sand with minor fines but clay content increasing downwards
8.84	9.14	fine grey sand with clay stringers
9.14	9.75	massive grey clay
9.75	10.36	fine tan to grey sand
10.36	10.67	fine red-tan sand, dirty

GEOLOGIC LOG OF BOREHOLE NEAR U1 AT THE RIO SALADO SITE

DEPTH (m)		DESCRIPTION OF SEDIMENT
FROM	TO	
0.0	0.79	medium to fine sand
0.79	1.77	well sorted medium to fine sand
1.77	3.05	fine to medium sand, some silt
3.05	3.96	siltly fine to medium sand, 5% gravel
3.96	4.57	medium to fine sand, some gravel
4.57	21.03	medium to fine sand, 5-10% gravel

GEOLOGIC LOG OF BOREHOLE NEAR WELL U20 AT THE RIO SALADO SITE

DEPTH (m) FROM	TO	DESCRIPTION OF SEDIMENT
0.0	1.52	medium to coarse sand, cobbles near 1.5 m.
1.52	3.35	poorly sorted sand to pea gravel
3.35	4.57	gravely sand
4.57	5.79	medium to coarse sand, coarsening downwards to very coarse pebbly sand.
5.79	7.32	medium to very coarse sand
7.32	9.14	medium to coarse sand, poorly sorted with gravel
9.14	22.25	coarse to very coarse sand. Some fines near 17m
22.25	unknown	impermeable. Fragments from split spoon after drop hammer was used indicate a shale.

APPENDIX 2

CONVOLUTION PROGRAM

```
C     THIS PROGRAM PERFORMS THE CONVOLUTION OF THE INVERSE
C     PROBLEM OF DETERMINING THE RECHARGE RATE FROM OBSERVATIONS
C     ON A SINGLE WELL.  THE VALUES OF THE WATER LEVEL DATA  ARE
C     INPUT INTO THE PROGRAM WHEN IT ASKS.  THESE VALUES ARE
C     COMPUTED A-PRIORI.  IN ADDITION THE VALUES OF THE RESPONSE
C     FUNCTION, h(i) ARE ALSO COMPUTED A-PRIORI AND INPUT WHEN
C     THE PROGRAM REQUESTS THEM.  THE OUTPUT IS DIRECTED TO THE
C     FILE F(i).DAT, AND CONSIST OF THE F(i) VALUES AND THE
C     TOTAL RECHARGE OVER THE CUMULATIVE TIME PERIOD, GIVEN IN
C     CENTIMETERS OF WATER.
C
      PROGRAM CONVOLUTE
C
      DIMENSION F(100),G(100),H(100),FT(100)
      INTEGER COUNT,FLAG
C
C
C
C
      OPEN(1,FILE='F(i).DAT',STATUS='NEW')
      OPEN(2,FILE='H(I)F(I).DAT',STATUS='NEW')
      WRITE(*,5)
5     FORMAT(' ENTER THE TOTAL NUMBER OF OBSERVATIONS > ',\)
      READ(*,*)COUNT
      FLAG=COUNT
C
C
      DO 20 I=1,COUNT
           WRITE(*,10)
10         FORMAT(' ENTER THE VALUE FOR h(i) > ',\)
           WRITE(*,15)i
15         FORMAT(10X,I2,5X,\)
           READ(*,16)h(i)
16         FORMAT(F10.6)
           F(i)=0
           G(i)=0
           FT(i)=0
20    CONTINUE
C
C
      DO 40 i=1,COUNT
           WRITE(*,25)
25         FORMAT(' ENTER VALUE FOR G( ) > ',\)
           WRITE(*,30)i
```

```
30          FORMAT(10X,I3,5X,\)
            READ(*,16)g(i)
40     CONTINUE
C
C
       COUNT=2
       L=1
       F(1)=G(1)/h(1)
       WRITE(1,65)L,F(1),F(1)
       WRITE(2,61)L,G(1),H(1)
61     FORMAT(I3,2X,F10.3,2X,F10.6)
       DO 70 i=2,FLAG
            DO 60 j=2,i
                 F(i)=F(i)-h(j)*F(i-j+1)
60          CONTINUE
            F(i)=(G(i)+F(i))/h(1)
C
            IF(F(i).LT.0)THEN
               IF(COUNT.LE.2)FT(COUNT)=FT(COUNT-1)
               IF(COUNT.GT.3)FT(COUNT)=FT(COUNT-1)
               IF(COUNT.EQ.3)FT(COUNT)=FT(COUNT-1)+F(1)
               GO TO 64
            END IF
            IF(COUNT.LE.2)FT(COUNT)=FT(COUNT-1)+F(i)
            IF(COUNT.GT.3)FT(COUNT)=FT(COUNT-1)+F(i)
            IF(COUNT.EQ.3)FT(COUNT)=FT(COUNT-1)+F(i)+F(1)
C
64          WRITE(1,65)i,F(i),FT(COUNT)
65          FORMAT(I3,3X,F9.3,3X,F10.3)
            write(2,61)i,g(i),h(i)
C
            IF(COUNT.EQ.FLAG)GO TO 90
            COUNT=COUNT+1
C
70     CONTINUE
C
90     STOP
       END
```

APPENDIX 3

STREAM STAGE DATA
RIO PUERCO

Julian Day Since January 1, 1985	Stream Stage (m)
416.496	1442.008
416.525	1442.463
416.533	1442.464
416.566	1442.468
416.611	1442.473
416.669	1442.474
416.818	1442.470
416.970	1442.464
417.028	1442.458
417.189	1442.452
417.300	1442.447
417.379	1442.443
417.498	1442.440
417.606	1442.441
417.758	1442.436
417.820	1442.435
417.931	1442.439
418.039	1442.442
418.171	1442.443
418.266	1442.444
418.373	1442.443
418.484	1442.438
418.604	1442.434
418.748	1442.437
418.888	1442.439
418.987	1442.443
419.078	1442.448
419.161	1442.453
419.194	1442.460
419.243	1442.470
419.342	1442.473
419.433	1442.471
419.536	1442.463
419.627	1442.461
419.668	1442.463
419.718	1442.463
419.730	1442.460
419.813	1442.455
419.916	1442.449

419.990	1442.442
420.056	1442.438
420.225	1442.424
420.320	1442.417
420.411	1442.411
420.534	1442.403
420.629	1442.393
420.691	1442.384
420.761	1442.377
420.819	1442.369
420.889	1442.361
420.939	1442.363
420.980	1442.367
421.108	1442.369
421.244	1442.368
421.310	1442.370
421.376	1442.372
421.425	1442.372
421.570	1442.367
421.673	1442.356
421.751	1442.346
421.830	1442.342
421.912	1442.336
421.958	1442.332
422.011	1442.326
422.052	1442.321
422.131	1442.316
422.217	1442.311
422.300	1442.304
422.345	1442.299
422.403	1442.291
422.473	1442.286
422.519	1442.283
422.601	1442.280
422.655	1442.278
422.729	1442.275
422.849	1442.270
422.923	1442.266
422.968	1442.263
423.014	1442.261
423.117	1442.260
423.203	1442.258
423.335	1442.257
423.509	1442.247
423.459	1442.252
423.599	1442.269
423.632	1442.267
423.987	1442.256

424.544	1442.253
424.697	1442.254
424.808	1442.258
424.870	1442.251
424.936	1442.246
425.150	1442.236
425.291	1442.227
425.501	1442.216
425.555	1442.216
425.654	1442.209
425.777	1442.196
425.856	1442.186
425.909	1442.181
425.971	1442.179
426.103	1442.172
426.260	1442.162
426.409	1442.150
426.483	1442.146
426.603	1442.142
426.730	1442.139
426.879	1442.136
427.102	1442.134
427.415	1442.133
427.704	1442.130
428.446	1442.131
428.880	1442.129
429.441	1442.128
429.680	1442.125
429.936	1442.124
430.439	1442.123
431.045	1442.125
431.532	1442.121
431.503	1442.009
461.605	1442.009
461.683	1442.194
461.741	1442.268
461.803	1442.366
461.807	1442.444
461.869	1442.591
461.926	1442.602
462.009	1442.605
462.058	1442.604
462.120	1442.600
462.166	1442.595
462.211	1442.586
462.228	1442.581
462.248	1442.582
462.285	1442.580

462.310	1442.581
462.351	1442.592
462.401	1442.622
462.413	1442.638
462.434	1442.644
462.442	1442.652
462.487	1442.642
462.549	1442.636
462.599	1442.628
462.673	1442.613
462.690	1442.597
462.727	1442.581
462.772	1442.567
462.822	1442.554
462.859	1442.544
462.912	1442.539
462.958	1442.537
463.020	1442.538
463.065	1442.550
463.131	1442.550
463.201	1442.547
463.238	1442.547
463.337	1442.551
463.395	1442.543
463.486	1442.520
463.531	1442.521
463.568	1442.524
463.630	1442.524
463.704	1442.518
463.791	1442.508
463.865	1442.494
463.915	1442.483
463.997	1442.481
464.039	1442.477
464.117	1442.484
464.171	1442.494
464.237	1442.495
464.282	1442.487
464.319	1442.482
464.377	1442.479
464.435	1442.477
464.529	1442.475
464.641	1442.472
464.777	1442.467
464.868	1442.461
464.921	1442.458
465.020	1442.457
465.082	1442.449

465.136	1442.441
465.181	1442.432
465.214	1442.424
465.276	1442.417
465.338	1442.421
465.350	1442.432
465.367	1442.453
465.379	1442.465
465.499	1442.432
465.693	1442.401
465.759	1442.386
465.788	1442.379
465.928	1442.364
466.146	1442.355
466.225	1442.349
466.229	1442.349
466.299	1442.295
466.365	1442.281
466.431	1442.271
466.435	1442.224
466.444	1442.248
466.538	1442.265
466.580	1442.264
466.716	1442.263
466.922	1442.273
467.091	1442.268
467.248	1442.266
467.434	1442.263
467.405	1442.265
467.475	1442.303
467.594	1442.311
467.693	1442.320
467.776	1442.342
467.809	1442.352
467.891	1442.343
467.990	1442.389
468.028	1442.392
468.098	1442.475
468.114	1442.482
468.151	1442.479
468.176	1442.471
468.308	1442.415
468.345	1442.411
468.399	1442.402
468.506	1442.425
468.622	1442.397
468.770	1442.376
468.943	1442.337

469.112	1442.307
469.335	1442.267
469.480	1442.248
469.641	1442.240
470.024	1442.213
470.247	1442.202
470.437	1442.315
470.461	1442.325
470.486	1442.329
470.540	1442.325
470.787	1442.286
470.907	1442.262
471.006	1442.238
471.076	1442.224
471.225	1442.204
471.390	1442.183
471.550	1442.166
471.621	1442.162
471.682	1442.181
471.781	1442.180
471.930	1442.257
471.996	1442.281
472.025	1442.285
472.078	1442.281
472.190	1442.267
472.342	1442.242
472.611	1442.212
472.710	1442.205
472.788	1442.196
472.825	1442.196
473.056	1442.177
473.328	1442.152
473.432	1442.144
473.407	1442.130
473.603	1442.142
473.933	1442.136
474.259	1442.126
474.527	1442.119
474.750	1442.118
475.014	1442.111
475.237	1442.104
475.431	1442.099
475.728	1442.104
475.843	1442.103
475.983	1442.099
476.280	1442.075
476.330	1442.073
476.458	1442.079

476.569	1442.113
476.714	1442.139
476.829	1442.142
477.122	1442.138
477.291	1442.141
477.481	1442.161
477.592	1442.167
477.741	1442.164
477.889	1442.153
478.260	1442.133
478.351	1442.140
478.516	1442.152
478.586	1442.155
478.685	1442.151
478.929	1442.123
478.970	1442.117
478.970	1442.104
479.098	1442.103
479.279	1442.087
479.481	1442.075
479.729	1442.064
479.906	1442.054
480.080	1442.046
480.220	1442.040
481.004	1442.024
487.699	1442.210
487.612	1442.215
487.666	1442.206
487.682	1442.207
487.905	1442.191
487.942	1442.193
487.975	1442.221
487.996	1442.251
488.054	1442.233
488.153	1442.206
488.268	1442.192
488.437	1442.180
488.536	1442.165
488.693	1442.144
488.829	1442.135
488.932	1442.123
489.031	1442.112
489.126	1442.104
489.221	1442.097
489.365	1442.094
489.555	1442.075
489.605	1442.066
489.741	1442.068

489.844	1442.065
490.009	1442.066
490.096	1442.071
490.199	1442.071
490.199	1442.086
490.261	1442.306
490.285	1442.309
490.331	1442.307
490.504	1442.323
490.516	1442.393
490.595	1442.396
490.661	1442.386
490.710	1442.375
490.764	1442.385
490.784	1442.397
490.867	1442.395
490.958	1442.373
491.024	1442.357
491.065	1442.345
491.119	1442.333
491.176	1442.352
491.209	1442.388
491.213	1442.414
491.234	1442.436
491.255	1442.473
491.308	1442.501
491.424	1442.492
491.531	1442.475
491.609	1442.681
491.663	1442.703
491.696	1442.704
491.729	1442.702
491.799	1442.678
491.865	1442.651
491.997	1442.589
492.084	1442.545
492.191	1442.504
492.344	1442.448
492.550	1442.403
492.682	1442.376
492.810	1442.353
492.925	1442.336
493.061	1442.320
493.161	1442.315
493.243	1442.314
493.284	1442.328
493.375	1442.396
493.441	1442.468

493.458	1442.468
493.466	1442.470
493.507	1442.490
493.577	1442.492
493.647	1442.489
493.870	1442.448
494.192	1442.408
494.369	1442.385
494.485	1442.369
494.567	1442.354
494.559	1442.345
495.054	1442.279
495.306	1442.257
495.487	1442.244
495.603	1442.233
496.704	1442.253
496.770	1442.349
496.861	1442.396
496.980	1442.399
497.071	1442.376
497.203	1442.319
497.315	1442.269
497.405	1442.238
497.480	1442.210
497.603	1442.169
497.723	1442.146
497.958	1442.113
498.090	1442.092
498.362	1442.057
498.556	1442.037
498.783	1442.022
501.658	1442.009
508.147	1442.009
511.790	1442.009
511.835	1442.062
511.996	1442.068
512.223	1442.071
512.347	1442.073
512.499	1442.075
512.685	1442.076
512.957	1442.078
513.308	1442.080
513.572	1442.081
513.712	1442.082
513.795	1442.083
513.865	1442.116
513.914	1442.158
513.968	1442.245

513.997	1442.255
514.050	1442.252
514.092	1442.248
514.137	1442.243
514.145	1442.230
514.199	1442.217
514.228	1442.208
514.310	1442.203
514.405	1442.199
514.459	1442.201
514.512	1442.203
514.611	1442.196
514.640	1442.274
514.648	1442.286
514.694	1442.284
514.735	1442.265
514.772	1442.266
514.785	1442.296
514.809	1442.337
514.818	1442.361
514.834	1442.371
514.867	1442.363
514.983	1442.265
515.044	1442.239
515.123	1442.220
515.222	1442.212
515.333	1442.207
515.416	1442.204
515.436	1442.216
515.515	1442.206
515.536	1442.207
516.175	1442.177
516.769	1442.143
517.524	1442.110
517.697	1442.697
517.697	1442.764
517.755	1442.674
517.800	1442.593
517.904	1442.517
517.936	1442.504
518.027	1442.513
518.184	1442.481
518.217	1442.508
518.225	1442.520
518.291	1442.514
518.394	1442.488
518.663	1442.463
518.922	1442.439

518.955	1442.441
518.960	1442.504
518.984	1442.532
519.125	1442.517
519.178	1442.505
519.257	1442.492
519.343	1442.482
519.376	1442.480
519.409	1442.495
519.413	1442.541
519.422	1442.660
519.459	1442.675
519.521	1442.660
519.595	1442.601
519.768	1442.517
520.073	1442.480
520.214	1442.459
520.259	1442.455
520.329	1442.460
520.457	1442.458
520.779	1442.445
520.952	1442.439
521.315	1442.400
521.435	1442.802
521.472	1442.925
521.546	1442.898
521.715	1442.796
521.785	1442.681
521.855	1442.651
522.053	1442.584
522.119	1442.604
522.330	1442.577
522.524	1442.572
522.680	1442.578
522.685	1442.570
522.709	1442.732
522.713	1442.810
522.953	1442.784
522.957	1442.767
522.949	1442.747
522.990	1442.724
523.019	1442.692
523.048	1442.776
523.052	1442.799
523.105	1442.796
523.155	1442.788
523.217	1442.742
523.225	1442.700

523.250	1442.679
523.250	1442.648
523.254	1442.609
523.274	1442.553
523.291	1442.542
523.390	1442.542
523.423	1442.547
523.435	1442.555
523.472	1442.555
523.563	1442.544
523.613	1442.541
523.666	1442.538
523.786	1442.518
523.893	1442.497
524.120	1442.465
524.335	1442.429
524.586	1442.386
524.809	1442.353
525.065	1442.319
525.296	1442.289
525.564	1442.253
525.807	1442.223
525.985	1442.203
526.306	1442.170
526.513	1442.149
526.777	1442.120
527.028	1442.095
527.020	1442.096
527.523	1442.054
527.936	1442.021
528.522	1442.009
541.206	1442.009
541.305	1442.123
541.359	1442.150
541.400	1442.182
541.429	1442.226
541.446	1442.266
541.462	1442.297
541.532	1442.329
541.557	1442.359
541.664	1442.391
541.751	1442.403
541.912	1442.406
541.994	1442.406
542.250	1442.380
542.382	1442.350
542.498	1442.321
542.584	1442.274

542.642	1442.233
542.704	1442.191
542.791	1442.155
542.861	1442.120
542.923	1442.090
543.005	1442.062
543.088	1442.037
543.149	1442.018
543.409	1442.567
543.459	1442.768
543.587	1442.983
543.492	1443.161
543.611	1443.160
543.640	1443.158
543.657	1443.109
543.702	1443.095
543.772	1443.081
543.966	1443.059
544.168	1443.046
544.379	1443.034
544.734	1443.020
545.125	1443.007
545.501	1442.997
545.744	1442.990
545.868	1442.988
545.889	1442.996
545.897	1443.017
545.913	1443.036
545.930	1443.039
546.074	1443.041
546.136	1443.041
546.400	1443.036
546.664	1443.028
546.982	1443.022
547.233	1443.018
547.551	1443.011
547.889	1443.005
547.976	1443.013
548.112	1443.014
548.591	1443.007
548.999	1443.002
549.383	1442.997
549.787	1442.993
549.985	1442.991
550.274	1442.989
550.439	1442.998
550.348	1442.985
550.463	1442.982

551.012	1442.977
551.297	1442.972
551.697	1442.967
552.002	1442.963
552.316	1442.959
552.563	1442.958
552.889	1442.957
553.182	1442.956
553.458	1442.954
553.730	1442.952
553.891	1442.950
553.924	1442.988
554.032	1442.990
554.143	1442.988
554.164	1442.994
554.374	1442.990
554.737	1442.987
555.154	1442.983
555.339	1442.981
555.517	1442.979
555.521	1442.999
555.541	1443.031
555.541	1443.067
555.690	1443.067
555.715	1443.079
555.818	1443.130
556.012	1443.129
556.300	1443.126
556.647	1443.122
557.039	1443.116
557.237	1443.115
557.529	1443.136
557.846	1443.139
558.684	1443.140
559.682	1443.141
560.495	1443.143
561.497	1443.142
562.186	1443.143
562.892	1443.143
563.630	1443.144
564.315	1443.148
564.319	1443.152
564.645	1443.157
564.995	1443.160
565.173	1443.159
565.643	1443.157
566.130	1443.140
566.435	1443.128

566.646	1443.115
571.200	1443.100
571.331	1442.462
571.534	1442.428
571.748	1442.378
571.983	1442.337
572.161	1442.311
572.284	1442.287
572.499	1442.245
572.631	1442.218
572.759	1442.196
572.862	1442.180
573.015	1442.154
573.126	1442.136
573.196	1442.125
573.378	1442.089
573.452	1442.078
573.716	1442.071
574.025	1442.055
574.392	1442.039
574.722	1442.021
575.011	1442.005
585.229	1442.009
585.530	1442.018
585.613	1442.026
585.683	1442.035
585.811	1442.055
585.947	1442.093
585.922	1442.127
585.440	1442.145
585.452	1442.140
585.493	1442.125
585.666	1442.094
585.860	1442.063
586.054	1442.033
586.100	1442.025
586.116	1442.025
586.458	1442.022
586.520	1442.020
586.566	1442.044
586.376	1442.061
586.430	1442.065
586.496	1442.068
586.500	1442.065
586.817	1442.062
587.015	1442.052
587.292	1442.034
587.337	1442.034

587.081	1442.039
587.139	1442.030
587.646	1442.009
600.583	1442.005
602.093	1442.004
602.914	1442.004
603.842	1442.003
604.358	1442.004
604.500	1442.300
604.700	1442.600
604.900	1442.800
604.923	1442.700
605.010	1442.600
605.129	1442.500
605.290	1442.400
605.385	1442.300
605.426	1442.200
605.476	1442.128
605.707	1442.591
605.831	1442.550
605.959	1442.522
606.099	1442.507
606.206	1442.510
606.227	1442.534
606.231	1442.543
606.392	1442.510
606.574	1442.492
606.615	1442.483
606.706	1442.487
606.730	1442.506
606.776	1442.521
606.862	1442.515
606.920	1442.487
606.966	1442.460
606.999	1442.427
607.011	1442.405
607.077	1442.378
607.118	1442.344
607.168	1442.341
607.180	1442.342
607.263	1442.335
607.378	1442.317
607.456	1442.283
607.510	1442.265
607.555	1442.254
607.667	1442.245
607.811	1442.239
607.902	1442.228

608.001	1442.213
608.079	1442.194
608.187	1442.180
608.310	1442.165
608.405	1442.151
608.488	1442.145
608.677	1442.142
608.814	1442.135
608.958	1442.119
609.090	1442.103
609.218	1442.088
609.342	1442.078
609.461	1442.068
609.494	1442.098
609.568	1442.152
609.676	1442.195
609.816	1442.209
610.043	1442.192
610.245	1442.173
610.410	1442.159
610.513	1442.153
610.666	1442.155
610.765	1442.154
610.835	1442.148
610.979	1442.131
611.082	1442.116
611.202	1442.100
611.252	1442.096
611.260	1442.177
611.334	1442.225
611.359	1442.231
611.437	1442.211
611.516	1442.167
611.594	1442.134
611.705	1442.094
611.775	1442.080
611.920	1442.046
612.068	1442.020
614.044	1442.021
614.614	1442.024
615.063	1442.028
615.546	1442.023
616.000	1442.025
616.379	1442.028
616.453	1442.135
616.478	1442.160
616.536	1442.164
616.705	1442.160

