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Pumping Tests of Well Campbell et al. No. 2 Gila Hot Springs, Grant County, New Mexico

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Prepared for the
U.S. Department of Energy
Idaho Operations Office
Under DOE Contract No. DE-AC07-76ID01570

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Printed in the United States of America

Available from
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161
NTIS Price Codes: Printed Copy A14
Microfiche A01

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PUMPING TESTS OF WELL CAMPBELL ET AL. NO. 2 GILA HOT SPRINGS, GRANT COUNTY, NEW MEXICO

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Published March 1982

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**Prepared for EG&G Idaho, Inc.
Under Subcontract No. K-7836, Modification No. 1
and the U.S. Department of Energy
Idaho Operations Office
Under DOE Contract No. DE-AC07-76ID01570**

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I

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PREFACE

W.K. Summers and Associates, Inc., prepared this report for EG&G Idaho on Subcontract No. K-7836, Modification No. 1 under the Department of Energy's Outreach Program. It is

being reissued as an EG&G formal report to make it available to others who may be interested in this geothermal application.

[illegible]

IV

FOREWORD

The Geothermal Technical Assistance Program was developed under the premise that the majority of groups or individuals with available geothermal resources do not have the experience or manpower necessary to do a preliminary engineering and economic feasibility evaluation for geothermal energy projects. In order to disseminate technical information and to facilitate expanded use of geothermal energy resources, assistance was provided through FY-1981 in a consulting format on a first-come, staff-and-funds-available basis. Technical assistance can relate to conceptualization; engineering; economics; water chemistry implications for environmental, disposal, and material selection considerations; and planning and development strategies. This report is one of a series adapted from consultation provided to requesters either through in-house efforts or through limited efforts subcontracted to local engineering firms. The Geothermal Technical Assistance (GTA) Reports in this series, which are listed below, will be available for purchase early in 1982 by those with interest in specific geothermal applications from the U.S. National Technical Information Service:

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2.	*EGG-GTH-5521	<i>Preliminary Geothermal Disposal Considerations, State Health Laboratory, Boise, Idaho</i>
3.	*EGG-GTH-5573	<i>Geothermal Conversion at Veterans Hospital, Boise, Idaho</i>
4.	*EGG-GTH-5574	<i>Geothermal Applications for Highway Rest Areas</i>
5.	*EGG-GTH-5575	<i>Geothermal Applications for a Tannery</i>
6.	*EGG-GTH-5599	<i>Preliminary Conceptual Design for Geothermal Space Heating Conversion of School District 50 Joint Facilities at Pagosa Springs, Colorado</i>
7.	EGG-GTH-5617	<i>Selected Geothermal Technical Assistance Efforts (comprising short descriptions of ten space heating projects, five district heating projects, and three heat exchanger projects)</i>
8.	*EGG-2137	<i>Geothermal Source Potential and Utilization for Methane Generation and Alcohol Production (subcontractor report)</i>
9.	*EGG-2138	<i>Geothermal Source Potential and Utilization for Alcohol Production (subcontractor report)</i>

<u>GTA Report Number</u>	<u>EG&G Report Number</u>	<u>Title</u>
10.	*EGG-2139	<i>Potential Geothermal Energy Applications for Idaho Elks Rehabilitation Hospital (subcontractor report)</i>
11.	*EGG-2144	<i>Technical Assistance Report on a Geothermal Heating Utility for Lemmon, South Dakota (subcontractor report)</i>
12.	*EGG-2145	<i>Economic Analysis for Utilization of Geothermal Energy by North Dakota Concrete Products Company (subcontractor report)</i>
13.	EGG-2146	<i>Geothermal Feasibility Analysis II for Polo School District No. 29-2, South Dakota (subcontractor report)</i>
14.	EGG-2147	<i>Preliminary Feasibility Study of Heating and Cooling Alternatives for Nebraska Western College, Scottsbluff, Nebraska (subcontractor report)</i>
15.	*EGG-2148	<i>Inventory of Thermal Springs and Wells Within a One-Mile Radius of Yucca Lodge, Truth or Consequences, New Mexico (subcontractor report)</i>
16.	EGG-2149	<i>Space Heating for Spa Facilities at Ojo Caliente, New Mexico (subcontractor report)</i>
17.	EGG-2150	<i>Space Heating for Office Building at Glenwood Springs, Colorado (subcontractor report)</i>
18.	EGG-2151	<i>District Heating for Subdivision in Dickinson, North Dakota (subcontractor report)</i>
19.	EGG-2152	<i>Space Heating for Subdivision in Truth or Consequences, New Mexico (subcontractor report)</i>
20.	EGG