616.812	1442.148
616.891	1442.130
616.986	1442.117
617.134	1442.112
617.188	1442.126
617.225	1442.133
617.299	1442.135
617.410	1442.139
617.505	1442.138
617.629	1442.137
617.674	1442.137
617.683	1442.138
617.699	1442.224
617.699	1442.262
617.712	1442.301
617.761	1442.380
617.769	1442.409
617.769	1442.411
617.806	1442.461
617.778	1442.507
617.815	1442.547
617.918	1442.549
618.116	1442.549
618.190	1442.563
618.268	1442.593
618.339	1442.626
618.367	1442.651
618.462	1442.683
618.590	1442.679
618.598	1442.659
618.615	1442.637
618.681	1442.608
618.768	1442.578
618.829	1442.552
618.933	1442.517
619.007	1442.475
619.073	1442.446
619.168	1442.422
619.242	1442.403
619.329	1442.386
619.436	1442.374
619.568	1442.362
619.659	1442.358
619.774	1442.350
619.836	1442.346
619.980	1442.378
620.121	1442.407
620.228	1442.409

620.327	1442.403
620.306	1442.403
620.327	1442.397
620.706	1442.403
621.152	1442.347
621.354	1442.331
621.519	1442.334
621.581	1442.337
621.940	1442.296
622.117	1442.282
622.257	1442.275
622.381	1442.283
622.534	1442.278
622.591	1442.276
622.695	1442.356
622.666	1442.495
622.773	1442.559
622.901	1442.563
623.012	1442.657
623.033	1442.777
623.173	1442.885
623.482	1442.863
624.369	1442.575
625.198	1442.334
625.784	1442.250
626.069	1442.221
626.197	1442.328
626.246	1442.370
626.341	1442.412
626.436	1442.426
626.568	1442.402
627.195	1442.259
627.385	1442.252
627.665	1442.224
627.884	1442.249
628.024	1442.252
628.160	1442.237
628.441	1442.219
628.453	1442.218
628.891	1442.178
629.183	1442.169
629.567	1442.161
629.951	1442.138
630.256	1442.150
630.442	1442.150
630.524	1442.158
631.102	1442.129
631.902	1442.100

632.170	1442.101
632.529	1442.099
632.772	1442.108
633.201	1442.123
633.412	1442.114
633.552	1442.100
633.750	1442.103
633.890	1442.104
633.915	1442.118
634.002	1442.116
634.344	1442.107
634.497	1442.121
634.558	1442.186
634.596	1442.233
634.893	1442.211
635.194	1442.182
635.280	1442.264
635.429	1442.324
635.581	1442.339
635.742	1442.329
636.398	1442.244
636.617	1442.229
636.807	1442.223
637.417	1442.187
637.677	1442.189
638.114	1442.165
638.415	1442.143
638.675	1442.151
638.960	1442.169
639.340	1442.158
639.616	1442.167
639.678	1442.173
639.995	1442.148
640.235	1442.126
640.474	1442.113
640.490	1442.114
640.614	1442.121
640.952	1442.106
641.472	1442.081
641.745	1442.082
642.285	1442.074
642.557	1442.082
642.586	1442.121
642.619	1442.184
642.652	1442.190
642.747	1442.165
642.809	1442.159
643.048	1442.193

643.432	1442.197
643.720	1442.190
643.811	1442.190
643.869	1442.213
643.894	1442.236
643.947	1442.214
644.026	1442.205
644.096	1442.216
644.191	1442.222
644.253	1442.220
644.512	1442.215
644.677	1442.239
644.871	1442.238
645.201	1442.212
645.276	1442.206
645.317	1442.313
645.408	1442.478
645.540	1442.588
645.701	1442.662
645.799	1442.682
646.002	1442.674
646.224	1442.638
646.917	1442.536
647.272	1442.479
647.280	1442.476
647.425	1442.466
647.615	1442.464
647.751	1442.468
648.006	1442.442
648.097	1442.555
648.398	1442.654
648.572	1442.703
648.732	1442.680
648.831	1442.693
648.881	1442.700
649.034	1442.670
649.256	1442.609
649.533	1442.538
649.636	1442.516
649.640	1442.556
649.764	1442.528
649.838	1442.509
649.912	1442.495
649.966	1442.493
650.044	1442.499
650.053	1442.558
650.123	1442.578
650.634	1442.932

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652.338	1443.325
652.429	1443.321
652.437	1443.340
652.441	1444.001
652.486	1444.084
652.738	1443.965
652.767	1443.676
652.808	1443.351
653.023	1443.241
653.151	1443.073
653.237	1443.063
653.431	1443.064
653.745	1443.064
653.749	1443.064
653.835	1443.063
654.240	1443.069
654.355	1443.071
654.537	1443.073
655.007	1442.956
655.432	1442.877
655.919	1442.808
656.187	1442.728
656.207	1442.557
656.228	1442.556
656.315	1442.582
656.327	1442.611
656.409	1442.563
656.438	1442.530
656.496	1442.578
656.661	1442.573
656.727	1442.555
656.900	1442.537
657.074	1442.490
657.164	1442.505
657.218	1442.494
657.350	1442.443
657.441	1442.417
657.486	1442.449
657.527	1442.500
657.577	1442.506
657.791	1442.455
657.890	1442.431
658.035	1442.431
658.249	1442.388
658.344	1442.380
658.344	1442.380
658.406	1442.404

658.447	1442.432
658.534	1442.469
658.670	1442.442
658.905	1442.367
659.041	1442.343
659.289	1442.371
659.429	1442.347
659.474	1442.540
659.507	1442.724
659.524	1442.785
659.660	1442.826
660.085	1442.835
660.485	1442.817
660.588	1442.822
660.782	1442.797
660.823	1442.817
660.877	1442.808
661.001	1442.750
661.075	1442.739
661.170	1442.760
661.261	1442.749
661.343	1442.716
661.442	1442.693
661.500	1442.750
661.549	1442.827
661.664	1442.833
663.046	1442.860
663.480	1442.864
664.020	1442.874
664.602	1442.883
664.981	1442.890
665.282	1442.897
666.619	1442.900
667.106	1442.891
668.269	1442.876
668.356	1442.875
668.376	1442.875
668.475	1442.875
668.492	1442.875
668.599	1442.876
668.611	1442.880
668.962	1442.937
669.242	1442.945
669.799	1442.938
670.397	1442.952
670.525	1442.980
670.645	1442.987
670.785	1442.972

671.284	1442.918
671.553	1442.907
671.583	1443.168
671.755	1443.509
672.122	1443.775
672.019	1444.150
672.100	1444.376
672.736	1444.329
672.900	1444.200
675.670	1443.600
682.550	1442.200
682.711	1442.300
689.600	1442.150
704.530	1442.150
718.212	1442.050
720.233	1442.050
720.427	1442.080
720.811	1442.090
721.046	1442.100
721.557	1442.120
721.912	1442.140
722.589	1442.150
738.475	1442.150
745.254	1442.168
745.386	1442.168
745.510	1442.165
745.679	1442.160
745.848	1442.156
745.997	1442.153
746.240	1442.148
746.430	1442.145
746.673	1442.139
746.937	1442.133
747.432	1442.123
747.671	1442.118
747.795	1442.118
748.014	1442.109
748.208	1442.105
748.381	1442.100
748.596	1442.095
748.732	1442.090
748.884	1442.086
749.103	1442.079
749.235	1442.074
749.421	1442.068
749.557	1442.063
749.668	1442.060
749.808	1442.055

749.932	1442.050
750.068	1442.046
750.196	1442.046
750.287	1442.045
750.415	1442.039
750.518	1442.035
750.670	1442.030
750.765	1442.028
750.889	1442.024
750.988	1442.019
751.075	1442.016
751.174	1442.015
751.252	1442.014
751.343	1442.010
751.512	1442.011
751.780	1442.011
752.069	1442.010
752.345	1442.012
752.461	1442.012
752.618	1442.011
752.890	1441.997
752.923	1442.001
753.014	1442.002
753.088	1442.007
760.340	1442.008
760.352	1442.009
760.806	1442.009
761.511	1442.009
762.167	1442.009
764.024	1442.015
763.046	1442.015
763.178	1442.029
763.339	1442.054
763.533	1442.086
763.611	1442.113
763.755	1442.147
763.768	1442.159
763.793	1442.185
763.834	1442.236
763.945	1442.267
764.061	1442.298
764.180	1442.331
764.213	1442.368
764.250	1442.413
764.358	1442.453
764.411	1442.491
764.597	1442.558
764.721	1442.592

764.783	1442.617
764.906	1442.893
765.179	1442.952
765.381	1442.998
765.703	1443.000
766.173	1442.953
766.231	1442.926
766.259	1442.902
766.297	1442.859
766.309	1442.836
766.334	1442.811
766.375	1442.783
766.396	1442.750
766.441	1442.712
766.462	1442.531
766.457	1442.531
766.688	1442.525
766.940	1442.523
767.113	1442.524
767.237	1442.524
767.315	1442.525
767.448	1442.519
767.509	1442.515
767.592	1442.512
767.621	1442.512
767.683	1442.516
767.765	1442.522
767.819	1442.530
767.877	1442.536
767.959	1442.541
768.087	1442.539
768.190	1442.538
768.268	1442.537
768.376	1442.532
768.400	1442.523
768.405	1442.512
768.466	1442.503
768.520	1442.497
768.574	1442.495
768.652	1442.503
768.726	1442.517
768.809	1442.531
768.850	1442.541
768.879	1442.547
768.924	1442.553
769.110	1442.554
769.300	1442.552
769.436	1442.547

769.461	1442.538
769.518	1442.529
769.572	1442.522
769.626	1442.521
769.683	1442.552
769.729	1442.565
769.778	1442.588
769.811	1442.596
769.898	1442.589
769.939	1442.580
769.980	1442.578
770.034	1442.573
770.071	1442.563
770.112	1442.555
770.178	1442.552
770.244	1442.539
770.306	1442.530
770.343	1442.526
770.393	1442.516
770.442	1442.489
770.512	1442.469
770.558	1442.458
770.611	1442.432
770.644	1442.409
770.686	1442.392
770.743	1442.403
770.805	1442.443
770.855	1442.468
770.904	1442.494
770.946	1442.513
770.958	1442.522
771.078	1442.522
771.263	1442.520
771.321	1442.517
771.395	1442.527
771.482	1442.525
771.560	1442.519
771.614	1442.514
771.668	1442.526
771.746	1442.534
771.853	1442.545
771.944	1442.550
772.068	1442.550
772.171	1442.543
772.224	1442.539
772.315	1442.529
772.460	1442.529
772.583	1442.541

772.678	1442.550
772.785	1442.557
772.934	1442.559
773.045	1442.554
773.128	1442.550
773.198	1442.549
773.264	1442.542
773.396	1442.540
773.565	1442.542
773.742	1442.542
773.924	1442.540
774.081	1442.534
774.209	1442.536
774.275	1442.539
774.279	1442.536
774.485	1442.537
774.774	1442.542
775.104	1442.541
775.248	1442.546
775.520	1442.546
775.764	1442.548
775.995	1442.550
776.263	1442.564
776.424	1442.576
776.585	1442.587
776.725	1442.601
776.865	1442.594
777.010	1442.580
777.142	1442.565
777.377	1442.553
777.628	1442.552
777.793	1442.551
777.921	1442.545
778.148	1442.547
778.255	1442.552
778.387	1442.558
778.474	1442.563
778.767	1442.569
779.027	1442.569
779.435	1442.584
779.547	1442.589
779.769	1442.577
779.963	1442.564
780.157	1442.553
780.161	1442.548
780.603	1442.553
780.842	1442.568
780.970	1442.581

781.168	1442.593
781.374	1442.607
781.572	1442.624
781.725	1442.635
781.914	1442.650
782.067	1442.676
782.174	1442.695
782.579	1442.727
782.785	1442.746
783.061	1442.765
783.131	1442.765
783.280	1442.764
783.507	1442.769
783.610	1442.768
783.746	1442.780
783.845	1442.789
783.985	1442.791
784.113	1442.789
784.187	1442.791
784.274	1442.768
784.315	1442.764
784.409	1442.761
784.680	1442.754
785.004	1442.757
785.230	1442.755
785.386	1442.770
785.546	1442.771
785.644	1442.766
785.771	1442.757
786.062	1442.766
786.337	1442.773
786.427	1442.771
786.883	1442.767
787.108	1442.775
787.297	1442.784
787.379	1442.784
787.395	1442.791
787.453	1442.787
787.506	1442.779
787.559	1442.777
787.572	1442.784
787.629	1442.778
787.633	1442.773
787.682	1442.777
787.699	1442.779
787.715	1442.765
787.773	1442.747
787.818	1442.729

787.851	1442.708
787.892	1442.678
787.945	1442.689
787.953	1442.703
787.982	1442.709
788.052	1442.707
788.084	1442.701
788.175	1442.706
788.232	1442.722
788.285	1442.733
788.335	1442.739
788.388	1442.755
788.458	1442.771
788.490	1442.781
788.577	1442.792
788.634	1442.795
788.732	1442.788
788.757	1442.781
788.790	1442.785
788.835	1442.781
788.872	1442.772
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788.946	1442.761
789.020	1442.763
789.118	1442.764
789.155	1442.774
789.204	1442.788
789.253	1442.805
789.290	1442.822
789.340	1442.847
789.409	1442.863
789.458	1442.877
789.524	1442.881
789.664	1442.878
789.811	1442.877
789.959	1442.877
790.098	1442.878
790.189	1442.876
790.275	1442.864
790.324	1442.863
790.410	1442.876
790.435	1442.882
790.549	1442.881
790.623	1442.878
790.746	1442.850
790.800	1442.836
790.915	1442.834
791.054	1442.830

791.103	1442.818
791.120	1442.798
791.185	1442.779
791.251	1442.758
791.292	1442.734
791.316	1442.712
791.341	1442.695
791.374	1442.688
791.456	1442.712
791.526	1442.715
791.579	1442.701
791.608	1442.688
791.641	1442.681
791.723	1442.688
791.837	1442.684
791.989	1442.682
792.108	1442.682
792.129	1442.671
792.161	1442.667
792.215	1442.672
792.264	1442.659
792.301	1442.642
792.362	1442.622
792.412	1442.606
792.469	1442.583
792.510	1442.566
792.625	1442.537
792.703	1442.526
792.756	1442.535
792.830	1442.544
792.924	1442.544
792.982	1442.546
793.072	1442.548
793.113	1442.553
793.129	1442.569
793.162	1442.573
793.166	1442.594
793.228	1442.594
793.343	1442.576
793.412	1442.565
793.490	1442.552
793.556	1442.542
793.630	1442.539
793.691	1442.550
793.782	1442.545
793.859	1442.541
793.974	1442.543
794.077	1442.544

794.142	1442.548
794.151	1442.565
794.204	1442.575
794.249	1442.575
794.311	1442.564
794.360	1442.550
794.553	1442.514
794.561	1442.512
794.581	1442.513
794.663	1442.541
794.791	1442.543
794.893	1442.550
795.037	1442.549
795.131	1442.561
795.201	1442.579
795.229	1442.598
794.700	1442.576
794.704	1442.575
794.737	1442.589
794.729	1442.610
794.791	1442.632
794.848	1442.652
794.893	1442.651
795.016	1442.641
795.069	1442.657
795.106	1442.675
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795.459	1442.774
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795.709	1442.878
795.849	1442.890
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796.329	1442.896
796.427	1442.901
796.443	1442.905
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797.251	1442.955
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797.625	1442.963

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799.643	1442.894
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800.196	1442.887
800.319	1442.877
800.414	1442.877
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800.615	1442.855
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801.525	1442.571
801.546	1442.558

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801.652	1442.555
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802.522	1442.544
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803.966	1442.568
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804.364	1442.588
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817.649	1442.256
817.796	1442.255
817.924	1442.250
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818.526	1442.183
818.629	1442.182
818.744	1442.187
818.998	1442.186
819.195	1442.187
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820.245	1442.169
820.446	1442.160
820.598	1442.156
820.893	1442.151
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821.668	1442.142
821.836	1442.139
821.964	1442.143
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822.739	1442.171
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823.116	1442.177
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823.346	1442.146
823.465	1442.156
823.500	1442.161
823.512	1442.182
823.562	1442.207
823.595	1442.222
823.628	1442.240
823.653	1442.257
823.686	1442.275
823.814	1442.302
823.904	1442.319
823.983	1442.331
824.003	1442.335
824.020	1442.339
824.131	1442.341
824.181	1442.346
824.284	1442.351
824.375	1442.355
824.412	1442.366
824.453	1442.385
824.482	1442.392
824.659	1442.392
824.758	1442.387
824.865	1442.384
825.055	1442.379
825.125	1442.375
825.249	1442.366
825.348	1442.358
825.439	1442.350
825.509	1442.341
825.579	1442.336
825.711	1442.331
825.789	1442.320
825.831	1442.314
825.917	1442.306
826.016	1442.301
826.119	1442.296
826.190	1442.288
826.272	1442.278

826.379	1442.276
826.429	1442.283
826.458	1442.293
826.524	1442.298
826.619	1442.294
826.668	1442.290
826.747	1442.284
826.817	1442.285
826.973	1442.287
827.122	1442.293
827.275	1442.292
827.407	1442.300
827.473	1442.303
827.617	1442.308
827.844	1442.320
828.042	1442.318
828.149	1442.315
828.314	1442.312
828.413	1442.317
828.574	1442.328
828.710	1442.336
828.929	1442.335
829.114	1442.332
829.267	1442.327
829.399	1442.331
829.547	1442.333
829.704	1442.335
829.750	1442.329
829.836	1442.335
829.906	1442.324
829.968	1442.322
830.014	1442.314
830.121	1442.310
830.232	1442.301
830.298	1442.295
830.397	1442.285
830.480	1442.284
830.562	1442.293
830.612	1442.290
830.698	1442.275
830.793	1442.249
830.855	1442.233
830.905	1442.220
830.971	1442.209
831.049	1442.201
831.169	1442.200
831.268	1442.199
831.342	1442.200

831.437	1442.227
831.495	1442.250
831.556	1442.255
831.598	1442.271
831.812	1442.491
831.948	1442.539
832.105	1442.598
832.175	1442.638
832.237	1442.670
832.249	1442.679
832.315	1442.719
832.456	1442.743
832.538	1442.757
832.633	1442.754
832.732	1442.746
832.852	1442.741
832.975	1442.756
833.062	1442.787
833.206	1442.835
833.240	1442.866
833.322	1442.900
833.392	1442.929
833.454	1442.937
833.557	1442.930
833.607	1442.909
833.664	1442.879
833.689	1442.866
833.747	1442.846
833.817	1442.838
833.912	1442.849
833.957	1442.872
834.040	1442.906
834.093	1442.942
834.143	1442.974
834.209	1443.008
834.287	1443.037
834.395	1443.063
834.535	1443.067
834.638	1443.059
834.667	1443.043
834.700	1443.028
834.741	1443.019
834.766	1442.997
834.848	1442.986
834.935	1442.986
835.083	1443.005
835.224	1443.026
835.343	1443.034

835.438	1443.030
835.479	1443.017
835.541	1442.982
835.616	1442.946
835.677	1442.913
835.739	1442.881
835.789	1442.859
835.838	1442.847
835.929	1442.836

APPENDIX 4

RIO PUERCO WELL P1

1985

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
228	1440.915	305	1440.973
235	1440.909	312	1440.985
236	1440.893	318	1440.991
256	1440.832	326	1441.000
270	1440.838	333	1441.003
274	1440.857	340	1441.006
283	1440.881	347	1441.003
290	1440.912	354	1441.003
297	1440.942	361	1440.994

1986

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
3	1440.991	164	1440.927
9	1440.982	171	1440.854
17	1440.982	178	1440.860
23	1440.973	185	1441.049
31	1440.966	192	1441.274
38	1440.960	193	1441.283
45	1440.957	199	1441.338
52	1440.945	206	1441.408
55	1440.951	213	1441.277
59	1440.954	220	1441.134
66	1440.963	227	1441.073
73	1440.973	234	1440.973
80	1440.921	240	1440.957
87	1440.985	249	1440.957
94	1440.969	255	1441.122
101	1441.082	269	1441.094
108	1441.143	275	1441.091
115	1441.137	282	1441.186
122	1441.113	289	1441.381
129	1441.137	304	1441.384
136	1441.091	310	1441.628
143	1441.040	317	1441.552
150	1440.976	324	1441.506
153	1440.960	338	1441.479
157	1440.985	352	1441.579

1987

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
8	1441.536	71	1441.771
22	1441.439	85	1441.783
36	1441.567	99	1441.786
57	1441.701	105	1441.890

RIO PUERCO WELL P2

1985

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
256	1440.787	312	1441.250
270	1441.656	318	1441.183
274	1441.293	326	1441.120
283	1441.132	333	1441.089
290	1441.427	340	1441.058
297	1441.433	347	1441.043
305	1441.330	354	1441.007
312	1441.250	361	1440.988

1986

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
3	1440.973	157	1441.092
9	1440.943	171	1440.918
15	1440.940	178	1440.900
23	1440.933	185	1441.171
31	1440.921	192	1441.549
38	1440.912	193	1441.607
45	1440.906	199	1441.638
52	1441.141	206	1441.726
55	1441.211	213	1441.516
59	1441.238	220	1441.287
66	1441.147	227	1441.208
73	1441.089	234	1441.123
80	1441.049	240	1441.022
87	1441.025	249	1441.055
94	1441.001	255	1441.196
101	1441.193	269	1441.247
108	1441.287	275	1441.223
115	1441.263	282	1441.348
122	1441.208	289	1441.766
129	1441.284	304	1441.577
133	1441.302	310	1441.988
136	1441.232	317	1441.784
143	1441.150	324	1441.696
150	1441.068	338	1441.641
153	1441.037	352	1441.561

1987

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
8	1441.750	71	1442.052
36	1442.122	85	1442.010
57	1441.967	99	1442.031
71	1442.052	105	1442.202

RIO PUERCO WELL P3

1985

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
228	1440.912	305	1441.040
235	1440.809	312	1440.982
236	1440.827	318	1440.961
256	1440.720	326	1440.934
270	1440.897	333	1440.931
274	1440.903	340	1440.903
283	1440.888	347	1440.894
290	1440.998	354	1440.870
297	1441.019	361	1440.876

1986

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
3	1440.873	164	1440.860
9	1440.857	171	1440.809
17	1440.857	178	1440.818
23	1440.857	185	1440.924
31	1440.870	192	1441.055
38	1440.854	193	1441.058
45	1440.851	199	1441.086
52	1440.915	206	1441.123
55	1440.949	213	1441.043
59	1440.964	220	1440.964
66	1441.019	227	1440.934
73	1440.946	234	1440.866
80	1440.918	240	1440.863
87	1440.924	249	1440.912
94	1440.918	255	1440.915
101	1440.982	269	1440.955
108	1441.013	275	1440.949
115	1441.013	282	1440.995
122	1440.995	289	1441.138
129	1441.016	304	1441.144
136	1440.985	310	1441.278
143	1440.949	317	1441.214
150	1440.909	324	1441.193
153	1440.900	338	1441.183
157	1440.909	352	1441.180

1987

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
8	1441.229	71	1441.302
22	1441.159	85	1441.315
36	1441.220	99	1441.360
57	1441.287	105	1441.421

RIO PUERCO WELL P4

1985

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
256	1440.623	312	1440.796
270	1440.683	318	1440.790
274	1440.699	326	1440.781
283	1440.714	333	1440.769
290	1440.775	340	1440.757
297	1440.778	347	1440.760
305	1440.812	354	1440.741
312	1440.796	361	1440.760

1986

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
3	1440.760	157	1440.802
9	1440.760	164	1440.775
17	1440.769	171	1440.745
23	1440.769	178	1440.766
31	1440.781	185	1440.781
38	1440.790	192	1440.796
45	1440.790	199	1440.793
52	1440.796	206	1440.793
59	1440.805	213	1440.766
66	1440.830	220	1440.751
73	1440.839	227	1440.738
80	1440.818	234	1440.717
87	1440.830	240	1440.729
94	1440.839	249	1440.726
101	1440.845	255	1440.735
108	1440.836	269	1440.763
115	1440.851	275	1440.763
122	1440.848	282	1440.781
129	1440.854	289	1440.812
136	1440.839	304	1440.857
143	1440.821	310	1440.891
150	1440.802	317	1440.863
153	1440.808	338	1440.882
157	1440.802	352	1440.882

1987

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
8	1440.900	71	1440.955
22	1440.891	85	1440.988
36	1440.897	99	1441.007
57	1440.952	105	1441.016

RIO PUERCO WELL P5

1985

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
256	1440.110	312	1440.251
270	1440.162	318	1440.245
274	1440.171	326	1440.229
283	1440.193	333	1440.226
290	1440.241	340	1440.211
297	1440.254	347	1440.199
305	1440.275	354	1440.345
312	1440.251	361	1440.308

1986

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
3	1440.205	164	1440.245
9	1440.202	171	1440.220
17	1440.211	178	1440.272
23	1440.217	185	1440.260
31	1440.229	192	1440.269
38	1440.232	199	1440.260
45	1440.232	206	1440.254
52	1440.238	213	1440.223
59	1440.251	220	1440.366
66	1440.272	227	1440.211
73	1440.284	234	1440.187
80	1440.266	240	1440.208
87	1440.275	249	1440.220
94	1440.287	255	1440.214
101	1440.293	269	1440.223
108	1440.284	275	1440.229
115	1440.293	282	1440.238
122	1440.296	289	1440.269
129	1440.312	304	1440.308
136	1440.293	310	1440.336
143	1440.284	317	1440.351
150	1440.269	324	1440.321
157	1440.272	338	1440.312

1987

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
8	1440.305	71	1440.278
22	1440.275	85	1440.305
36	1440.281	99	1440.318
57	1440.299	105	1440.333

SEVILLETA WELL U8

1985

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
282	1478.732	311	1478.907
286	1479.145	316	1478.862
288	1479.054	319	1478.840
293	1479.221	323	1478.807
295	1479.145	327	1478.779
297	1479.090	330	1478.761
301	1479.023	337	1478.719
304	1478.996	344	1478.676
305	1478.978	348	1478.645
309	1478.935	358	1478.594

1986

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
0	1478.563	157	1478.008
7	1478.523	164	1477.969
17	1478.490	171	1477.935
23	1478.456	178	1478.249
31	1478.432	185	1478.569
38	1478.414	192	1479.237
45	1478.398	199	1479.316
52	1478.359	206	1479.313
59	1478.341	213	1479.109
66	1478.310	220	1479.008
73	1478.292	227	1479.060
80	1478.267	234	1478.947
87	1478.249	240	1479.106
94	1478.219	249	1479.039
101	1478.228	255	1479.072
108	1478.191	269	1478.956
115	1478.152	275	1478.886
122	1478.133	282	1479.496
129	1478.097	289	1479.682
136	1478.072	304	1479.307
143	1478.039	324	1479.438
150	1478.005	338	1479.255
157	1478.008	352	1479.328

1987

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
8	1479.176	57	1479.590
22	1479.081	71	1479.276
30	1479.511	85	1479.148
57	1479.590	99	1479.069

SEVILLETA WELL U9

1985

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
282	1479.064	311	1479.234
286	1479.573	316	1479.189
288	1479.451	319	1479.155
293	1479.625	323	1479.113
295	1479.533	327	1479.088
297	1479.466	330	1479.067
301	1479.378	337	1479.015
304	1479.341	344	1478.972
305	1479.311	348	1478.942
309	1479.262	358	1478.896

1986

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
0	1478.856	157	1478.314
7	1478.817	164	1478.268
17	1478.780	171	1478.235
23	1478.747	178	1478.625
31	1478.725	185	1479.076
38	1478.698	192	1479.945
45	1478.671	199	1479.844
52	1478.649	206	1479.740
59	1478.622	213	1479.478
66	1478.600	220	1479.365
73	1478.576	227	1479.448
80	1478.555	234	1479.292
87	1478.533	240	1479.561
94	1478.509	249	1479.390
101	1478.494	255	1479.427
108	1478.472	269	1479.283
115	1478.445	275	1479.289
122	1478.411	282	1479.984
129	1478.384	289	1480.094
136	1478.363	304	1479.722
143	1478.332	324	1479.759
150	1478.302	338	1479.570
157	1478.314	352	1479.585

1987

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
8	1479.481	57	1479.868
22	1479.390	71	1479.570
36	1479.753	85	1479.448
57	1479.868	99	1479.375

SEVILLETA WELL U10

1985

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
286	1480.673	311	1480.283
288	1480.521	316	1480.240
293	1480.685	319	1480.201
295	1480.585	323	1480.161
297	1480.518	327	1480.130
301	1480.429	330	1480.106
304	1480.393	337	1480.057
305	1480.362	344	1480.012
309	1480.313	348	1479.981
311	1480.283	358	1479.929

1986

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
0	1479.893	157	1479.329
7	1479.850	164	1479.289
17	1479.807	171	1479.250
23	1479.795	178	1479.692
31	1479.753	185	1480.158
38	1479.725	192	1480.950
45	1479.679	199	1480.877
52	1479.676	206	1480.755
59	1479.628	213	1480.505
66	1479.618	220	1480.405
73	1479.588	227	1480.530
80	1479.576	234	1480.350
87	1479.548	240	1480.615
94	1479.527	249	1480.448
101	1479.509	255	1480.487
108	1479.484	269	1480.335
115	1479.439	275	1480.255
122	1479.429	282	1481.002
129	1479.411	289	1481.203
136	1479.378	304	1480.676
143	1479.344	324	1480.813
150	1479.317	338	1480.630
153	1479.302	352	1480.691

1987

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
8	1480.573	57	1480.990
22	1480.478	71	1480.652
36	1480.893	85	1480.542
57	1480.990	99	1480.493

SEVILLETA WELL U11

1985

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
286	1479.959	311	1479.789
288	1479.907	316	1479.749
293	1480.060	319	1479.712
295	1480.020	323	1479.685
297	1479.956	327	1479.661
301	1479.898	330	1479.642
304	1479.874	337	1479.591
305	1479.853	344	1479.551
309	1479.810	348	1479.526
311	1479.789	358	1479.472

1986

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
0	1479.438	157	1478.874
7	1479.398	164	1478.838
17	1479.359	171	1478.801
23	1479.334	178	1479.051
31	1479.298	185	1479.380
38	1479.277	192	1479.932
45	1479.237	199	1480.078
52	1479.225	206	1480.118
59	1479.197	213	1479.950
66	1479.194	220	1479.871
73	1479.182	227	1479.926
80	1479.130	234	1479.825
87	1479.255	240	1479.956
94	1479.088	249	1479.904
101	1479.063	255	1479.944
108	1479.036	269	1479.837
115	1479.017	275	1479.786
122	1478.987	282	1480.228
129	1478.966	289	1480.459
136	1478.932	304	1480.167
143	1478.902	324	1480.319
150	1478.874	338	1480.148
157	1478.874	352	1480.209

1987

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
8	1480.093	57	1480.490
22	1479.990	71	1480.185
36	1480.420	85	1480.066
57	1480.490	99	1479.990

SEVILLETA WELL U12

1985

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
286	1479.390	311	1479.448
288	1479.420	316	1479.429
293	1479.539	319	1479.402
295	1479.542	323	1479.375
297	1479.530	327	1479.356
301	1479.515	330	1479.344
304	1479.509	337	1479.302
305	1479.506	344	1479.237
309	1479.472	348	1479.271
311	1479.448	358	1479.201

1986

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
0	1479.167	157	1478.610
7	1479.113	164	1478.585
17	1479.097	171	1478.552
23	1479.070	178	1478.607
31	1479.048	185	1478.814
38	1479.021	192	1479.115
45	1478.994	199	1479.359
52	1478.972	206	1479.542
59	1478.945	213	1479.515
66	1478.927	220	1479.478
73	1478.914	227	1479.503
80	1478.878	234	1479.457
87	1478.850	240	1479.494
94	1478.826	249	1479.521
101	1478.808	255	1479.551
108	1478.792	269	1479.487
115	1478.765	275	1479.448
122	1478.738	282	1479.646
129	1478.716	289	1479.881
136	1478.689	304	1479.807
143	1478.658	324	1479.951
150	1478.625	338	1479.829
157	1478.610	352	1479.804

1987

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
8	1479.783	57	1480.045
22	1479.716	71	1479.899
36	1479.963	85	1479.771
57	1480.045	99	1479.698

LOWER SALADO WELL L2

1985

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
256	1443.649	305	1444.313
262	1443.685	312	1444.231
265	1443.746	319	1444.155
270	1443.950	326	1444.097
274	1443.984	333	1444.045
277	1443.966	340	1443.984
284	1443.926	347	1443.926
291	1444.161	354	1443.883
298	1444.359	361	1443.834

1986

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
3	1443.795	171	1443.109
10	1443.752	185	1443.182
17	1443.713	192	1443.676
23	1443.685	193	1443.935
31	1443.652	199	1444.356
38	1443.615	206	1444.977
45	1443.584	213	1444.947
55	1443.517	220	1444.807
66	1443.487	234	1444.670
80	1443.423	240	1444.612
101	1443.350	255	1444.670
122	1443.271	269	1444.578
132	1443.225	289	1446.514
143	1443.200	324	1446.212
150	1443.170	338	1445.870
164	1443.118	352	1445.599

1987

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
8	1445.304	57	1445.118
22	1445.057	71	1445.066
36	1445.096	85	1444.874

LOWER SALADO WELL L3

1985

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
256	1443.767	305	1444.374
262	1443.761	312	1444.300
265	1443.773	319	1444.240
270	1443.910	326	1444.182
277	1444.002	333	1444.130
284	1443.980	340	1444.020
291	1444.133	347	1444.020
298	1444.343	354	1443.977
305	1444.374	361	1443.938

1986

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
3	1443.892	171	1443.191
10	1443.849	185	1443.221
17	1443.813	192	1443.474
23	1443.782	193	1443.593
31	1443.752	199	1444.154
38	1443.712	206	1444.706
45	1443.685	213	1444.913
59	1443.618	220	1444.843
66	1443.587	234	1444.724
80	1443.523	240	1444.666
101	1443.444	255	1444.712
122	1443.359	269	1444.642
132	1443.328	289	1445.846
143	1443.282	324	1446.218
150	1443.261	338	1445.946
164	1443.209	352	1445.678

1987

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
8	1445.382	57	1445.139
22	1445.005	71	1445.111
36	1445.136	85	1444.953

LOWER SALADO WELL L4

1985

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
256	1445.459	305	1446.059
262	1445.440	312	1446.029
265	1445.468	319	1445.971
270	1445.568	326	1445.916
277	1445.672	333	1445.864
284	1445.669	340	1445.727
291	1445.803	347	1445.754
298	1446.001	354	1445.712
305	1446.059	361	1445.666

1986

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
3	1445.620	171	1444.919
10	1445.574	185	1444.928
17	1445.541	192	1445.123
23	1445.510	193	1445.245
31	1445.465	199	1445.818
38	1445.425	206	1446.276
45	1445.392	213	1446.562
59	1445.337	220	1446.550
66	1445.321	234	1446.458
80	1445.245	240	1446.404
101	1445.160	255	1446.446
122	1445.084	269	1446.385
132	1445.047	289	1447.294
143	1445.005	324	1447.985
150	1444.983	338	1447.729
164	1444.943	352	1447.495

1987

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
8	1447.169	57	1446.928
22	1446.775	71	1446.986
36	1446.912	85	1447.104

APPENDIX 5

RIO PUERCO NEUTRON ACCESS TUBE PN1

PERCENT VOLUME MOISTURE CONTENT (CORRECTED)

1985

JULIAN	DEPTH BELOW LAND SURFACE (M)						
DATE	.3	.6	.9	1.2	1.5	1.8	2.1
274	9.1	13.5	10.3	7.9	15.9	27.4	33.7
290	15.6	17.9	12.9	7.8	17.7	32.0	37.0
297	14.6	18.9	14.4	8.3	16.7	32.2	36.9
305	13.5	18.1	14.6	8.4	13.9	25.7	35.2
311	12.7	17.6	14.5	7.9	12.9	20.6	31.8
318	12.4	17.7	14.0	8.1	12.3	18.1	27.8
325	12.3	16.9	13.9	8.1	11.4	16.3	23.7
333	11.8	16.5	14.1	7.8	11.1	16.0	22.6
340	12.1	16.5	14.3	8.3	11.0	15.4	21.9
346	11.8	16.4	13.6	8.0	10.3	15.3	20.1
354	12.4	16.0	14.4	8.6	10.6	15.2	19.2
361	11.9	15.9	14.0	8.3	10.3	14.3	19.4

1986

JULIAN	DEPTH BELOW LAND SURFACE (M)						
DATE	.3	.6	.9	1.2	1.5	1.8	2.1
3	11.5	16.0	13.7	8.1	10.0	14.0	17.2
9	11.3	15.4	13.6	8.0	9.9	13.7	17.5
17	11.8	15.5	13.5	8.0	9.9	13.8	17.2
23	11.6	15.6	13.8	8.3	9.6	13.8	17.3
31	11.6	15.3	13.8	8.1	9.8	13.7	17.2
38	11.3	15.4	13.8	8.3	9.7	13.5	16.6
45	11.3	14.9	13.5	7.8	9.3	13.4	16.0
52	12.2	15.2	13.8	7.9	9.2	14.3	27.5
59	11.6	15.0	13.6	7.9	9.9	17.4	29.5
66	11.2	15.1	13.9	8.1	9.7	16.0	24.7
73	11.4	15.1	13.5	8.1	9.8	15.4	22.5
80	10.9	15.1	13.5	8.1	9.8	14.5	20.7
94	11.1	14.6	13.5	8.1	9.4	13.7	17.4
101	10.7	14.2	13.2	8.0	9.5	15.6	23.9
108	10.4	13.7	13.9	8.2	9.8	19.7	28.7
115	10.0	13.3	13.0	8.1	10.0	19.8	27.3
122	9.1	12.6	12.7	8.0	9.8	17.4	25.4
136	7.5	11.1	12.1	8.0	10.2	19.2	27.8
143	6.9	10.1	12.0	8.1	11.1	18.7	25.5
150	6.5	9.1	11.6	7.1	9.8	15.9	20.3

SEVILLETA WELL U13

1985

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
282	1479.959	311	1480.139
286	1480.014	316	1480.124
288	1480.051	319	1480.099
293	1480.142	323	1480.075
295	1480.157	327	1480.063
297	1480.163	330	1480.051
301	1480.169	337	1480.011
304	1480.172	344	1479.980
305	1480.163	348	1479.959
309	1480.154	358	1479.919

1986

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
0	1479.892	157	1479.343
7	1479.855	164	1479.322
17	1479.822	171	1479.295
23	1479.795	178	1479.307
31	1479.773	185	1479.459
38	1479.746	192	1479.694
45	1479.718	199	1479.913
52	1479.706	206	1480.087
59	1479.673	213	1480.130
66	1479.657	220	1480.127
73	1479.639	227	1480.157
80	1479.606	234	1480.133
87	1479.572	240	1480.154
94	1479.566	249	1480.197
101	1479.542	255	1480.224
108	1479.514	269	1480.203
115	1479.499	275	1480.160
122	1479.462	282	1480.246
129	1479.444	289	1480.441
136	1479.420	304	1480.471
143	1479.392	324	1480.611
150	1479.365	338	1480.526
157	1479.343	352	1480.511

1987

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
8	1480.502	57	1480.712
22	1480.422	71	1480.596
36	1480.639	85	1480.511
57	1480.712	99	1480.438

SEVILLETA WELL U14

1985

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
282	1480.414	311	1480.627
286	1480.645	316	1480.578
288	1480.667	319	1480.548
293	1480.783	323	1480.517
295	1480.773	327	1480.484
297	1480.758	330	1480.459
301	1480.713	337	1480.411
304	1480.688	344	1480.365
305	1480.697	348	1480.365
309	1480.642	358	1480.283

1986

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
0	1480.243	157	1479.658
7	1480.213	164	1479.643
17	1480.164	171	1479.612
23	1480.133	178	1479.725
31	1480.109	185	1480.078
38	1480.078	192	1480.533
45	1480.057	199	1480.703
52	1480.027	206	1480.828
59	1479.996	213	1480.743
66	1479.978	220	1480.664
73	1479.950	227	1480.667
80	1479.929	234	1480.627
87	1479.905	240	1480.673
94	1479.877	249	1480.719
101	1479.844	255	1480.719
108	1479.829	269	1480.664
115	1479.804	275	1480.591
122	1479.786	282	1480.853
129	1479.755	289	1481.115
136	1479.731	304	1480.962
143	1479.710	324	1481.151
150	1479.682	338	1480.999
157	1479.658	352	1480.959

1987

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
8	1480.959	57	1481.224
22	1480.844	71	1481.048
36	1481.164	85	1480.929

SEVILLETA WELL U15

1985

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
282	1481.036	311	1481.197
286	1481.511	316	1481.149
288	1481.398	319	1481.112
293	1481.566	323	1481.072
295	1481.475	327	1481.045
297	1481.417	330	1481.024
301	1481.331	337	1480.966
304	1481.298	344	1480.920
305	1481.273	348	1480.892
309	1481.222	358	1480.838

1986

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
0	1480.798	157	1480.219
7	1480.755	164	1480.176
17	1480.713	171	1480.143
23	1480.685	178	1480.585
31	1480.649	185	1480.975
38	1480.624	192	1481.657
45	1480.597	193	1481.679
52	1480.572	206	1481.597
59	1480.551	213	1481.383
66	1480.521	220	1481.298
73	1480.493	227	1481.389
80	1480.469	234	1481.252
87	1480.457	240	1481.469
94	1480.420	249	1481.341
101	1480.390	255	1481.386
108	1480.377	269	1481.249
115	1480.353	275	1481.170
122	1480.313	282	1481.682
129	1480.292	289	1481.920
136	1480.265	304	1481.563
143	1480.237	324	1481.737
150	1480.204	338	1481.560
157	1480.219	352	1481.737

1987

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
8	1481.523	57	1481.926
22	1481.417	71	1481.621
36	1481.911	85	1481.493

SEVILLETA WELL U16

1985

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
282	1482.254	311	1482.419
286	1482.687	316	1482.367
288	1482.614	319	1482.331
293	1482.766	323	1482.117
295	1482.699	327	1481.904
297	1482.635	330	1481.883
301	1482.556	337	1481.822
304	1482.520	344	1481.773
305	1482.510	348	1481.745
309	1482.443	358	1481.681

1986

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
0	1481.642	157	1481.041
7	1481.599	164	1480.999
17	1481.556	171	1480.965
23	1481.526	178	1481.361
31	1481.495	185	1481.788
38	1481.465	192	1482.389
45	1481.431	199	1482.446
52	1481.413	206	1482.446
59	1481.380	213	1482.245
66	1481.355	220	1482.163
73	1481.325	227	1482.254
80	1481.300	234	1482.111
87	1481.270	240	1482.306
94	1481.249	249	1482.209
101	1481.230	255	1482.297
108	1481.191	269	1482.257
115	1481.178	275	1482.029
122	1481.139	282	1482.456
129	1481.117	289	1482.727
136	1481.090	299	1482.419
143	1481.060	324	1482.602
150	1481.029	338	1482.434
157	1481.041	352	1482.611

1987

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
8	1482.416	57	1482.745
22	1482.312	71	1482.510
36	1482.727	85	1482.328

SEVILLETA WELL U17

1985

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
282	1481.231	311	1481.383
286	1481.338	316	1481.365
288	1481.380	319	1481.338
293	1481.493	323	1481.307
295	1481.505	327	1481.286
297	1481.490	330	1481.264
301	1481.472	337	1481.222
304	1481.456	344	1481.182
305	1481.456	348	1481.155
309	1481.414	358	1481.109

1986

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
0	1481.072	157	1480.487
7	1481.017	164	1480.466
17	1480.978	171	1480.438
23	1480.950	178	1480.499
31	1480.932	185	1480.740
38	1480.905	192	1481.094
45	1480.880	199	1481.301
52	1480.859	206	1481.472
59	1480.828	213	1481.475
66	1480.807	220	1481.414
73	1480.777	227	1481.459
80	1480.755	234	1481.405
87	1480.731	240	1481.450
94	1480.710	249	1481.496
101	1480.679	255	1481.542
108	1480.633	269	1481.435
115	1480.630	275	1481.395
122	1480.612	282	1481.539
129	1480.578	289	1481.770
136	1480.554	304	1481.722
143	1480.527	324	1481.883
150	1480.518	338	1481.776
157	1480.487	352	1481.786

1987

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
8	1481.767	57	1481.987
22	1481.670	71	1481.853
36	1481.932	85	1481.719

SEVILLETA WELL U18

1985

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
282	1480.834	311	1480.990
286	1480.837	316	1480.990
288	1480.865	319	1480.968
293	1480.907	323	1480.950
295	1480.935	327	1480.950
297	1480.947	330	1480.944
301	1480.981	337	1480.904
304	1480.996	344	1480.883
305	1481.011	348	1480.862
309	1480.999	358	1480.834

1986

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
0	1480.807	157	1480.280
7	1480.770	164	1480.261
17	1480.743	171	1480.237
23	1480.731	178	1480.225
31	1480.700	185	1480.313
38	1480.673	192	1480.447
45	1480.648	199	1480.612
52	1480.627	206	1480.755
59	1480.603	213	1480.849
66	1480.584	220	1480.901
73	1480.548	227	1480.938
80	1480.536	234	1480.956
87	1480.514	240	1480.968
94	1480.481	249	1480.996
101	1480.475	255	1481.048
108	1480.420	269	1481.042
115	1480.407	275	1481.035
122	1480.398	282	1481.060
129	1480.380	289	1481.157
136	1480.359	304	1481.270
143	1480.334	324	1481.401
150	1480.304	338	1481.395
157	1480.280	352	1481.377

1987

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
8	1481.401	57	1481.523
22	1481.343	71	1481.493
36	1481.438	85	1481.422

SEVILLETA WELL U19

1986

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
38	1481.782	129	1481.410
45	1481.751	136	1481.380
52	1481.721	143	1481.349
59	1481.706	150	1481.322
66	1481.669	153	1481.313
73	1481.633	157	1481.340
80	1481.605	164	1481.291
87	1481.581	171	1481.261
94	1481.544	178	1481.837
101	1481.523	185	1482.282
108	1481.499	192	1482.937
115	1481.462	199	1482.934
122	1481.441	206	1482.904

SEVILLETA WELL # U20

1986

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
94	1482.032	143	1481.931
101	1482.090	150	1481.904
108	1482.071	153	1481.892
115	1482.041	157	1481.922
122	1482.013	164	1481.873
129	1481.989	171	1481.840
136	1481.962	178	1482.428
143	1481.931	185	1482.879

SEVILLETA WELL U21

1986

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
108	1482.061	150	1481.893
115	1482.033	153	1481.884
122	1482.009	157	1481.915
129	1481.985	164	1481.860
136	1481.951	171	1481.829
143	1481.921	178	1482.427
150	1481.893	185	1482.869

SEVILLETA WELL U22

1986

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
108	1482.075	150	1481.901
115	1482.038	153	1481.889
122	1482.017	157	1481.913
129	1481.983	164	1481.870
136	1481.959	171	1481.837
143	1481.925	178	1482.443

LOWER SALADO WELL L1

1985

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
256	1443.670	305	1444.280
262	1443.634	312	1444.173
265	1443.832	319	1444.097
270	1443.954	326	1444.061
277	1443.942	333	1443.972
284	1443.884	340	1443.914
291	1444.268	347	1443.856
298	1444.402	354	1443.817
298	1444.402	361	1443.759

1986

JULIAN DATE	WATER TABLE ELEVATION (M)	JULIAN DATE	WATER TABLE ELEVATION (M)
3	1443.728	164	1443.030
10	1443.677	171	1443.021
17	1443.643	178	1443.024
23	1443.612	185	1443.228
31	1443.573	192	1444.585
38	1443.500	193	1444.841
45	1443.466	199	1444.661
59	1443.433	202	1445.011
66	1443.408	206	1445.328
80	1443.308	213	1444.948
101	1443.268	220	1444.740
122	1443.189	234	1444.621
132	1443.152	240	1444.627
143	1443.106	255	1444.658
150	1443.085	269	1444.597

RIO PUERCO NEUTRON ACCESS TUBE PN1

PERCENT VOLUME MOISTURE CONTENT (CORRECTED)

1986

JULIAN	DEPTH BELOW LAND SURFACE (M)						
DATE	.3	.6	.9	1.2	1.5	1.8	2.1
153	6.3	8.8	10.9	7.2	9.0	15.4	19.4
157	6.0	8.7	10.9	7.2	8.7	15.6	20.1
171	5.3	7.2	8.9	6.4	8.3	14.1	17.1
178	5.8	6.8	8.3	6.2	8.1	13.7	15.8
185	6.0	6.5	7.7	6.1	7.9	22.5	31.1
193	5.9	6.3	12.6	9.8	33.0	37.2	36.0
199	5.8	6.1	14.6	10.5	31.8	36.7	35.5
206	6.6	7.4	19.9	14.9	35.3	40.6	39.1
213	6.7	7.6	19.4	12.7	25.8	39.1	38.4
220	5.3	6.4	15.9	9.2	14.6	24.4	31.0
227	5.5	6.1	14.8	9.1	13.2	21.3	28.1
234	5.1	5.8	13.8	8.6	11.6	17.8	21.3
240	5.6	6.5	13.3	8.3	11.1	16.9	20.3
249	4.9	6.2	11.3	7.6	10.1	16.7	20.5
255	5.2	5.9	10.8	7.5	9.8	19.3	28.2
269	5.0	6.2	9.9	7.7	10.4	22.1	28.8
275	5.3	6.1	9.8	7.5	10.2	21.7	28.5
282	5.1	5.6	8.7	7.0	10.6	27.8	31.5
289	25.0	29.9	25.6	15.5	36.6	35.8	36.0
310	29.3	31.6	30.4	31.4	36.0	36.0	36.4
324	18.4	25.6	24.4	13.7	33.5	36.8	36.2

1987

JULIAN	DEPTH BELOW LAND SURFACE (M)						
DATE	.3	.6	.9	1.2	1.5	1.8	2.1
8	15.9	22.3	22.9	12.7	32.5	36.6	35.9
22	15.3	21.8	21.4	11.5	24.5	36.1	37.2
36	15.3	22.9	24.4	15.8	36.1	38.4	38.6
57	16.7	25.0	27.1	19.4	36.7	38.5	38.6
71	12.6	16.6	25.9	17.9	34.6	36.9	36.7
85	18.						

RIO PUERCO NEUTRON ACCESS TUBE PN2

PERCENT VOLUME MOISTURE CONTENT (CORRECTED)

1985

JULIAN DATE	.3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0
	DEPTH BELOW LAND SURFACE (M)									
290	16.4	18.6	16.6	30.0	28.0	19.0	23.5	37.3	38.0	37.7
297	14.7	18.3	16.1	28.5	26.8	17.8	20.9	36.5	38.1	38.0
306	13.3	17.1	15.6	28.5	24.8	15.6	14.7	28.7	36.7	38.4
311	12.7	16.7	15.1	27.2	23.6	15.0	13.4	22.6	34.5	37.6
318	12.8	16.3	14.5	27.5	23.8	14.4	12.1	17.9	30.0	38.3
325	11.7	15.6	14.6	26.3	22.4	14.1	11.3	14.6	25.6	36.6
332	11.4	15.6	14.4	25.9	22.6	14.2	11.4	13.7	23.2	36.3
340	11.5	15.5	14.4	25.9	21.9	13.6	11.3	12.7	20.8	35.3
347	10.9	14.9	14.0	25.9	21.7	13.3	10.9	11.9	19.6	34.3
354	10.7	14.8	13.9	25.5	21.9	13.2	10.6	11.6	18.0	33.7
361	11.4	14.8	13.8	25.6	21.4	13.3	10.6	11.4	17.9	32.9

1986

JULIAN DATE	.3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0
	DEPTH BELOW LAND SURFACE (M)									
3	10.9	14.8	13.3	25.6	21.4	13.2	10.6	10.7	16.5	32.3
9	10.3	14.9	13.6	25.6	21.2	12.6	10.4	11.0	15.4	30.7
15	10.8	14.8	13.6	26.0	21.1	12.9	10.4	10.8	15.6	30.4
23	10.6	14.8	13.3	25.8	20.5	12.8	10.2	10.5	14.6	30.2
31	10.8	14.3	13.5	25.3	20.6	12.7	10.4	10.1	14.6	29.4
38	10.5	14.3	13.5	25.2	20.6	12.8	10.3	10.1	14.1	28.4
45	10.5	13.9	13.0	25.3	20.2	12.7	9.7	9.8	13.3	28.0
52	10.5	14.2	13.0	25.1	20.8	12.7	11.7	22.5	33.9	34.7
59	10.2	14.2	13.4	25.3	20.4	12.9	11.9	20.5	33.7	34.9
66	10.4	14.1	13.4	25.2	19.8	12.8	11.2	15.2	26.9	34.8
73	10.0	13.9	13.1	25.0	20.3	13.1	10.5	13.4	22.6	33.3
80	10.1	14.1	12.9	24.8	19.6	12.3	10.6	12.1	19.5	32.7
94	9.3	13.6	12.3	24.9	19.5	12.4	10.0	10.9	16.5	31.1
101	9.1	13.4	12.3	24.5	19.9	12.2	11.4	19.6	32.9	35.3
108	9.1	12.8	11.8	23.7	19.4	12.5	12.2	23.5	34.7	35.5
115	8.5	12.0	11.4	23.0	18.2	12.4	11.6	20.0	33.6	36.0
122	8.1	11.7	10.9	22.0	17.9	12.2	11.6	18.3	32.0	36.6
136	7.2	10.7	9.1	21.8	18.0	12.4	13.0	24.7	34.3	37.0
143	6.9	9.2	8.0	18.0	14.2	10.9	10.8	18.5	30.8	36.0
150	6.5	8.5	7.2	15.4	12.9	10.4	9.7	13.5	23.4	35.8
153	6.8	8.3	7.2	15.3	12.3	10.0	9.7	12.2	21.1	35.0

RIO PUERCO NEUTRON ACCESS TUBE PN2

PERCENT VOLUME MOISTURE CONTENT (CORRECTED)

1986

JULIAN DATE	.3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0
	DEPTH BELOW LAND SURFACE (M)									
157	6.3	7.9	6.9	14.2	11.8	9.8	10.0	14.7	26.3	36.0
171	5.1	6.8	6.2	10.6	8.7	7.7	8.2	10.0	14.6	30.8
178	8.4	7.0	5.8	10.1	8.5	7.1	7.4	9.3	14.0	29.0
185	8.9	7.0	5.6	9.7	8.2	7.2	16.1	35.2	35.7	35.7
193	8.4	6.9	5.6	13.5	26.6	31.3	35.6	37.8	36.6	36.2
199	8.6	6.9	6.1	21.5	27.5	29.9	33.5	36.3	36.2	36.3
206	8.3	7.7	8.9	24.9	29.5	31.0	35.1	38.6	37.4	37.3
213	8.6	9.2	10.3	24.0	23.0	19.6	23.6	37.4	37.8	39.7
220	6.2	8.2	13.4	21.5	18.6	13.1	13.3	23.1	34.1	36.0
227	5.8	7.9	8.2	20.0	16.6	11.7	11.9	19.9	32.2	36.5
234	5.0	7.7	7.2	15.2	14.2	10.5	9.5	13.5	22.6	35.3
240	4.9	7.4	6.5	15.3	12.3	9.2	8.7	11.6	20.3	34.1
249	4.7	6.8	6.2	12.4	10.8	8.4	8.5	13.5	24.8	36.2
255	4.5	6.7	6.2	9.5	7.8	11.4	29.6	35.5	36.6	39.5
269	4.6	6.6	5.8	10.5	9.1	9.1	12.0	23.6	34.3	36.6
275	4.6	6.6	5.7	10.6	9.4	8.8	11.7	23.0	34.4	37.0
282	4.7	6.2	5.5	11.0	9.3	9.0	17.5	34.0	34.5	35.8
289	26.0	31.8	33.6	35.0	33.5	34.7	35.8	39.4	38.8	39.4
310	28.6	32.6	35.1	36.7	33.7	33.3	34.9	37.6	37.7	37.8
324	18.6	26.1	24.8	31.5	28.0	23.2	32.0	38.9	38.0	39.0

1987

JULIAN DATE	.3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0
	DEPTH BELOW LAND SURFACE (M)									
8	14.3	20.0	19.8	28.2	25.6	23.6	31.6	37.4	37.3	37.2
22	15.1	18.1	18.6	27.4	23.5	17.1	20.5	36.7	36.7	37.1
36	15.6	20.0	19.5	30.6	31.3	33.8	36.4	40.4	39.4	39.7
57	15.6	22.0	22.5	32.3	33.3	35.1	37.1	39.9	39.9	39.3
71	12.7	14.5	15.1	28.9	28.1	31.2	35.7	38.5	38.2	39.2
85	19.2	24.1	24.3	33.3	34.0	34.6	35.8	39.2	38.7	38.5
99	17.1	23.8	24.0	32.8	33.5	34.6	36.4	39.5	38.6	39.1

RIO PUERCO NEUTRON ACCESS TUBE PN 3

PERCENT VOLUME MOISTURE CONTENT (CORRECTED)

1985

JULIAN DATE	DEPTH BELOW LAND SURFACE (M) .3	.6	.9	1.2	1.5	1.8	2.1	2.4
290	19.8	8.2	9.9	10.0	10.0	23.3	20.2	36.5
297	17.5	8.2	9.8	9.9	10.7	25.8	21.2	36.9
305	16.0	8.5	9.8	9.8	10.7	24.3	17.9	36.5
311	14.9	8.1	9.8	9.7	10.6	23.6	16.6	36.2
318	14.1	8.4	9.6	9.9	10.0	23.2	15.6	32.4
325	13.3	8.1	9.5	10.0	10.1	22.6	14.9	25.2
332	13.6	8.2	9.5	9.7	9.9	22.5	14.3	19.9
340	12.8	8.6	9.8	9.9	9.5	22.4	14.3	17.6
346	12.3	8.3	9.9	9.7	9.6	22.2	14.4	15.4
354	12.1	8.6	9.6	9.7	9.4	21.4	13.3	13.5
361	11.8	8.6	9.6	9.9	9.6	21.7	13.5	12.6

1986

JULIAN DATE	DEPTH BELOW LAND SURFACE (M) .3	.6	.9	1.2	1.5	1.8	2.1	2.4
3	11.9	8.6	10.0	9.8	9.4	20.5	13.3	11.7
9	11.6	8.5	9.8	9.9	9.1	21.2	13.2	10.9
17	14.3	9.1	9.8	9.9	9.2	20.9	13.5	10.5
23	11.4	8.9	9.8	9.8	9.1	21.0	12.7	10.3
31	11.1	9.1	9.8	9.7	9.3	21.1	12.8	9.9
38	11.3	8.7	9.7	9.8	9.3	20.6	12.8	9.7
45	11.7	9.0	9.8	9.4	8.7	20.7	12.4	9.2
52	11.5	9.2	9.6	9.6	9.1	20.5	12.7	19.0
59	11.4	9.2	9.6	9.7	9.1	21.2	13.2	29.9
66	11.1	9.4	10.0	9.6	9.2	21.0	13.3	26.3
73	10.6	9.5	10.0	9.7	9.2	20.9	13.1	23.2
80	10.3	8.9	10.0	9.4	8.8	20.9	12.8	16.7
94	9.5	9.5	9.6	9.6	8.9	20.7	12.7	12.9
101	9.1	9.0	9.9	10.0	8.8	20.1	12.8	25.0
108	8.5	9.3	10.0	9.2	9.1	21.0	14.0	33.4
115	8.1	8.9	10.5	9.9	9.3	21.9	15.6	33.2
122	7.2	8.7	9.8	9.4	9.6	21.6	14.1	32.9
136	5.8	7.9	9.2	9.3	9.5	21.3	14.4	34.4
143	5.5	6.9	9.0	9.0	8.9	20.9	13.2	30.3
150	5.7	6.5	8.4	8.8	8.7	20.2	12.7	20.4
153	6.0	6.3	8.5	8.8	8.6	19.8	12.6	16.7

RIO PUERCO NEUTRON ACCESS TUBE PN3

PERCENT VOLUME MOISTURE CONTENT (CORRECTED)

1986

JULIAN	DEPTH BELOW LAND SURFACE (M)							
DATE	.3	.6	.9	1.2	1.5	1.8	2.1	2.4
157	5.9	6.3	8.1	8.3	8.6	19.7	12.8	18.7
171	5.4	5.8	8.6	9.5	8.8	19.0	11.8	10.7
178	11.6	5.7	6.8	7.8	8.2	17.7	10.6	8.6
185	10.8	5.8	6.6	7.6	8.1	16.7	11.0	26.8
193	9.8	5.5	6.5	7.3	7.7	22.9	31.8	36.0
199	9.6	5.3	6.3	7.2	10.4	29.0	32.8	37.0
206	8.6	5.9	7.1	7.7	17.1	35.1	36.0	36.7
213	6.0	5.9	6.4	9.0	16.3	34.4	29.8	36.2
220	5.3	7.0	6.9	10.3	15.9	32.2	19.1	37.0
227	7.9	8.6	9.5	12.2	16.3	32.9	19.1	35.7
234	4.1	5.2	5.8	8.3	11.3	24.9	14.8	21.3
240	4.2	5.4	5.5	8.2	10.8	23.3	12.9	14.2
249	4.4	5.8	5.9	8.6	10.6	22.8	12.6	19.0
255	4.1	5.7	5.9	8.1	9.9	21.6	13.0	27.9
269	4.4	5.4	5.7	7.6	9.9	21.2	14.9	35.3
275	6.1	6.8	6.5	9.1	10.4	24.1	15.8	36.3
282	5.3	5.3	5.6	7.2	9.4	20.5	15.4	34.7
310	29.4	16.9	7.4	17.4	30.9	36.0	34.6	38.1
324	22.8	17.6	12.7	19.5	26.1	36.3	35.5	38.3

1987

JULIAN	DEPTH BELOW LAND SURFACE (M)							
DATE	.3	.6	.9	1.2	1.5	1.8	2.1	2.4
8	18.1	16.7	16.8	19.4	24.4	36.8	34.8	38.4
22	15.7	16.0	15.5	17.2	20.4	34.2	31.7	35.8
36	16.7	16.1	16.0	19.0	24.5	36.8	35.9	39.5
57	16.7	16.3	18.2	24.1	32.1	37.4	35.3	38.6
71	13.6	15.5	16.6	22.6	28.7	33.6	33.5	38.4
85	17.9	16.3	21.8	30.4	32.8	36.4	34.3	37.8
99	19.8	17.1	21.6	29.7	33.2	36.1	34.3	38.2

RIO PUERCO NEUTRON ACCESS TUBE PN4

PERCENT VOLUME MOISTURE CONTENT (CORRECTED)

1985

JULIAN DATE	DEPTH BELOW LAND SURFACE (M) .3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0
290	7.7	4.7	8.0	5.8	4.8	7.0	31.0	38.2	35.4	38.6
297	15.9	4.9	7.9	5.7	5.0	7.7	31.4	38.7	35.3	38.5
305	14.9	5.3	7.9	5.7	4.9	7.4	30.7	37.5	35.5	38.2
311	15.5	5.7	8.0	5.9	5.0	7.3	29.5	37.2	35.9	38.0
318	14.8	6.0	8.2	5.7	5.0	7.2	28.1	36.4	35.6	38.3
325	14.0	6.1	7.8	5.7	4.8	6.8	26.5	36.0	34.7	37.2
332	14.3	6.2	7.9	5.5	5.2	6.8	24.8	36.1	35.2	38.1
340	14.1	6.5	8.2	5.6	5.0	6.5	24.1	35.7	35.0	38.1
346	13.8	6.6	8.1	5.5	5.1	6.7	23.8	34.7	35.2	37.8
354	13.8	6.6	8.1	5.8	5.3	6.7	23.1	34.1	34.8	37.3
361	13.2	6.8	8.2	5.6	5.1	6.8	23.0	33.6	35.4	38.3

1986

JULIAN DATE	DEPTH BELOW LAND SURFACE (M) .3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0
3	12.8	6.8	8.1	5.7	5.2	6.5	22.3	33.1	35.2	37.9
9	12.9	7.1	8.0	5.6	4.9	6.5	21.8	32.5	35.2	37.5
17	12.9	7.0	7.7	5.7	5.2	6.5	21.3	32.2	35.3	38.1
23	12.7	6.8	8.2	5.7	4.8	6.6	21.2	32.4	35.2	38.9
31	12.9	6.9	8.0	5.5	4.9	6.6	21.1	31.5	35.3	38.5
38	12.9	6.8	8.1	5.7	4.9	6.1	20.4	30.6	35.1	37.3
45	12.9	7.0	7.9	5.4	4.7	6.2	20.1	30.5	34.7	37.6
52	13.6	6.8	8.0	5.6	4.9	6.4	21.9	32.1	36.0	38.2
59	13.3	7.2	8.2	5.5	4.8	7.0	24.4	33.9	34.8	37.8
66	13.5	7.3	8.1	5.6	5.0	6.6	23.3	34.5	35.8	38.5
73	13.2	7.4	8.3	5.7	4.7	6.5	22.0	33.7	36.2	38.0
80	12.9	7.3	8.2	5.7	4.8	6.4	22.2	33.1	34.9	37.4
94	12.4	7.2	8.3	5.7	4.7	6.4	21.6	32.1	35.2	37.9
101	12.4	7.4	8.3	5.7	4.9	6.4	21.3	34.0	36.1	37.8
108	11.7	6.9	8.4	5.6	4.9	6.9	26.1	35.7	36.2	37.9
115	11.4	7.4	8.3	5.8	4.8	6.9	27.2	36.6	37.4	38.9
122	11.0	7.8	8.3	5.6	5.1	6.7	23.9	35.5	36.7	38.6
136	8.1	6.2	8.3	5.4	4.5	6.7	26.5	36.2	36.0	38.1
143	6.7	6.1	8.3	5.4	4.5	6.7	25.0	36.2	36.2	38.3
150	6.2	5.7	6.9	5.5	4.6	6.1	23.8	34.5	36.4	37.8
153	5.9	5.6	8.1	5.1	4.4	5.9	23.2	33.9	36.2	38.0

RIO PUERCO NEUTRON ACCESS TUBE PN4

PERCENT VOLUME MOISTURE CONTENT (CORRECTED)

1986

JULIAN	DEPTH BELOW LAND SURFACE (M)									
DATE	.3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0
157	5.7	5.5	8.1	5.9	4.1	5.9	23.1	34.0	36.5	37.4
171	5.2	4.9	7.6	5.2	4.0	5.4	20.9	31.6	36.3	38.2
178	5.7	5.0	7.5	5.2	4.0	5.5	19.5	29.3	36.1	37.7
185	6.4	5.0	7.1	4.9	4.1	5.7	21.7	31.9	36.2	37.9
193	6.3	5.2	7.3	5.1	4.0	7.4	34.3	41.9	36.5	38.0
199	8.3	6.9	8.5	5.1	5.8	9.4	36.4	41.1	37.6	36.9
213	6.8	6.5	7.3	7.2	6.1	11.5	37.6	41.5	38.5	39.4
220	4.8	4.8	6.4	5.1	4.3	8.4	33.6	37.5	36.8	37.5
227	6.0	4.9	6.7	4.4	4.5	8.6	32.6	38.7	37.5	38.3
234	4.9	4.6	6.1	4.4	3.9	7.2	26.2	34.8	35.9	38.1
240	4.7	4.5	5.9	4.3	4.0	6.4	23.4	33.3	36.6	37.2
249	4.8	4.5	7.1	4.1	3.9	6.6	24.0	33.6	36.5	38.0
255	5.1	5.5	6.1	5.1	4.9	7.8	25.1	34.4	37.0	37.7
269	5.0	4.6	5.9	4.3	4.0	7.2	27.8	36.7	37.2	38.5
275	5.4	5.5	6.1	3.9	4.1	6.8	28.0	36.8	37.8	39.5
310	22.9	10.3	6.0	4.4	6.4	31.4	39.0	41.8	37.8	40.1
324	20.9	12.7	7.8	6.3	7.1	20.0	38.9	41.1	38.8	40.7

1987

JULIAN	DEPTH BELOW LAND SURFACE (M)									
DATE	.3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0
8	17.8	11.4	13.5	6.8	7.0	18.1	37.9	38.8	36.8	37.8
22	17.0	11.1	14.0	7.2	6.7	13.5	37.5	38.7	36.4	37.8
36	19.5	11.9	14.6	6.8	6.7	23.0	39.0	41.2	39.2	41.7
57	19.5	13.1	15.6	7.9	9.0	26.6	39.7	41.1	39.6	42.0
71	12.8	63.8	13.7	8.0	9.5	26.0	36.8	41.6	38.3	39.6
86	19.6	13.4	18.5	10.6	21.5	36.5	38.0	38.9	37.6	39.7
99	22.0	14.6	19.3	11.2	18.9	36.6	38.0	39.0	37.8	37.8

RIO PUERCO NEUTRON ACCESS TUBE PN5

PERCENT VOLUME MOISTURE CONTENT (CORRECTED)

1986

JULIAN DATE	DEPTH BELOW LAND SURFACE (M) .3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.3
157	5.5	5.7	5.7	3.8	3.9	5.6	5.2	5.6	6.4	6.7	13.6
171	5.2	5.9	5.7	4.1	3.9	5.5	5.2	5.6	6.2	6.5	13.3
178	7.4	5.8	5.6	4.2	3.9	5.4	5.2	5.4	6.1	6.8	13.6
185	8.0	5.7	5.7	4.1	4.0	5.4	5.1	5.6	6.2	6.8	13.4
193	6.5	5.9	5.7	4.1	4.0	5.4	5.0	5.7	6.0	6.8	13.2
199	6.3	7.8	7.2	5.5	4.7	5.8	5.4	5.6	6.5	7.7	10.6
206	5.6	5.8	5.8	4.1	4.1	5.5	5.2	5.6	6.3	6.9	13.5
213	4.8	5.5	5.7	4.0	3.9	5.5	5.1	5.5	6.8	6.9	13.8
220	4.1	5.3	6.2	5.3	5.0	6.0	6.4	6.8	7.4	8.5	15.0
227	4.0	5.3	5.8	4.1	3.9	5.5	5.0	5.6	6.3	6.9	13.8
234	4.4	5.2	5.6	3.9	4.0	5.6	4.9	5.5	6.1	6.8	13.6
240	3.9	6.1	5.7	4.0	4.3	5.4	5.0	5.3	6.1	7.9	13.6
249	3.8	4.9	5.4	3.9	3.9	5.5	5.1	5.3	5.9	6.7	13.4
255	3.8	5.0	5.4	4.0	4.0	6.1	5.9	5.6	6.9	7.4	13.7
269	3.9	4.6	5.8	4.2	4.7	6.0	5.9	6.0	6.7	7.3	14.1
275	3.6	4.9	5.3	3.8	4.0	5.4	5.7	5.6	6.3	6.8	13.0
282	4.3	5.1	5.5	4.2	4.1	5.9	5.2	6.0	6.1	6.8	13.0
289	5.8	4.9	5.5	3.9	3.9	5.4	5.0	5.5	6.1	6.9	13.1
310	9.4	5.1	5.3	3.9	4.0	5.4	5.1	5.5	6.1	6.9	13.6
324	10.1	4.8	5.4	3.9	4.0	5.5	5.0	5.4	6.1	7.0	13.8
338	10.6	5.7	5.9	4.7	5.1	5.5	5.0	5.4	6.1	7.0	13.8

1987

JULIAN DATE	DEPTH BELOW LAND SURFACE (M) .3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.3
8	12.0	5.9	5.2	3.7	4.1	5.2	4.9	5.4	5.8	6.9	15.4
22	12.6	6.8	5.3	3.8	3.9	5.3	5.0	5.2	5.9	7.0	15.8
36	13.3	7.1	5.3	3.4	3.9	5.0	4.6	5.0	5.7	6.8	16.6
57	13.3	6.7	5.3	3.5	3.8	4.9	4.5	5.0	5.7	6.7	16.7
71	9.1	4.6	5.0	3.8	4.0	5.5	5.1	5.4	6.1	6.8	15.3

RIO PUERCO NEUTRON ACCESS TUBE PN6

PERCENT VOLUME MOISTURE CONTENT (CORRECTED)

1985

JULIAN	DEPTH BELOW LAND SURFACE (M)												
DATE	.3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.7	4.3	4.9
290	18.7	5.7	5.3	5.0	4.8	4.0	5.1	5.0	4.8	7.7	9.1	8.9	11.1
297	16.3	9.7	5.4	4.7	4.8	4.0	4.9	5.0	5.0	7.4	8.9	9.0	11.3
305	14.9	11.1	5.4	4.9	4.9	4.1	5.1	4.9	4.8	7.6	8.9	8.7	11.4
312	14.4	11.3	5.4	4.8	4.9	3.8	5.1	4.9	4.9	7.3	8.8	8.6	10.9
318	14.1	12.1	5.4	4.7	5.0	4.0	5.3	5.0	4.8	7.4	8.7	8.7	11.7
325	13.4	11.7	5.6	4.3	5.0	4.0	5.0	5.0	4.8	7.6	8.6	8.6	11.3
333	13.5	12.0	5.6	4.9	4.8	4.0	5.1	5.1	5.0	7.5	8.8	8.7	11.6
340	13.2	12.2	5.6	4.8	4.7	4.2	5.1	5.1	5.1	7.4	8.9	8.6	11.3
346	13.4	11.9	5.8	5.1	4.8	4.0	5.5	5.6	5.0	7.6	8.6	8.4	12.2
354	12.7	11.8	6.1	5.4	5.3	4.2	5.3	5.2	5.3	7.4	9.5	9.1	11.7
361	12.8	12.1	5.7	4.9	5.0	4.1	5.0	5.0	4.9	7.5	8.6	9.0	11.5

1986

JULIAN	DEPTH BELOW LAND SURFACE (M)												
DATE	.3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.7	4.3	4.9
3	12.7	12.0	5.6	4.9	4.9	4.1	5.0	5.0	4.8	7.4	8.6	8.9	11.6
9	12.6	11.8	6.0	4.9	4.7	4.0	5.0	5.2	4.9	7.4	8.7	8.8	11.6
17	12.8	12.1	5.8	4.9	4.9	4.1	5.1	5.1	5.0	7.7	8.8	8.9	11.4
23	12.3	11.7	6.0	4.9	4.8	4.0	5.1	5.0	4.8	7.3	8.8	8.9	11.6
38	12.1	11.5	6.0	4.8	4.8	3.8	5.0	5.2	4.9	7.4	8.8	8.7	11.8
45	12.3	11.7	5.8	4.9	4.8	4.0	5.1	4.9	4.9	7.5	8.7	8.5	11.8
52	12.2	12.1	6.2	5.0	4.6	4.0	4.9	5.1	4.8	7.5	8.8	8.6	11.6
59	12.1	12.0	6.0	4.9	4.8	4.0	5.3	5.0	4.7	7.4	8.6	8.7	12.0
66	12.1	11.2	6.2	5.6	4.7	4.0	5.2	5.0	4.9	7.6	8.8	8.8	11.7
73	12.1	11.8	6.3	4.8	4.7	4.2	5.1	5.2	4.8	7.5	8.7	8.7	12.0
80	11.4	11.2	6.0	5.0	4.7	4.1	5.1	5.0	4.7	7.5	8.6	8.6	11.9
94	10.6	11.3	6.1	5.2	4.9	4.1	5.2	4.9	5.0	7.5	8.6	8.8	12.1
101	10.6	11.4	6.4	5.0	4.8	4.0	5.2	4.9	4.9	7.5	8.6	8.5	12.1
108	9.7	10.9	6.2	5.0	4.8	4.3	5.1	4.8	4.4	7.5	8.8	8.6	12.4
115	8.5	10.2	6.3	4.7	4.8	4.1	5.0	4.8	4.8	7.4	8.7	8.8	11.8
122	7.6	9.9	6.5	4.8	4.8	4.0	5.1	5.0	5.0	7.6	8.4	8.7	12.2
136	6.8	7.8	6.4	5.0	4.7	4.1	4.9	5.1	4.9	7.2	8.2	8.9	12.4
143	7.3	6.8	6.1	4.9	4.9	4.1	4.9	5.1	4.9	7.9	8.8	9.3	12.2
150	6.8	6.8	6.1	5.0	4.9	4.2	5.3	5.2	5.0	7.3	8.8	8.7	12.3
157	6.9	6.9	6.2	4.9	4.7	4.1	5.1	4.9	4.8	7.5	8.5	8.6	11.9
171	6.1	6.4	6.1	4.9	4.8	4.1	4.9	4.7	5.0	7.4	8.6	8.7	11.6

RIO PUERCO NEUTRON ACCESS TUBE PN6

PERCENT VOLUME MOISTURE CONTENT (CORRECTED)

1986

JULIAN	DEPTH BELOW LAND SURFACE (M)												
DATE	.3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.7	4.3	4.9
178	7.5	6.4	6.0	4.9	4.8	4.1	5.1	4.9	4.8	7.6	8.8	8.9	12.0
185	8.0	6.4	6.0	5.1	4.9	4.1	5.0	5.1	4.9	7.5	8.8	8.8	11.8
193	7.7	6.2	6.1	5.1	4.8	4.2	5.3	4.8	4.8	7.6	8.5	8.9	11.7
199	7.6	6.0	5.7	5.0	5.4	4.3	5.2	4.9	4.7	7.9	8.8	8.9	11.0
206	7.4	6.4	5.9	4.7	4.9	4.5	5.4	6.3	6.4	9.1	9.9	8.7	11.6
213	8.1	8.9	8.4	7.2	7.6	6.7	7.4	6.9	6.5	9.0	10.7	10.5	12.9
220	8.6	9.6	8.8	10.3	9.5	8.6	9.6	9.0	9.0	11.5	11.3	8.5	11.0
227	5.4	5.9	6.0	4.9	4.9	4.1	5.1	5.1	4.8	7.2	8.5	8.9	11.7
234	4.9	5.5	5.7	5.1	5.6	4.1	4.9	5.1	4.9	7.4	8.6	8.4	12.0
240	4.9	5.0	5.6	5.1	4.9	4.0	5.0	5.0	4.9	7.3	8.4	8.5	11.6
249	4.7	5.7	5.5	5.0	5.0	4.1	5.1	4.9	4.9	7.3	8.7	8.6	11.1
255	4.8	5.5	5.3	4.8	4.9	4.1	5.1	5.0	5.0	7.2	8.3	8.7	10.9
269	4.7	5.7	5.6	4.9	5.1	4.4	5.1	5.0	4.9	8.1	8.9	8.6	10.9
275	4.8	6.3	5.9	5.5	5.6	5.0	6.2	6.4	6.7	10.1	10.7	10.1	13.4
289	11.2	5.4	6.0	4.9	5.1	4.0	5.0	4.8	4.9	7.4	8.5	8.5	11.2
310	14.9	5.8	5.3	4.7	4.7	4.0	4.9	5.1	4.9	7.7	9.4	9.0	11.3
324	14.6	7.6	5.9	5.4	5.6	4.8	5.9	5.8	5.8	8.4	9.2	9.1	11.8

1987

JULIAN	DEPTH BELOW LAND SURFACE (M)												
DATE	.3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.7	4.3	4.9
8	14.5	12.6	6.1	5.8	5.5	4.6	5.2	5.6	5.8	8.3	9.4	9.2	12.9
22	13.8	11.6	5.3	4.7	4.7	3.9	4.8	4.8	4.8	7.3	8.7	8.6	12.4
36	15.4	12.6	5.2	4.4	4.4	3.6	4.5	4.5	4.6	7.0	8.6	8.4	12.4
57	15.3	12.5	5.0	4.3	4.4	3.7	4.4	4.5	4.6	7.0	8.5	8.4	12.2
71	13.6	6.1	6.2	5.0	4.5	3.8	4.7	4.5	4.8	7.2	9.0	9.1	13.5
85	17.8	14.9	9.7	4.9	4.7	4.1	5.0	5.1	5.0	7.3	8.6	9.0	15.1
99	16.9	18.7	13.8	5.1	4.9	4.1	5.0	5.1	4.9	7.6	8.6	8.9	16.3

SEVILLETA NEUTRON ACCESS TUBE UN1

PERCENT VOLUME MOISTURE CONTENT (CORRECTED)

1985

JULIAN DATE	DEPTH BELOW LAND SURFACE (M) .3	.6	.9	1.2	1.5	1.8	2.1
38	6.3	8.0	8.1	8.7	10.3	11.9	18.4
45	6.3	8.1	7.7	8.4	10.3	11.7	17.8
52	6.5	8.2	8.1	8.9	10.4	11.4	17.1
59	6.6	8.6	8.2	8.6	10.2	11.6	15.8
66	6.8	8.4	8.2	8.8	10.6	11.6	15.5
73	6.8	8.1	8.2	8.9	10.7	11.5	15.0
80	6.6	8.0	8.2	8.6	10.2	11.3	14.3
94	6.7	8.4	8.2	8.6	10.5	11.4	13.2
101	6.3	8.3	8.2	8.9	10.4	11.1	12.4
108	6.3	8.4	8.5	8.7	10.6	11.0	12.6
115	5.8	8.1	8.1	8.7	10.1	11.6	12.4
122	5.6	7.7	8.1	8.6	10.6	11.2	12.0
136	5.1	7.3	7.9	8.4	10.0	11.3	11.4
143	5.0	6.6	7.4	7.8	9.7	11.0	11.2
150	4.7	6.3	7.3	7.2	8.9	10.4	11.2
153	4.8	6.3	7.4	6.7	8.9	10.4	10.9
157	4.9	6.4	7.1	6.8	8.6	10.1	10.8
171	4.7	5.6	6.4	5.8	7.3	9.1	10.4
178	7.1	6.3	6.3	5.7	7.2	10.6	21.5
185	7.2	6.4	6.2	7.6	13.9	26.8	30.6
193	6.4	7.6	15.4	29.7	29.9	27.9	31.2
199	7.4	8.2	17.3	28.4	29.8	27.3	30.3

LOWER SALADO NEUTRON ACCESS TUBE LN3

PERCENT VOLUME MOISTURE CONTENT (CORRECTED)

1985

JULIAN	DEPTH BELOW LAND SURFACE (M)																		
DATE	.3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.7	4.3	4.9	5.5	6.1	6.7	7.3	7.9	8.5
265	5.0	4.2	5.0	5.5	5.3	5.3	5.6	6.3	5.8	5.0	6.8	6.3	7.1	11.4	14.8	15.3	13.3	14.6	16.1
270	5.0	4.4	5.1	5.3	5.3	5.3	5.7	5.8	5.8	5.0	7.1	5.8	7.4	11.5	14.8	15.7	13.4	14.9	16.5
277	5.1	4.7	4.2	4.5	4.7	5.1	4.5	5.9	5.4	4.8	7.2	6.3	6.0	11.4	14.0	14.5	13.7	12.1	16.2
284	9.7	4.7	4.6	4.6	4.5	5.0	4.6	6.1	5.6	4.8	7.5	6.1	6.1	11.7	14.2	14.9	13.7	12.3	15.8
287	14.0	4.9	4.3	4.4	4.6	5.0	4.7	6.1	5.5	4.8	7.4	6.4	6.0	11.7	14.0	14.5	13.7	12.5	15.8
298	10.8	5.5	4.4	4.6	4.7	5.2	4.9	6.1	5.5	5.1	7.4	6.7	6.6	12.0	14.4	14.6	14.0	12.5	15.7
305	10.5	6.3	4.2	4.6	4.5	4.8	5.2	6.1	5.6	5.1	7.4	6.2	6.0	11.5	14.3	14.8	13.6	12.0	15.8
312	10.5	6.3	4.4	4.6	4.7	4.9	4.5	5.9	5.7	4.9	7.8	6.3	6.1	11.5	14.2	14.6	13.8	11.9	16.2
319	10.1	6.7	4.8	4.7	4.6	4.7	4.6	5.9	5.8	4.4	7.4	6.3	6.5	11.7	14.6	15.2	14.5	12.4	16.7
326	9.9	6.8	4.3	4.6	4.8	5.1	4.5	6.2	5.7	4.9	7.5	6.4	6.2	11.2	13.8	14.8	13.7	12.0	15.8
333	9.7	6.9	5.2	4.8	4.8	4.9	4.7	6.3	5.7	4.8	7.6	6.4	6.1	10.8	14.4	14.9	13.9	12.2	16.0
340	9.6	6.8	4.4	4.7	4.7	5.1	4.9	6.6	5.8	4.9	7.6	6.7	6.1	11.4	14.5	14.9	14.0	11.9	14.4
347	9.8	7.6	4.5	4.8	4.8	5.1	4.7	6.0	5.4	4.9	7.5	6.7	6.3	11.8	14.7	15.1	14.5	12.7	16.4
354	9.3	7.0	4.3	4.5	4.7	5.0	4.6	6.2	5.6	4.9	8.1	6.4	6.1	11.4	13.9	14.9	14.1	12.1	15.8
361	9.7	7.6	4.4	4.6	5.0	5.0	4.6	6.2	5.8	5.0	7.6	6.6	6.4	11.8	14.0	14.9	14.1	12.1	16.0

1986

JULIAN	DEPTH BELOW LAND SURFACE (M)																		
DATE	.3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.7	4.3	4.9	5.5	6.1	6.7	7.3	7.9	8.5
3	9.6	8.0	4.8	5.1	4.7	5.2	5.1	6.2	5.9	5.1	7.7	6.6	6.2	11.5	14.1	15.1	13.8	12.3	16.0
10	9.7	7.0	4.4	4.4	4.7	4.8	4.5	5.9	5.5	4.8	7.8	6.7	6.1	11.4	14.2	14.5	13.6	12.0	16.2
31	9.8	7.6	4.6	4.5	4.8	4.8	4.6	6.0	5.7	4.9	7.9	6.6	6.6	11.6	14.0	14.9	14.0	12.1	16.0
38	9.6	7.3	4.7	4.8	4.7	4.9	4.7	6.1	5.8	5.1	8.1	6.6	6.0	11.6	14.3	14.9	13.8	12.3	16.0
45	9.3	7.5	4.5	4.7	4.8	5.0	4.3	6.0	5.7	4.9	7.8	6.5	5.9	11.4	13.8	15.0	13.4	12.2	15.7
59	9.5	7.5	4.7	4.5	4.6	4.9	4.5	6.1	5.7	5.0	7.9	6.5	6.2	11.6	14.1	15.1	14.1	12.3	15.9
66	9.4	7.7	4.7	4.5	4.9	5.0	4.6	6.2	5.7	4.9	7.9	6.4	6.1	11.9	14.0	15.4	13.9	12.3	16.0
80	9.5	7.5	4.7	4.6	4.6	4.9	4.7	6.2	5.7	4.9	8.1	6.7	6.0	11.3	13.8	14.9	14.1	12.2	15.5
101	9.0	7.5	4.9	4.6	4.9	4.7	4.7	6.2	5.9	5.0	8.2	6.6	6.3	11.6	14.2	15.1	13.9	12.7	16.0
132	8.9	7.0	4.8	4.8	5.1	4.9	4.7	6.4	5.9	4.9	8.0	6.6	6.1	11.5	14.1	14.6	14.1	12.5	15.4
143	7.3	6.9	4.9	4.6	5.1	5.1	4.7	6.2	5.8	5.2	8.2	6.4	5.9	11.5	13.9	14.6	13.8	12.5	15.7
150	6.5	6.2	4.9	4.6	5.0	5.0	4.7	6.3	6.0	5.2	8.2	6.6	6.0	11.2	14.0	14.2	13.5	12.1	15.6
171	5.2	4.9	4.2	4.5	4.5	4.9	4.9	6.4	6.0	5.1	8.1	6.8	6.1	10.4	13.4	14.2	13.3	11.8	14.1
185	8.9	5.0	4.4	4.5	4.6	5.0	4.7	6.4	6.0	4.9	8.1	6.4	6.1	11.2	13.9	13.6	13.4	11.5	15.4
193	7.5	5.2	5.0	5.8	5.5	6.5	6.2	6.7	6.3	5.4	8.0	7.1	8.4	13.0	16.4	18.3	15.6	13.4	17.5
199	6.2	5.1	5.1	4.9	5.1	6.0	5.4	7.8	6.4	6.5	9.4	8.5	7.3	14.2	14.7	16.6	15.4	12.6	16.4
213	7.0	6.4	4.6	4.7	5.3	5.1	4.5	7.1	6.4	5.9	7.9	6.1	6.0	10.9	13.7	14.3	13.5	11.3	14.8

LOWER SALADO NEUTRON ACCESS TUBE LN4

PERCENT VOLUME MOISTURE CONTENT (CORRECTED)

1985

JULIAN DATE	DEPTH BELOW LAND SURFACE (M) .3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.7	4.3	4.9	5.5	6.1	6.7	7.3	7.9	8.5
265	4.3	4.6	4.7	5.5	5.0	5.0	5.6	4.8	4.5	5.4	5.0	4.3	4.5	4.4	4.0	4.7	5.2	5.5	9.5
270	4.8	5.0	5.4	5.5	5.7	4.9	5.6	5.1	4.6	5.3	4.9	4.5	4.4	4.5	4.2	4.8	5.5	5.7	9.5
277	4.3	4.4	4.6	4.8	4.9	5.1	4.2	5.1	4.5	4.0	4.3	5.6	4.1	4.3	3.8	3.9	4.9	5.3	5.0
284	8.9	4.6	4.6	5.0	4.8	5.3	4.6	5.2	4.6	4.2	4.5	5.4	3.9	3.9	4.1	3.9	5.0	5.4	5.3
291	13.8	5.5	4.4	4.6	4.9	5.0	4.4	5.1	4.7	4.1	4.4	5.4	4.0	3.9	4.0	4.1	4.8	5.0	5.0
298	11.4	7.0	4.7	4.8	5.1	5.3	4.6	5.3	4.9	4.1	4.6	5.5	4.0	4.0	4.1	4.0	4.9	5.2	5.2
305	10.7	7.6	4.7	5.0	4.9	5.2	4.5	5.1	4.7	4.2	4.3	5.5	3.9	3.9	3.9	4.1	5.0	5.2	5.2
312	10.2	7.9	4.7	4.8	4.9	5.2	4.4	5.2	4.6	4.1	4.3	5.3	4.0	4.0	4.0	3.8	4.9	5.2	5.1
319	9.9	8.3	5.0	5.2	4.8	5.3	4.9	5.8	4.7	4.4	4.4	5.5	4.3	4.3	4.1	4.2	5.3	5.5	5.4
326	9.3	8.5	5.0	4.7	5.0	5.0	4.8	6.1	5.1	4.6	4.3	5.2	4.0	5.7	5.2	5.0	5.8	6.9	6.7
333	9.0	8.2	4.8	4.8	5.0	5.2	4.5	5.2	4.6	4.2	4.4	5.5	4.0	3.9	3.7	4.0	4.9	5.1	5.2
340	9.0	8.6	5.2	4.9	5.0	5.3	4.5	5.4	4.5	4.1	4.3	5.3	3.9	4.0	3.8	3.9	5.1	5.3	5.1
347	9.3	8.5	5.2	4.8	5.0	5.2	4.4	5.3	4.6	4.0	4.3	5.3	4.0	4.0	4.0	3.7	4.7	5.2	5.0
354	9.0	8.5	5.1	4.8	4.9	5.1	4.5	5.1	4.5	4.1	4.3	5.3	4.0	3.9	3.9	3.7	4.9	5.0	5.1
361	9.0	8.6	5.2	4.9	4.9	5.3	4.4	5.4	4.6	4.1	4.5	5.4	4.1	4.0	3.9	4.0	4.9	5.3	5.2

1986

JULIAN DATE	DEPTH BELOW LAND SURFACE (M) .3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.7	4.3	4.9	5.5	6.1	6.7	7.3	7.9	8.5
3	8.8	8.6	5.3	4.9	4.8	5.3	4.6	5.1	4.5	4.1	4.3	5.4	3.9	4.0	3.8	3.8	4.9	4.9	4.9
10	8.8	8.5	5.1	4.9	4.9	5.6	4.5	5.2	4.6	4.1	4.3	5.4	4.0	3.9	3.8	3.7	4.8	5.1	5.1
31	8.7	8.6	5.6	4.9	4.9	5.3	4.5	5.2	4.7	4.0	4.4	5.6	3.9	4.0	3.6	3.7	4.9	4.7	4.9
38	8.9	8.8	5.5	4.9	4.8	5.0	4.4	5.3	4.3	3.8	4.2	5.5	3.8	3.9	3.8	3.9	4.7	4.5	4.7
45	8.9	8.7	5.6	4.8	4.9	5.2	4.4	5.1	4.4	3.9	4.1	5.5	4.0	3.9	3.8	3.9	4.7	4.6	4.4
59	8.3	8.7	5.8	4.7	4.8	5.2	4.4	5.0	5.2	3.9	4.3	5.3	4.0	3.9	3.8	3.7	4.8	4.6	4.5
66	8.2	8.8	6.1	4.9	4.9	5.2	4.5	5.4	4.6	4.1	4.2	5.4	4.0	3.9	3.8	3.9	4.8	4.8	4.3
80	7.7	8.3	5.8	4.8	5.1	4.9	4.4	5.5	4.5	4.1	4.4	5.2	3.7	3.9	3.8	3.9	4.7	4.7	4.6
101	6.3	8.2	5.8	4.8	5.1	5.2	4.6	5.2	4.5	4.1	4.4	5.4	4.1	3.9	3.9	3.8	4.6	4.7	4.4
132	5.7	6.1	5.6	5.1	5.1	5.3	4.4	5.4	4.5	3.9	4.3	5.5	4.2	4.4	5.2	4.9	5.4	6.1	5.0
143	5.8	5.9	5.9	4.8	4.9	5.1	4.8	5.6	4.6	4.5	4.8	5.4	3.8	3.7	4.3	3.8	4.4	4.6	4.4
150	6.6	6.6	5.5	4.9	5.4	5.4	4.6	5.3	4.8	3.9	4.3	5.7	4.3	3.9	3.9	3.8	5.1	5.8	5.4
171	5.9	5.8	5.6	5.4	5.9	6.1	4.9	5.9	4.7	4.4	4.0	5.9	4.5	3.8	4.2	4.4	4.7	4.3	4.8
185	11.0	6.0	5.9	5.1	7.2	5.6	5.1	5.7	4.8	4.0	4.9	5.6	3.8	4.2	3.8	4.6	5.3	4.8	4.5
193	10.7	6.5	5.1	5.6	5.5	5.1	4.5	5.5	5.1	4.6	4.3	6.4	5.7	5.6	4.7	4.0	4.8	4.7	4.4
199	9.5	7.4	5.5	5.7	5.7	5.9	5.2	7.0	6.2	5.6	5.7	5.8	3.7	4.1	4.0	3.8	4.3	4.4	4.2
213	4.3	6.7	7.3	6.6	5.8	5.7	4.9	5.6	5.8	4.8	5.3	6.4	4.1	4.2	3.7	3.4	4.2	4.4	4.4

LOWER SALADO NEUTRON ACCESS TUBE LN4

PERCENT VOLUME MOISTURE CONTENT (CORRECTED)

1986

JULIAN DATE	DEPTH BELOW LAND SURFACE (M) .3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.7	4.3	4.9	5.5	6.1	6.7	7.3	7.9	8.5
220	3.9	4.9	5.1	5.0	5.0	5.1	4.5	5.4	4.4	3.9	4.3	5.3	3.6	4.9	3.8	3.5	4.2	4.5	4.5
240	3.7	4.9	4.8	5.2	5.8	5.5	5.4	5.8	5.2	4.4	4.5	5.0	3.7	4.8	3.7	3.8	4.6	5.0	4.6
255	4.6	6.2	6.0	6.6	6.9	7.6	6.3	7.3	6.7	5.3	5.1	6.1	4.6	4.3	4.3	4.0	4.8	5.1	4.9
269	3.7	4.9	5.0	5.9	5.4	5.5	4.9	5.6	5.8	4.4	4.5	5.5	4.7	4.3	4.7	4.0	4.7	5.1	5.3
289	8.3	4.6	4.7	4.9	4.9	5.3	4.4	5.3	4.5	3.8	4.2	5.2	3.8	3.4	3.6	3.1	3.9	4.3	29.3
324	10.6	6.1	4.6	4.9	5.1	5.2	4.5	5.3	4.7	4.1	4.4	5.3	3.7	3.6	3.5	3.1	5.8	8.6	30.7

1987

JULIAN DATE	DEPTH BELOW LAND SURFACE (M) .3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.7	4.3	4.9	5.5	6.1	6.7	7.3	7.9	8.5
8	10.2	7.2	4.5	4.7	5.1	5.5	5.1	5.2	4.7	4.2	4.8	5.3	3.8	3.7	4.0	3.2	5.8	8.2	29.3
71	11.0	8.0	4.5	4.9	5.4	5.8	5.5	5.6	5.0	4.4	5.1	5.6	3.6	3.7	4.0	3.1	5.9	7.9	28.9
85	10.9	9.8	4.4	4.8	4.9	5.4	5.0	5.1	4.6	4.0	4.8	5.2	3.8	3.8	3.8	3.1	5.6	8.1	28.5
113	9.0	9.2	4.7	4.8	4.9	5.4	5.0	5.1	4.6	3.9	4.8	5.2	3.8	3.7	3.8	3.1	5.7	8.1	27.5

LOWER SALADO NEUTRON ACCESS TUBE LN2

PERCENT VOLUME MOISTURE CONTENT (CORRECTED)

1985

JULIAN DATE	DEPTH BELOW LAND SURFACE (M) .3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.7	4.3	4.9	5.5	6.1	6.7	7.3	7.9	8.5
274	4.5	5.8	4.4	4.0	3.9	4.4	5.0	5.1	4.9	4.6	5.0	6.6	4.9	4.9	5.1	5.4	5.7	5.7	6.2
277	5.2	6.0	4.4	4.6	4.1	4.5	4.8	5.5	5.6	4.6	4.9	6.2	5.0	5.0	5.3	5.7	6.2	6.4	6.4
284	11.3	6.5	4.5	4.1	4.5	5.1	5.5	6.1	6.3	5.4	5.0	6.1	5.3	5.2	5.3	6.2	6.1	6.3	6.6
291	10.6	9.0	4.7	3.9	3.9	4.4	4.6	5.0	5.3	4.3	4.7	6.2	5.1	5.1	4.9	5.6	6.0	5.8	6.3
298	8.3	9.7	5.2	3.8	3.9	4.1	4.8	4.9	5.1	4.4	4.8	6.4	5.3	5.1	5.3	5.5	6.2	5.9	6.6
305	7.6	10.6	5.8	3.8	3.8	4.1	4.7	5.0	5.1	4.6	4.8	6.1	5.1	5.2	5.5	5.6	5.9	6.0	6.4
312	7.8	10.1	6.2	3.8	3.7	4.1	4.5	4.9	5.2	4.2	4.7	6.5	4.8	5.1	5.0	5.6	5.8	6.0	6.5
319	7.3	10.5	6.4	4.0	3.9	4.0	4.4	4.9	5.1	4.3	4.5	6.1	5.3	5.2	5.3	5.7	6.3	5.9	6.3
326	6.9	9.8	6.4	3.9	3.8	3.8	4.7	4.8	5.7	4.2	4.5	6.0	5.1	5.1	5.0	5.7	6.1	5.9	6.3
333	7.0	10.2	6.8	3.9	3.7	4.0	4.6	4.8	5.3	4.3	4.7	6.0	5.0	5.2	5.1	5.8	6.1	6.0	6.6
340	6.8	10.0	7.0	4.0	3.7	3.9	4.5	5.2	5.1	4.3	4.6	6.2	5.0	5.2	5.8	5.6	6.3	6.4	6.2
347	6.7	10.0	6.9	3.9	3.6	3.9	4.5	4.7	5.2	4.1	4.5	6.0	5.1	5.0	5.2	5.4	5.9	6.0	6.2
354	6.6	10.0	6.8	3.9	3.6	4.0	4.4	4.8	5.0	4.3	4.6	5.9	5.1	5.2	5.4	5.7	5.9	5.9	6.4
361	6.6	10.1	7.3	4.1	3.5	3.9	4.7	4.8	5.2	4.2	4.7	4.7	6.1	5.0	5.2	5.4	5.8	6.0	6.2

1986

JULIAN DATE	DEPTH BELOW LAND SURFACE (M) .3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.7	4.3	4.9	5.5	6.1	6.7	7.3	7.9	8.5
3	6.6	10.0	7.2	3.9	3.5	3.9	4.5	4.6	4.9	4.2	4.5	6.3	5.0	5.3	5.1	5.6	5.9	6.0	6.6
10	6.5	9.5	6.9	3.8	3.5	4.0	4.6	5.0	4.9	4.2	4.6	6.2	4.9	5.1	5.1	5.8	6.1	5.8	6.5
31	6.7	10.0	7.0	3.9	3.6	3.9	4.5	4.8	5.1	4.2	4.6	6.2	4.8	5.0	5.1	5.5	6.1	6.0	6.3
38	6.7	9.6	7.1	3.8	3.4	4.0	4.8	4.9	5.1	4.2	4.4	6.0	4.9	5.0	5.2	5.4	6.0	6.1	6.3
45	6.6	9.7	6.9	4.0	3.4	3.8	4.4	4.8	5.1	4.3	4.6	6.0	4.9	4.9	5.3	5.5	5.8	5.8	6.4
59	6.4	9.9	7.0	3.9	3.3	3.8	4.6	4.5	4.8	4.2	4.7	6.0	4.7	5.1	5.1	5.5	5.9	5.9	6.4
66	6.3	9.9	7.0	4.2	3.6	4.0	4.3	4.8	5.1	4.4	4.6	6.3	4.8	4.8	5.1	4.7	6.0	5.9	6.5
80	5.9	9.8	6.9	4.0	3.5	3.7	4.5	4.5	5.1	4.3	4.6	6.2	4.8	5.1	5.0	5.5	6.0	5.9	6.4
101	4.7	9.1	6.8	3.9	3.3	3.8	4.4	4.8	5.0	4.3	4.7	5.9	4.8	5.1	5.1	5.4	5.9	6.1	6.7
122	4.3	8.3	6.4	4.9	4.1	4.5	4.8	5.2	5.4	4.8	5.1	6.5	6.5	6.8	6.5	7.4	6.9	6.8	8.2
143	4.6	6.1	4.7	3.8	3.4	3.8	4.5	4.6	4.6	4.1	4.4	5.9	4.5	4.7	4.7	5.3	5.5	5.7	6.3
150	4.7	6.0	4.3	3.9	3.5	3.8	4.4	4.5	4.8	3.9	4.3	5.9	4.3	5.1	5.0	5.8	5.7	5.8	6.0
171	4.1	5.6	4.3	3.3	3.3	3.9	4.4	4.6	4.7	4.1	4.5	5.4	4.0	4.3	4.5	4.9	5.1	5.2	5.7
185	8.2	6.1	4.2	3.3	3.3	3.9	4.3	4.5	4.8	4.0	4.3	5.5	4.3	4.4	4.4	5.1	5.0	5.0	5.5
193	7.0	6.7	4.5	3.4	3.3	5.3	6.6	5.5	6.9	6.6	6.3	6.1	5.3	6.4	5.1	4.9	5.8	5.7	6.0
199	6.0	5.9	4.7	3.4	3.8	3.9	5.0	5.1	5.5	4.9	6.2	6.9	5.3	5.1	5.6	6.3	5.9	5.8	6.3
213	3.8	6.0	4.3	3.5	3.3	5.3	4.1	4.7	4.3	3.8	4.1	5.4	4.1	4.4	4.3	5.0	5.0	4.9	5.7
220	3.7	5.3	4.1	3.1	3.2	3.8	4.0	4.1	4.1	3.7	3.9	5.2	4.0	4.4	4.1	4.7	4.9	4.9	5.7

LOWER SALADO NEUTRON ACCESS TUBE LN2

PERCENT VOLUME MOISTURE CONTENT (CORRECTED)

1986

JULIAN	DEPTH BELOW LAND SURFACE (M)																	
DATE	.3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.7	4.3	4.9	5.5	6.1	6.7	7.3	7.9	8.5
240	3.1	5.0	3.6	4.7	5.0	4.4	4.3	4.3	4.0	5.3	3.7	4.9	4.3	4.2	5.1	5.4	5.9	5.2	5.6
255	3.4	4.6	3.6	2.7	3.0	4.4	4.6	4.4	4.5	4.3	4.5	5.7	5.1	5.2	4.0	5.6	5.4	5.7	6.5
269	3.4	5.4	4.2	3.2	3.7	4.2	4.9	4.8	4.7	4.7	4.5	6.4	6.0	5.7	4.8	4.7	5.4	5.6	6.3
289	7.3	4.9	3.7	2.9	3.0	3.8	4.0	4.1	4.2	3.5	3.8	4.9	4.2	4.4	4.1	4.8	5.9	21.2	30.3
324	7.0	5.6	3.8	2.9	3.1	3.8	4.0	4.1	4.3	3.9	4.0	5.2	4.5	4.8	4.5	5.1	5.6	29.8	31.0

1987

JULIAN	DEPTH BELOW LAND SURFACE (M)																	
DATE	.3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.7	4.3	4.9	5.5	6.1	6.7	7.3	7.9	8.5
8	6.7	6.3	3.8	2.7	3.0	3.7	4.0	4.0	4.2	3.6	3.9	5.3	4.6	4.6	4.6	5.0	4.6	7.3	14.5
57	7.9	7.1	3.7	2.4	2.6	3.3	3.7	3.8	3.6	3.2	3.8	5.3	4.1	4.3	4.3	4.8	4.3	6.0	9.1
85	7.3	8.8	4.7	3.0	3.0	3.8	4.3	4.2	4.3	3.8	4.3	5.6	4.8	4.8	4.7	5.4	4.8	7.1	8.8
113	5.9	7.6	4.4	2.9	2.8	3.7	4.2	4.1	4.3	3.8	4.3	5.5	4.7	4.9	4.7	5.3	4.8	7.2	8.5

LOWER SALADO NEUTRON ACCESS TUBE LN3

PERCENT VOLUME MOISTURE CONTENT (CORRECTED)

1985

JULIAN DATE	DEPTH BELOW LAND SURFACE (M) .3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.7	4.3	4.9	5.5	6.1	6.7	7.3	7.9	8.5
265	5.0	4.2	5.0	5.5	5.3	5.3	5.6	6.3	5.8	5.0	6.8	6.3	7.1	11.4	14.8	15.3	13.3	14.6	16.1
270	5.0	4.4	5.1	5.3	5.3	5.3	5.7	5.8	5.8	5.0	7.1	5.8	7.4	11.5	14.8	15.7	13.4	14.9	16.5
277	5.1	4.7	4.2	4.5	4.7	5.1	4.5	5.9	5.4	4.8	7.2	6.3	6.0	11.4	14.0	14.5	13.7	12.1	16.2
284	9.7	4.7	4.6	4.6	4.5	5.0	4.6	6.1	5.6	4.8	7.5	6.1	6.1	11.7	14.2	14.9	13.7	12.3	15.8
287	14.0	4.9	4.3	4.4	4.6	5.0	4.7	6.1	5.5	4.8	7.4	6.4	6.0	11.7	14.0	14.5	13.7	12.5	15.8
298	10.8	5.5	4.4	4.6	4.7	5.2	4.9	6.1	5.5	5.1	7.4	6.7	6.6	12.0	14.4	14.6	14.0	12.5	15.7
305	10.5	6.3	4.2	4.6	4.5	4.8	5.2	6.1	5.6	5.1	7.4	6.2	6.0	11.5	14.3	14.8	13.6	12.0	15.8
312	10.5	6.3	4.4	4.6	4.7	4.9	4.5	5.9	5.7	4.9	7.8	6.3	6.1	11.5	14.2	14.6	13.8	11.9	16.2
319	10.1	6.7	4.8	4.7	4.6	4.7	4.6	5.9	5.8	4.4	7.4	6.3	6.5	11.7	14.6	15.2	14.5	12.4	16.7
326	9.9	6.8	4.3	4.6	4.8	5.1	4.5	6.2	5.7	4.9	7.5	6.4	6.2	11.2	13.8	14.8	13.7	12.0	15.8
333	9.7	6.9	5.2	4.8	4.8	4.9	4.7	6.3	5.7	4.8	7.6	6.4	6.1	10.8	14.4	14.9	13.9	12.2	16.0
340	9.6	6.8	4.4	4.7	4.7	5.1	4.9	6.6	5.8	4.9	7.6	6.7	6.1	11.4	14.5	14.9	14.0	11.9	14.4
347	9.8	7.6	4.5	4.8	4.8	5.1	4.7	6.0	5.4	4.9	7.5	6.7	6.3	11.8	14.7	15.1	14.5	12.7	16.4
354	9.3	7.0	4.3	4.5	4.7	5.0	4.6	6.2	5.6	4.9	8.1	6.4	6.1	11.4	13.9	14.9	14.1	12.1	15.8
361	9.7	7.6	4.4	4.6	5.0	5.0	4.6	6.2	5.8	5.0	7.6	6.6	6.4	11.8	14.0	14.9	14.1	12.1	16.0

1986

JULIAN DATE	DEPTH BELOW LAND SURFACE (M) .3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.7	4.3	4.9	5.5	6.1	6.7	7.3	7.9	8.5
3	9.6	8.0	4.8	5.1	4.7	5.2	5.1	6.2	5.9	5.1	7.7	6.6	6.2	11.5	14.1	15.1	13.8	12.3	16.0
10	9.7	7.0	4.4	4.4	4.7	4.8	4.5	5.9	5.5	4.8	7.8	6.7	6.1	11.4	14.2	14.5	13.6	12.0	16.2
31	9.8	7.6	4.6	4.5	4.8	4.8	4.6	6.0	5.7	4.9	7.9	6.6	6.6	11.6	14.0	14.9	14.0	12.1	16.0
38	9.6	7.3	4.7	4.8	4.7	4.9	4.7	6.1	5.8	5.1	8.1	6.6	6.0	11.6	14.3	14.9	13.8	12.3	16.0
45	9.3	7.5	4.5	4.7	4.8	5.0	4.3	6.0	5.7	4.9	7.8	6.5	5.9	11.4	13.8	15.0	13.4	12.2	15.7
59	9.5	7.5	4.7	4.5	4.6	4.9	4.5	6.1	5.7	5.0	7.9	6.5	6.2	11.6	14.1	15.1	14.1	12.3	15.9
66	9.4	7.7	4.7	4.5	4.9	5.0	4.6	6.2	5.7	4.9	7.9	6.4	6.1	11.9	14.0	15.4	13.9	12.3	16.0
80	9.5	7.5	4.7	4.6	4.6	4.9	4.7	6.2	5.7	4.9	8.1	6.7	6.0	11.3	13.8	14.9	14.1	12.2	15.5
101	9.0	7.5	4.9	4.6	4.9	4.7	4.7	6.2	5.9	5.0	8.2	6.6	6.3	11.6	14.2	15.1	13.9	12.7	16.0
132	8.9	7.0	4.8	4.8	5.1	4.9	4.7	6.4	5.9	4.9	8.0	6.6	6.1	11.5	14.1	14.6	14.1	12.5	15.4
143	7.3	6.9	4.9	4.6	5.1	5.1	4.7	6.2	5.8	5.2	8.2	6.4	5.9	11.5	13.9	14.6	13.8	12.5	15.7
150	6.5	6.2	4.9	4.6	5.0	5.0	4.7	6.3	6.0	5.2	8.2	6.6	6.0	11.2	14.0	14.2	13.5	12.1	15.6
171	5.2	4.9	4.2	4.5	4.5	4.9	4.9	6.4	6.0	5.1	8.1	6.8	6.1	10.4	13.4	14.2	13.3	11.8	14.1
185	8.9	5.0	4.4	4.5	4.6	5.0	4.7	6.4	6.0	4.9	8.1	6.4	6.1	11.2	13.9	13.6	13.4	11.5	15.4
193	7.5	5.2	5.0	5.8	5.5	6.5	6.2	6.7	6.3	5.4	8.0	7.1	8.4	13.0	16.4	18.3	15.6	13.4	17.5
199	6.2	5.1	5.1	4.9	5.1	6.0	5.4	7.8	6.4	6.5	9.4	8.5	7.3	14.2	14.7	16.6	15.4	12.6	16.4
213	7.0	6.4	4.6	4.7	5.3	5.1	4.5	7.1	6.4	5.9	7.9	6.1	6.0	10.9	13.7	14.3	13.5	11.3	14.8

LOWER SALADO NEUTRON ACCESS TUBE LN3

PERCENT VOLUME MOISTURE CONTENT (CORRECTED)

1986

JULIAN	DEPTH BELOW LAND SURFACE (M)																	
DATE	.3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.7	4.3	4.9	5.5	6.1	6.7	7.3	7.9	8.5
220	4.9	4.9	5.3	5.4	5.7	5.6	5.5	7.0	7.3	7.2	10.0	7.1	7.2	12.5	14.3	13.8	13.3	11.4	14.7
240	4.2	4.7	3.9	4.9	4.6	4.6	4.4	6.0	5.6	4.7	7.8	6.3	6.0	11.7	15.2	14.3	13.1	10.8	13.8
255	5.0	5.0	4.7	4.8	4.8	4.9	4.6	5.9	5.6	5.1	8.4	6.8	6.2	11.6	14.9	15.2	13.1	12.6	15.6
269	5.5	5.3	4.4	4.8	5.1	5.9	5.3	6.4	6.6	5.8	8.7	8.4	6.7	12.7	15.1	17.0	15.3	13.9	17.3
289	10.8	4.4	4.3	4.3	4.6	4.4	4.1	5.7	5.4	4.8	8.6	6.5	6.5	12.0	15.0	14.1	14.0	11.5	14.6
324	10.8	5.7	4.1	4.2	4.3	4.3	4.1	5.7	5.4	4.8	7.8	6.4	6.0	11.5	13.8	14.4	13.4	4.4	15.5

1987

JULIAN	DEPTH BELOW LAND SURFACE (M)																	
DATE	.3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.7	4.3	4.9	5.5	6.1	6.7	7.3	7.9	8.5
8	11.0	6.9	4.4	4.7	4.7	4.9	4.6	5.9	5.7	4.8	8.0	6.6	5.9	11.8	14.3	14.7	13.6	11.7	16.8
71	10.9	7.3	4.5	4.9	4.9	5.0	4.6	6.3	6.0	5.3	7.3	7.2	6.3	11.1	10.3	14.6	13.3	12.8	15.6
85	10.7	9.5	5.3	4.3	4.5	4.4	4.3	6.2	5.6	4.8	8.4	6.7	6.3	11.8	14.0	14.9	13.5	12.1	17.2
113	9.0	7.5	4.9	4.5	4.5	4.7	4.3	6.1	5.7	4.7	8.3	6.6	6.3	11.8	14.1	14.7	13.4	11.7	16.9

LOWER SALADO NEUTRON ACCESS TUBE LN3

PERCENT VOLUME MOISTURE CONTENT (CORRECTED)

1986

JULIAN	DEPTH BELOW LAND SURFACE (M)																		
DATE	.3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.7	4.3	4.9	5.5	6.1	6.7	7.3	7.9	8.5
220	4.9	4.9	5.3	5.4	5.7	5.6	5.5	7.0	7.3	7.2	10.0	7.1	7.2	12.5	14.3	13.8	13.3	11.4	14.7
240	4.2	4.7	3.9	4.9	4.6	4.6	4.4	6.0	5.6	4.7	7.8	6.3	6.0	11.7	15.2	14.3	13.1	10.8	13.8
255	5.0	5.0	4.7	4.8	4.8	4.9	4.6	5.9	5.6	5.1	8.4	6.8	6.2	11.6	14.9	15.2	13.1	12.6	15.6
269	5.5	5.3	4.4	4.8	5.1	5.9	5.3	6.4	6.6	5.8	8.7	8.4	6.7	12.7	15.1	17.0	15.3	13.9	17.3
289	10.8	4.4	4.3	4.3	4.6	4.4	4.1	5.7	5.4	4.8	8.6	6.5	6.5	12.0	15.0	14.1	14.0	11.5	14.6
324	10.8	5.7	4.1	4.2	4.3	4.3	4.1	5.7	5.4	4.8	7.8	6.4	6.0	11.5	13.8	14.4	13.4	4.4	15.5

1987

JULIAN	DEPTH BELOW LAND SURFACE (M)																		
DATE	.3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.7	4.3	4.9	5.5	6.1	6.7	7.3	7.9	8.5
8	11.0	6.9	4.4	4.7	4.7	4.9	4.6	5.9	5.7	4.8	8.0	6.6	5.9	11.8	14.3	14.7	13.6	11.7	16.8
71	10.9	7.3	4.5	4.9	4.9	5.0	4.6	6.3	6.0	5.3	7.3	7.2	6.3	11.1	10.3	14.6	13.3	12.8	15.6
85	10.7	9.5	5.3	4.3	4.5	4.4	4.3	6.2	5.6	4.8	8.4	6.7	6.3	11.8	14.0	14.9	13.5	12.1	17.2
113	9.0	7.5	4.9	4.5	4.5	4.7	4.3	6.1	5.7	4.7	8.3	6.6	6.3	11.8	14.1	14.7	13.4	11.7	16.9

LOWER SALADO NEUTRON ACCESS TUBE LN4

PERCENT VOLUME MOISTURE CONTENT (CORRECTED)

1985

JULIAN DATE	DEPTH BELOW LAND SURFACE (M) .3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.7	4.3	4.9	5.5	6.1	6.7	7.3	7.9	8.5
265	4.3	4.6	4.7	5.5	5.0	5.0	5.6	4.8	4.5	5.4	5.0	4.3	4.5	4.4	4.0	4.7	5.2	5.5	9.5
270	4.8	5.0	5.4	5.5	5.7	4.9	5.6	5.1	4.6	5.3	4.9	4.5	4.4	4.5	4.2	4.8	5.5	5.7	9.5
277	4.3	4.4	4.6	4.8	4.9	5.1	4.2	5.1	4.5	4.0	4.3	5.6	4.1	4.3	3.8	3.9	4.9	5.3	5.0
284	8.9	4.6	4.6	5.0	4.8	5.3	4.6	5.2	4.6	4.2	4.5	5.4	3.9	3.9	4.1	3.9	5.0	5.4	5.3
291	13.8	5.5	4.4	4.6	4.9	5.0	4.4	5.1	4.7	4.1	4.4	5.4	4.0	3.9	4.0	4.1	4.8	5.0	5.0
298	11.4	7.0	4.7	4.8	5.1	5.3	4.6	5.3	4.9	4.1	4.6	5.5	4.0	4.0	4.1	4.0	4.9	5.2	5.2
305	10.7	7.6	4.7	5.0	4.9	5.2	4.5	5.1	4.7	4.2	4.3	5.5	3.9	3.9	3.9	4.1	5.0	5.2	5.2
312	10.2	7.9	4.7	4.8	4.9	5.2	4.4	5.2	4.6	4.1	4.3	5.3	4.0	4.0	4.0	3.8	4.9	5.2	5.1
319	9.9	8.3	5.0	5.2	4.8	5.3	4.9	5.8	4.7	4.4	4.4	5.5	4.3	4.3	4.1	4.2	5.3	5.5	5.4
326	9.3	8.5	5.0	4.7	5.0	5.0	4.8	6.1	5.1	4.6	4.3	5.2	4.0	5.7	5.2	5.0	5.8	6.9	6.7
333	9.0	8.2	4.8	4.8	5.0	5.2	4.5	5.2	4.6	4.2	4.4	5.5	4.0	3.9	3.7	4.0	4.9	5.1	5.2
340	9.0	8.6	5.2	4.9	5.0	5.3	4.5	5.4	4.5	4.1	4.3	5.3	3.9	4.0	3.8	3.9	5.1	5.3	5.1
347	9.3	8.5	5.2	4.8	5.0	5.2	4.4	5.3	4.6	4.0	4.3	5.3	4.0	4.0	4.0	3.7	4.7	5.2	5.0
354	9.0	8.5	5.1	4.8	4.9	5.1	4.5	5.1	4.5	4.1	4.3	5.3	4.0	3.9	3.9	3.7	4.9	5.0	5.1
361	9.0	8.6	5.2	4.9	4.9	5.3	4.4	5.4	4.6	4.1	4.5	5.4	4.1	4.0	3.9	4.0	4.9	5.3	5.2

1986

JULIAN DATE	DEPTH BELOW LAND SURFACE (M) .3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.7	4.3	4.9	5.5	6.1	6.7	7.3	7.9	8.5
3	8.8	8.6	5.3	4.9	4.8	5.3	4.6	5.1	4.5	4.1	4.3	5.4	3.9	4.0	3.8	3.8	4.9	4.9	4.9
10	8.8	8.5	5.1	4.9	4.9	5.6	4.5	5.2	4.6	4.1	4.3	5.4	4.0	3.9	3.8	3.7	4.8	5.1	5.1
31	8.7	8.6	5.6	4.9	4.9	5.3	4.5	5.2	4.7	4.0	4.4	5.6	3.9	4.0	3.6	3.7	4.9	4.7	4.9
38	8.9	8.8	5.5	4.9	4.8	5.0	4.4	5.3	4.3	3.8	4.2	5.5	3.8	3.9	3.8	3.9	4.7	4.5	4.7
45	8.9	8.7	5.6	4.8	4.9	5.2	4.4	5.1	4.4	3.9	4.1	5.5	4.0	3.9	3.8	3.9	4.7	4.6	4.4
59	8.3	8.7	5.8	4.7	4.8	5.2	4.4	5.0	5.2	3.9	4.3	5.3	4.0	3.9	3.8	3.7	4.8	4.6	4.5
66	8.2	8.8	6.1	4.9	4.9	5.2	4.5	5.4	4.6	4.1	4.2	5.4	4.0	3.9	3.8	3.9	4.8	4.8	4.3
80	7.7	8.3	5.8	4.8	5.1	4.9	4.4	5.5	4.5	4.1	4.4	5.2	3.7	3.9	3.8	3.9	4.7	4.7	4.6
101	6.3	8.2	5.8	4.8	5.1	5.2	4.6	5.2	4.5	4.1	4.4	5.4	4.1	3.9	3.9	3.8	4.6	4.7	4.4
132	5.7	6.1	5.6	5.1	5.1	5.3	4.4	5.4	4.5	3.9	4.3	5.5	4.2	4.4	5.2	4.9	5.4	6.1	5.0
143	5.8	5.9	5.9	4.8	4.9	5.1	4.8	5.6	4.6	4.5	4.8	5.4	3.8	3.7	4.3	3.8	4.4	4.6	4.4
150	6.6	6.6	5.5	4.9	5.4	5.4	4.6	5.3	4.8	3.9	4.3	5.7	4.3	3.9	3.9	3.8	5.1	5.8	5.4
171	5.9	5.8	5.6	5.4	5.9	6.1	4.9	5.9	4.7	4.4	4.0	5.9	4.5	3.8	4.2	4.4	4.7	4.3	4.8
185	11.0	6.0	5.9	5.1	7.2	5.6	5.1	5.7	4.8	4.0	4.9	5.6	3.8	4.2	3.8	4.6	5.3	4.8	4.5
193	10.7	6.5	5.1	5.6	5.5	5.1	4.5	5.5	5.1	4.6	4.3	6.4	5.7	5.6	4.7	4.0	4.8	4.7	4.4
199	9.5	7.4	5.5	5.7	5.7	5.9	5.2	7.0	6.2	5.6	5.7	5.8	3.7	4.1	4.0	3.8	4.3	4.4	4.2
213	4.3	6.7	7.3	6.6	5.8	5.7	4.9	5.6	5.8	4.8	5.3	6.4	4.1	4.2	3.7	3.4	4.2	4.4	4.4

LOWER SALADO NEUTRON ACCESS TUBE LN4

PERCENT VOLUME MOISTURE CONTENT (CORRECTED)

1986

JULIAN DATE	DEPTH BELOW LAND SURFACE (M) .3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.7	4.3	4.9	5.5	6.1	6.7	7.3	7.9	8.5
220	3.9	4.9	5.1	5.0	5.0	5.1	4.5	5.4	4.4	3.9	4.3	5.3	3.6	4.9	3.8	3.5	4.2	4.5	4.5
240	3.7	4.9	4.8	5.2	5.8	5.5	5.4	5.8	5.2	4.4	4.5	5.0	3.7	4.8	3.7	3.8	4.6	5.0	4.6
255	4.6	6.2	6.0	6.6	6.9	7.6	6.3	7.3	6.7	5.3	5.1	6.1	4.6	4.3	4.3	4.0	4.8	5.1	4.9
269	3.7	4.9	5.0	5.9	5.4	5.5	4.9	5.6	5.8	4.4	4.5	5.5	4.7	4.3	4.7	4.0	4.7	5.1	5.3
289	8.3	4.6	4.7	4.9	4.9	5.3	4.4	5.3	4.5	3.8	4.2	5.2	3.8	3.4	3.6	3.1	3.9	4.3	29.3
324	10.6	6.1	4.6	4.9	5.1	5.2	4.5	5.3	4.7	4.1	4.4	5.3	3.7	3.6	3.5	3.1	5.8	8.6	30.7

1987

JULIAN DATE	DEPTH BELOW LAND SURFACE (M) .3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.7	4.3	4.9	5.5	6.1	6.7	7.3	7.9	8.5
8	10.2	7.2	4.5	4.7	5.1	5.5	5.1	5.2	4.7	4.2	4.8	5.3	3.8	3.7	4.0	3.2	5.8	8.2	29.3
71	11.0	8.0	4.5	4.9	5.4	5.8	5.5	5.6	5.0	4.4	5.1	5.6	3.6	3.7	4.0	3.1	5.9	7.9	28.9
85	10.9	9.8	4.4	4.8	4.9	5.4	5.0	5.1	4.6	4.0	4.8	5.2	3.8	3.8	3.8	3.1	5.6	8.1	28.5
113	9.0	9.2	4.7	4.8	4.9	5.4	5.0	5.1	4.6	3.9	4.8	5.2	3.8	3.7	3.8	3.1	5.7	8.1	27.5

LOWER SALADO NEUTRON ACCESS TUBE LN1

PERCENT VOLUME MOISTURE CONTENT (CORRECTED)

1985

JULIAN DATE	DEPTH BELOW LAND SURFACE (M) .3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.7	4.3	4.9	5.5	6.1	6.7	7.3	7.9	8.5
265	6.9	7.5	7.1	7.3	7.0	6.8	6.6	6.9	6.8	7.5	7.6	8.2	8.6	8.2	9.3	9.2	8.2	8.7	9.3
270	7.3	8.2	7.8	7.6	7.1	6.7	6.8	7.2	7.4	9.3	7.9	8.3	9.7	9.1	9.7	10.0	8.3	8.5	13.9
277	7.1	7.4	7.0	6.9	6.9	6.2	6.2	6.5	6.9	7.3	7.6	7.8	8.6	8.6	8.8	9.4	7.6	7.9	11.9
284	11.5	10.9	10.6	9.7	7.4	5.8	5.9	6.8	7.0	7.2	7.3	7.8	8.6	7.9	8.6	9.4	7.6	7.8	9.1
290	10.6	10.4	9.9	9.7	9.7	8.1	6.4	6.6	6.8	7.5	7.3	7.9	8.4	7.8	8.6	9.2	7.5	7.9	31.0
298	8.7	9.1	9.1	8.9	9.7	8.9	8.7	8.2	6.9	8.0	7.6	8.1	9.2	8.2	9.1	10.0	8.1	7.4	32.5
305	7.8	8.3	8.8	8.5	9.1	8.9	8.8	8.7	7.2	7.4	7.6	7.7	8.6	8.0	8.7	9.6	7.8	6.8	31.4
312	7.3	7.8	8.2	8.4	8.5	8.2	8.5	8.3	7.4	7.4	7.5	7.7	8.0	8.0	8.1	9.7	7.7	7.1	31.6
319	7.4	7.7	8.1	7.9	8.4	7.9	8.5	8.8	7.4	7.8	7.8	8.3	8.3	8.3	8.4	9.9	7.5	6.8	30.0
326	6.9	7.5	7.8	7.8	8.1	7.6	8.0	8.0	7.0	7.2	7.0	8.1	8.7	8.1	8.6	9.7	8.0	7.1	26.1
333	6.9	7.3	7.9	8.0	8.3	7.9	8.1	7.9	7.4	7.2	7.2	7.5	8.2	7.8	8.4	9.1	7.4	6.6	19.7
340	7.0	7.4	7.5	7.6	8.0	7.9	7.9	8.1	7.0	7.2	7.2	7.7	8.0	7.4	8.2	8.8	7.4	6.4	14.8
347	6.6	7.5	8.0	7.5	8.0	7.6	7.9	7.7	7.4	7.2	7.2	7.4	8.1	7.2	8.1	9.2	7.4	6.5	12.4
354	6.6	7.5	7.7	7.4	7.8	7.5	8.0	7.6	6.8	7.2	7.5	7.9	8.0	7.4	8.1	8.6	7.4	6.6	11.1
361	6.7	7.4	7.9	7.6	7.8	7.7	7.7	7.7	6.9	7.4	7.4	7.4	8.0	7.4	8.3	8.9	7.5	6.6	10.6

1986

JULIAN DATE	DEPTH BELOW LAND SURFACE (M) .3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.7	4.3	4.9	5.5	6.1	6.7	7.3	7.9	8.5
3	6.7	7.3	7.5	7.5	7.8	7.3	8.0	7.5	6.8	7.2	6.9	7.4	8.0	7.3	7.9	9.1	7.2	6.4	10.1
10	6.5	7.4	7.3	7.7	7.7	7.5	7.8	7.5	6.8	7.3	6.9	7.6	7.8	7.3	8.3	9.0	7.4	6.4	9.8
31	6.7	7.2	7.7	7.2	7.9	7.4	7.4	7.3	6.7	7.2	6.9	7.4	7.7	7.2	8.4	8.9	7.4	6.2	9.4
38	6.3	7.2	7.4	7.3	7.6	7.3	7.8	7.3	6.7	7.2	7.1	7.4	7.9	7.2	8.0	8.9	7.3	6.5	9.2
45	6.5	7.1	7.5	7.2	7.8	7.4	7.5	7.2	6.9	7.2	6.7	7.1	7.7	7.3	8.0	8.7	7.3	6.4	8.9
59	6.5	7.3	7.3	7.1	7.4	7.3	7.5	7.1	6.8	7.0	6.9	7.4	7.6	6.8	8.0	8.7	7.0	6.4	9.3
66	6.4	6.9	7.4	7.3	7.5	7.4	7.3	7.0	6.8	7.1	6.9	7.2	7.6	7.1	7.9	8.8	7.3	6.6	9.1
80	6.1	6.9	7.3	7.0	7.6	7.0	7.5	7.0	6.7	7.2	6.7	7.1	7.6	6.7	7.8	8.6	7.1	6.3	8.8
101	5.9	6.5	6.5	6.4	7.0	7.0	6.9	6.9	6.4	6.8	6.8	7.3	7.7	7.0	7.9	8.8	7.0	6.4	9.0
122	4.4	4.6	5.2	5.0	6.0	6.0	6.1	7.6	7.4	8.3	7.4	7.9	7.1	8.4	10.4	10.9	9.1	8.1	10.5
143	3.5	3.4	4.1	4.2	4.9	4.6	4.7	5.0	5.2	5.8	5.8	6.4	6.1	5.7	6.6	7.6	7.0	6.4	8.8
150	3.1	3.5	3.9	4.0	4.7	4.4	4.6	4.8	5.0	5.6	5.6	6.2	5.8	5.6	6.3	6.6	6.6	6.4	8.8
171	3.2	3.0	3.7	3.9	4.3	4.1	4.4	4.3	4.1	4.8	4.2	6.2	5.4	4.7	5.8	5.3	4.6	5.2	8.8
178	7.9	3.5	3.7	3.6	4.2	4.0	4.2	4.3	4.6	4.8	4.3	6.0	5.5	5.2	5.8	4.9	5.1	5.5	8.6
185	6.4	3.8	3.6	3.7	4.3	4.1	4.4	4.4	4.6	4.8	4.6	5.9	5.7	5.4	6.4	5.8	5.0	5.1	8.6
193	7.3	7.4	11.9	14.8	15.1	13.8	16.6	14.7	12.4	10.9	10.2	11.3	11.9	13.0	13.4	14.2	12.9	32.1	29.7
199	6.9	7.3	11.9	15.4	16.6	15.4	17.3	16.6	14.0	13.6	13.3	14.8	14.2	13.9	15.3	15.6	13.6	20.5	30.9

LOWER SALADO NEUTRON ACCESS TUBE LN2

PERCENT VOLUME MOISTURE CONTENT (CORRECTED)

1985

JULIAN DATE	DEPTH BELOW LAND SURFACE (M) .3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.7	4.3	4.9	5.5	6.1	6.7	7.3	7.9	8.5
274	4.5	5.8	4.4	4.0	3.9	4.4	5.0	5.1	4.9	4.6	5.0	6.6	4.9	4.9	5.1	5.4	5.7	5.7	6.2
277	5.2	6.0	4.4	4.6	4.1	4.5	4.8	5.5	5.6	4.6	4.9	6.2	5.0	5.0	5.3	5.7	6.2	6.4	6.4
284	11.3	6.5	4.5	4.1	4.5	5.1	5.5	6.1	6.3	5.4	5.0	6.1	5.3	5.2	5.3	6.2	6.1	6.3	6.6
291	10.6	9.0	4.7	3.9	3.9	4.4	4.6	5.0	5.3	4.3	4.7	6.2	5.1	5.1	4.9	5.6	6.0	5.8	6.3
298	8.3	9.7	5.2	3.8	3.9	4.1	4.8	4.9	5.1	4.4	4.8	6.4	5.3	5.1	5.3	5.5	6.2	5.9	6.6
305	7.6	10.6	5.8	3.8	3.8	4.1	4.7	5.0	5.1	4.6	4.8	6.1	5.1	5.2	5.5	5.6	5.9	6.0	6.4
312	7.8	10.1	6.2	3.8	3.7	4.1	4.5	4.9	5.2	4.2	4.7	6.5	4.8	5.1	5.0	5.6	5.8	6.0	6.5
319	7.3	10.5	6.4	4.0	3.9	4.0	4.4	4.9	5.1	4.3	4.5	6.1	5.3	5.2	5.3	5.7	6.3	5.9	6.3
326	6.9	9.8	6.4	3.9	3.8	3.8	4.7	4.8	5.7	4.2	4.5	6.0	5.1	5.1	5.0	5.7	6.1	5.9	6.3
333	7.0	10.2	6.8	3.9	3.7	4.0	4.6	4.8	5.3	4.3	4.7	6.0	5.0	5.2	5.1	5.8	6.1	6.0	6.6
340	6.8	10.0	7.0	4.0	3.7	3.9	4.5	5.2	5.1	4.3	4.6	6.2	5.0	5.2	5.8	5.6	6.3	6.4	6.2
347	6.7	10.0	6.9	3.9	3.6	3.9	4.5	4.7	5.2	4.1	4.5	6.0	5.1	5.0	5.2	5.4	5.9	6.0	6.2
354	6.6	10.0	6.8	3.9	3.6	4.0	4.4	4.8	5.0	4.3	4.6	5.9	5.1	5.2	5.4	5.7	5.9	5.9	6.4
361	6.6	10.1	7.3	4.1	3.5	3.9	4.7	4.8	5.2	4.2	4.7	4.7	6.1	5.0	5.2	5.4	5.8	6.0	6.2

1986

JULIAN DATE	DEPTH BELOW LAND SURFACE (M) .3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.7	4.3	4.9	5.5	6.1	6.7	7.3	7.9	8.5
3	6.6	10.0	7.2	3.9	3.5	3.9	4.5	4.6	4.9	4.2	4.5	6.3	5.0	5.3	5.1	5.6	5.9	6.0	6.6
10	6.5	9.5	6.9	3.8	3.5	4.0	4.6	5.0	4.9	4.2	4.6	6.2	4.9	5.1	5.1	5.8	6.1	5.8	6.5
31	6.7	10.0	7.0	3.9	3.6	3.9	4.5	4.8	5.1	4.2	4.6	6.2	4.8	5.0	5.1	5.5	6.1	6.0	6.3
38	6.7	9.6	7.1	3.8	3.4	4.0	4.8	4.9	5.1	4.2	4.4	6.0	4.9	5.0	5.2	5.4	6.0	6.1	6.3
45	6.6	9.7	6.9	4.0	3.4	3.8	4.4	4.8	5.1	4.3	4.6	6.0	4.9	4.9	5.3	5.5	5.8	5.8	6.4
59	6.4	9.9	7.0	3.9	3.3	3.8	4.6	4.5	4.8	4.2	4.7	6.0	4.7	5.1	5.1	5.5	5.9	5.9	6.4
66	6.3	9.9	7.0	4.2	3.6	4.0	4.3	4.8	5.1	4.4	4.6	6.3	4.8	4.8	5.1	4.7	6.0	5.9	6.5
80	5.9	9.8	6.9	4.0	3.5	3.7	4.5	4.5	5.1	4.3	4.6	6.2	4.8	5.1	5.0	5.5	6.0	5.9	6.4
101	4.7	9.1	6.8	3.9	3.3	3.8	4.4	4.8	5.0	4.3	4.7	5.9	4.8	5.1	5.1	5.4	5.9	6.1	6.7
122	4.3	8.3	6.4	4.9	4.1	4.5	4.8	5.2	5.4	4.8	5.1	6.5	6.5	6.8	6.5	7.4	6.9	6.8	8.2
143	4.6	6.1	4.7	3.8	3.4	3.8	4.5	4.6	4.6	4.1	4.4	5.9	4.5	4.7	4.7	5.3	5.5	5.7	6.3
150	4.7	6.0	4.3	3.9	3.5	3.8	4.4	4.5	4.8	3.9	4.3	5.9	4.3	5.1	5.0	5.8	5.7	5.8	6.0
171	4.1	5.6	4.3	3.3	3.3	3.9	4.4	4.6	4.7	4.1	4.5	5.4	4.0	4.3	4.5	4.9	5.1	5.2	5.7
185	8.2	6.1	4.2	3.3	3.3	3.9	4.3	4.5	4.8	4.0	4.3	5.5	4.3	4.4	4.4	5.1	5.0	5.0	5.5
193	7.0	6.7	4.5	3.4	3.3	5.3	6.6	5.5	6.9	6.6	6.3	6.1	5.3	6.4	5.1	4.9	5.8	5.7	6.0
199	6.0	5.9	4.7	3.4	3.8	3.9	5.0	5.1	5.5	4.9	6.2	6.9	5.3	5.1	5.6	6.3	5.9	5.8	6.3
213	3.8	6.0	4.3	3.5	3.3	5.3	4.1	4.7	4.3	3.8	4.1	5.4	4.1	4.4	4.3	5.0	5.0	4.9	5.7
220	3.7	5.3	4.1	3.1	3.2	3.8	4.0	4.1	4.1	3.7	3.9	5.2	4.0	4.4	4.1	4.7	4.9	4.9	5.7

LOWER SALADO NEUTRON ACCESS TUBE LN2

PERCENT VOLUME MOISTURE CONTENT (CORRECTED)

1986

JULIAN DATE	DEPTH BELOW LAND SURFACE (M) .3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.7	4.3	4.9	5.5	6.1	6.7	7.3	7.9	8.5
240	3.1	5.0	3.6	4.7	5.0	4.4	4.3	4.3	4.0	5.3	3.7	4.9	4.3	4.2	5.1	5.4	5.9	5.2	5.6
255	3.4	4.6	3.6	2.7	3.0	4.4	4.6	4.4	4.5	4.3	4.5	5.7	5.1	5.2	4.0	5.6	5.4	5.7	6.5
269	3.4	5.4	4.2	3.2	3.7	4.2	4.9	4.8	4.7	4.7	4.5	6.4	6.0	5.7	4.8	4.7	5.4	5.6	6.3
289	7.3	4.9	3.7	2.9	3.0	3.8	4.0	4.1	4.2	3.5	3.8	4.9	4.2	4.4	4.1	4.8	5.9	21.2	30.3
324	7.0	5.6	3.8	2.9	3.1	3.8	4.0	4.1	4.3	3.9	4.0	5.2	4.5	4.8	4.5	5.1	5.6	29.8	31.0

1987

JULIAN DATE	DEPTH BELOW LAND SURFACE (M) .3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.7	4.3	4.9	5.5	6.1	6.7	7.3	7.9	8.5
8	6.7	6.3	3.8	2.7	3.0	3.7	4.0	4.0	4.2	3.6	3.9	5.3	4.6	4.6	4.6	5.0	4.6	7.3	14.5
57	7.9	7.1	3.7	2.4	2.6	3.3	3.7	3.8	3.6	3.2	3.8	5.3	4.1	4.3	4.3	4.8	4.3	6.0	9.1
85	7.3	8.8	4.7	3.0	3.0	3.8	4.3	4.2	4.3	3.8	4.3	5.6	4.8	4.8	4.7	5.4	4.8	7.1	8.8
113	5.9	7.6	4.4	2.9	2.8	3.7	4.2	4.1	4.3	3.8	4.3	5.5	4.7	4.9	4.7	5.3	4.8	7.2	8.5

LOWER SALADO NEUTRON ACCESS TUBE LN1

PERCENT VOLUME MOISTURE CONTENT (CORRECTED)

1985

JULIAN DATE	DEPTH BELOW LAND SURFACE (M) .3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.7	4.3	4.9	5.5	6.1	6.7	7.3	7.9	8.5
265	6.9	7.5	7.1	7.3	7.0	6.8	6.6	6.9	6.8	7.5	7.6	8.2	8.6	8.2	9.3	9.2	8.2	8.7	9.3
270	7.3	8.2	7.8	7.6	7.1	6.7	6.8	7.2	7.4	9.3	7.9	8.3	9.7	9.1	9.7	10.0	8.3	8.5	13.9
277	7.1	7.4	7.0	6.9	6.9	6.2	6.2	6.5	6.9	7.3	7.6	7.8	8.6	8.6	8.8	9.4	7.6	7.9	11.9
284	11.5	10.9	10.6	9.7	7.4	5.8	5.9	6.8	7.0	7.2	7.3	7.8	8.6	7.9	8.6	9.4	7.6	7.8	9.1
290	10.6	10.4	9.9	9.7	9.7	8.1	6.4	6.6	6.8	7.5	7.3	7.9	8.4	7.8	8.6	9.2	7.5	7.9	31.0
298	8.7	9.1	9.1	8.9	9.7	8.9	8.7	8.2	6.9	8.0	7.6	8.1	9.2	8.2	9.1	10.0	8.1	7.4	32.5
305	7.8	8.3	8.8	8.5	9.1	8.9	8.8	8.7	7.2	7.4	7.6	7.7	8.6	8.0	8.7	9.6	7.8	6.8	31.4
312	7.3	7.8	8.2	8.4	8.5	8.2	8.5	8.3	7.4	7.4	7.5	7.7	8.0	8.0	8.1	9.7	7.7	7.1	31.6
319	7.4	7.7	8.1	7.9	8.4	7.9	8.5	8.8	7.4	7.8	7.8	8.3	8.3	8.3	8.4	9.9	7.5	6.8	30.0
326	6.9	7.5	7.8	7.8	8.1	7.6	8.0	8.0	7.0	7.2	7.0	8.1	8.7	8.1	8.6	9.7	8.0	7.1	26.1
333	6.9	7.3	7.9	8.0	8.3	7.9	8.1	7.9	7.4	7.2	7.2	7.5	8.2	7.8	8.4	9.1	7.4	6.6	19.7
340	7.0	7.4	7.5	7.6	8.0	7.9	7.9	8.1	7.0	7.2	7.2	7.7	8.0	7.4	8.2	8.8	7.4	6.4	14.8
347	6.6	7.5	8.0	7.5	8.0	7.6	7.9	7.7	7.4	7.2	7.2	7.4	8.1	7.2	8.1	9.2	7.4	6.5	12.4
354	6.6	7.5	7.7	7.4	7.8	7.5	8.0	7.6	6.8	7.2	7.5	7.9	8.0	7.4	8.1	8.6	7.4	6.6	11.1
361	6.7	7.4	7.9	7.6	7.8	7.7	7.7	7.7	6.9	7.4	7.4	7.4	8.0	7.4	8.3	8.9	7.5	6.6	10.6

1986

JULIAN DATE	DEPTH BELOW LAND SURFACE (M) .3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.7	4.3	4.9	5.5	6.1	6.7	7.3	7.9	8.5
3	6.7	7.3	7.5	7.5	7.8	7.3	8.0	7.5	6.8	7.2	6.9	7.4	8.0	7.3	7.9	9.1	7.2	6.4	10.1
10	6.5	7.4	7.3	7.7	7.7	7.5	7.8	7.5	6.8	7.3	6.9	7.6	7.8	7.3	8.3	9.0	7.4	6.4	9.8
31	6.7	7.2	7.7	7.2	7.9	7.4	7.4	7.3	6.7	7.2	6.9	7.4	7.7	7.2	8.4	8.9	7.4	6.2	9.4
38	6.3	7.2	7.4	7.3	7.6	7.3	7.8	7.3	6.7	7.2	7.1	7.4	7.9	7.2	8.0	8.9	7.3	6.5	9.2
45	6.5	7.1	7.5	7.2	7.8	7.4	7.5	7.2	6.9	7.2	6.7	7.1	7.7	7.3	8.0	8.7	7.3	6.4	8.9
59	6.5	7.3	7.3	7.1	7.4	7.3	7.5	7.1	6.8	7.0	6.9	7.4	7.6	6.8	8.0	8.7	7.0	6.4	9.3
66	6.4	6.9	7.4	7.3	7.5	7.4	7.3	7.0	6.8	7.1	6.9	7.2	7.6	7.1	7.9	8.8	7.3	6.6	9.1
80	6.1	6.9	7.3	7.0	7.6	7.0	7.5	7.0	6.7	7.2	6.7	7.1	7.6	6.7	7.8	8.6	7.1	6.3	8.8
101	5.9	6.5	6.5	6.4	7.0	7.0	6.9	6.9	6.4	6.8	6.8	7.3	7.7	7.0	7.9	8.8	7.0	6.4	9.0
122	4.4	4.6	5.2	5.0	6.0	6.0	6.1	7.6	7.4	8.3	7.4	7.9	7.1	8.4	10.4	10.9	9.1	8.1	10.5
143	3.5	3.4	4.1	4.2	4.9	4.6	4.7	5.0	5.2	5.8	5.8	6.4	6.1	5.7	6.6	7.6	7.0	6.4	8.8
150	3.1	3.5	3.9	4.0	4.7	4.4	4.6	4.8	5.0	5.6	5.6	6.2	5.8	5.6	6.3	6.6	6.6	6.4	8.8
171	3.2	3.0	3.7	3.9	4.3	4.1	4.4	4.3	4.1	4.8	4.2	6.2	5.4	4.7	5.8	5.3	4.6	5.2	8.8
178	7.9	3.5	3.7	3.6	4.2	4.0	4.2	4.3	4.6	4.8	4.3	6.0	5.5	5.2	5.8	4.9	5.1	5.5	8.6
185	6.4	3.8	3.6	3.7	4.3	4.1	4.4	4.4	4.6	4.8	4.6	5.9	5.7	5.4	6.4	5.8	5.0	5.1	8.6
193	7.3	7.4	11.9	14.8	15.1	13.8	16.6	14.7	12.4	10.9	10.2	11.3	11.9	13.0	13.4	14.2	12.9	32.1	29.7
199	6.9	7.3	11.9	15.4	16.6	15.4	17.3	16.6	14.0	13.6	13.3	14.8	14.2	13.9	15.3	15.6	13.6	20.5	30.9

LOWER SALADO NEUTRON ACCESS TUBE LN1

PERCENT VOLUME MOISTURE CONTENT (CORRECTED)

1985

JULIAN DATE	DEPTH BELOW LAND SURFACE (M) .3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.7	4.3	4.9	5.5	6.1	6.7	7.3	7.9	8.5
265	6.9	7.5	7.1	7.3	7.0	6.8	6.6	6.9	6.8	7.5	7.6	8.2	8.6	8.2	9.3	9.2	8.2	8.7	9.3
270	7.3	8.2	7.8	7.6	7.1	6.7	6.8	7.2	7.4	9.3	7.9	8.3	9.7	9.1	9.7	10.0	8.3	8.5	13.9
277	7.1	7.4	7.0	6.9	6.9	6.2	6.2	6.5	6.9	7.3	7.6	7.8	8.6	8.6	8.8	9.4	7.6	7.9	11.9
284	11.5	10.9	10.6	9.7	7.4	5.8	5.9	6.8	7.0	7.2	7.3	7.8	8.6	7.9	8.6	9.4	7.6	7.8	9.1
290	10.6	10.4	9.9	9.7	9.7	8.1	6.4	6.6	6.8	7.5	7.3	7.9	8.4	7.8	8.6	9.2	7.5	7.9	31.0
298	8.7	9.1	9.1	8.9	9.7	8.9	8.7	8.2	6.9	8.0	7.6	8.1	9.2	8.2	9.1	10.0	8.1	7.4	32.5
305	7.8	8.3	8.8	8.5	9.1	8.9	8.8	8.7	7.2	7.4	7.6	7.7	8.6	8.0	8.7	9.6	7.8	6.8	31.4
312	7.3	7.8	8.2	8.4	8.5	8.2	8.5	8.3	7.4	7.4	7.5	7.7	8.0	8.0	8.1	9.7	7.7	7.1	31.6
319	7.4	7.7	8.1	7.9	8.4	7.9	8.5	8.8	7.4	7.8	7.8	8.3	8.3	8.3	8.4	9.9	7.5	6.8	30.0
326	6.9	7.5	7.8	7.8	8.1	7.6	8.0	8.0	7.0	7.2	7.0	8.1	8.7	8.1	8.6	9.7	8.0	7.1	26.1
333	6.9	7.3	7.9	8.0	8.3	7.9	8.1	7.9	7.4	7.2	7.2	7.5	8.2	7.8	8.4	9.1	7.4	6.6	19.7
340	7.0	7.4	7.5	7.6	8.0	7.9	7.9	8.1	7.0	7.2	7.2	7.7	8.0	7.4	8.2	8.8	7.4	6.4	14.8
347	6.6	7.5	8.0	7.5	8.0	7.6	7.9	7.7	7.4	7.2	7.2	7.4	8.1	7.2	8.1	9.2	7.4	6.5	12.4
354	6.6	7.5	7.7	7.4	7.8	7.5	8.0	7.6	6.8	7.2	7.5	7.9	8.0	7.4	8.1	8.6	7.4	6.6	11.1
361	6.7	7.4	7.9	7.6	7.8	7.7	7.7	7.7	6.9	7.4	7.4	7.4	8.0	7.4	8.3	8.9	7.5	6.6	10.6

1986

JULIAN DATE	DEPTH BELOW LAND SURFACE (M) .3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.7	4.3	4.9	5.5	6.1	6.7	7.3	7.9	8.5
3	6.7	7.3	7.5	7.5	7.8	7.3	8.0	7.5	6.8	7.2	6.9	7.4	8.0	7.3	7.9	9.1	7.2	6.4	10.1
10	6.5	7.4	7.3	7.7	7.7	7.5	7.8	7.5	6.8	7.3	6.9	7.6	7.8	7.3	8.3	9.0	7.4	6.4	9.8
31	6.7	7.2	7.7	7.2	7.9	7.4	7.4	7.3	6.7	7.2	6.9	7.4	7.7	7.2	8.4	8.9	7.4	6.2	9.4
38	6.3	7.2	7.4	7.3	7.6	7.3	7.8	7.3	6.7	7.2	7.1	7.4	7.9	7.2	8.0	8.9	7.3	6.5	9.2
45	6.5	7.1	7.5	7.2	7.8	7.4	7.5	7.2	6.9	7.2	6.7	7.1	7.7	7.3	8.0	8.7	7.3	6.4	8.9
59	6.5	7.3	7.3	7.1	7.4	7.3	7.5	7.1	6.8	7.0	6.9	7.4	7.6	6.8	8.0	8.7	7.0	6.4	9.3
66	6.4	6.9	7.4	7.3	7.5	7.4	7.3	7.0	6.8	7.1	6.9	7.2	7.6	7.1	7.9	8.8	7.3	6.6	9.1
80	6.1	6.9	7.3	7.0	7.6	7.0	7.5	7.0	6.7	7.2	6.7	7.1	7.6	6.7	7.8	8.6	7.1	6.3	8.8
101	5.9	6.5	6.5	6.4	7.0	7.0	6.9	6.9	6.4	6.8	6.8	7.3	7.7	7.0	7.9	8.8	7.0	6.4	9.0
122	4.4	4.6	5.2	5.0	6.0	6.0	6.1	7.6	7.4	8.3	7.4	7.9	7.1	8.4	10.4	10.9	9.1	8.1	10.5
143	3.5	3.4	4.1	4.2	4.9	4.6	4.7	5.0	5.2	5.8	5.8	6.4	6.1	5.7	6.6	7.6	7.0	6.4	8.8
150	3.1	3.5	3.9	4.0	4.7	4.4	4.6	4.8	5.0	5.6	5.6	6.2	5.8	5.6	6.3	6.6	6.6	6.4	8.8
171	3.2	3.0	3.7	3.9	4.3	4.1	4.4	4.3	4.1	4.8	4.2	6.2	5.4	4.7	5.8	5.3	4.6	5.2	8.8
178	7.9	3.5	3.7	3.6	4.2	4.0	4.2	4.3	4.6	4.8	4.3	6.0	5.5	5.2	5.8	4.9	5.1	5.5	8.6
185	6.4	3.8	3.6	3.7	4.3	4.1	4.4	4.4	4.6	4.8	4.6	5.9	5.7	5.4	6.4	5.8	5.0	5.1	8.6
193	7.3	7.4	11.9	14.8	15.1	13.8	16.6	14.7	12.4	10.9	10.2	11.3	11.9	13.0	13.4	14.2	12.9	32.1	29.7
199	6.9	7.3	11.9	15.4	16.6	15.4	17.3	16.6	14.0	13.6	13.3	14.8	14.2	13.9	15.3	15.6	13.6	20.5	30.9

APPENDIX 6

VADOSE ZONE TOTAL HEAD DATA

TENSIOMETER STATION PT1

LOCATION: 1.756 METERS FROM P1 AWAY FROM THE CHANNEL ALONG THE LINE OF OBSERVATION WELLS

JULIAN DATE SINCE JANUARY 1, 1985	1.8m Depth	0.9 Meter Depth
305	406.	212.
312	227.	376.
318	240.	320.
326	228.	250.
333	--	--
340	--	--
347	--	--
354	256.	106.
361	252.	82.
368	233.	111.
374	249.	144.
382	234.	177.
388	261.	221.
396	241.	169.
403	267.	224.
410	228.	134.
417	226.	94.
424	207.	35.
431	204.	30.
445	--	--
452	192.	59.
459	237.	86.
466	235.	111.
473	197.	142.
480	187.	131.
487	223.	262.
501	224.	289.
508	224.	303.
515	241.	324.
536	232.	316.
543	243.	252.
550	222.	304.
557	173.	376.
564	174.	393.
571	167.	408.

578	202.	360.
585	213.	341.
592	221.	309.
599	218.	256.
605	240.	289.
614	249.	254.
620	226.	268.
634	220.	316.
640	178.	295.
647	170.	308.
654	--	340.
669	169.	311.
703	--	172.
717	--	143.
738	217.	123.
752	213.	148.
766	193.	148.
787	211.	117.
801	220.	165.
815	185.	197.

APPENDIX 6

VADOSE ZONE TOTAL HEAD DATA

TENSIOMETER STATION PT2

LOCATION: 9.147 METERS FROM P1 AWAY FROM THE CHANNEL ALONG THE LINE OF OBSERVATION WELLS

JULIAN DATE SINCE JANUARY 1, 1985	1.8 m Depth	0.9 Meter Depth
305	334.	--
312	256.	385.
318	--	250.
326	249.	109.
333	--	52.
340	100.	251.
347	80.	46.
354	264.	218.
361	260.	169.
368	268.	178.
374	194.	149.
382	181.	136.
388	218.	185.
396	227.	141.
403	258.	166.
410	221.	101.
417	158.	133.
424	211.	116.
431	207.	101.
445	86.	35.
452	204.	102.
459	226.	105.
466	238.	133.
473	235.	119.
480	240.	137.
487	252.	173.
501	266.	184.
508	253.	181.
515	222.	170.
536	220.	135.
543	223.	179.
550	224.	168.
557	240.	208.
564	198.	218.

VADOSE ZONE TOTAL HEAD DATA

TENSIOMETER STATION PT2

CONTINUED

571	173.	218.
578	155.	189.
585	160.	219.
592	172.	261.
599	206.	300.
605	203.	338.
614	193.	293.
620	206.	337.
634	227.	407.
640	221.	383.
647	123.	407.
654	--	450.
669	156.	385.
703	185.	103.
717	211.	113.
738	204.	120.
752	210.	73.
766	169.	81.
787	188.	109.
801	231.	180.
815	194.	218.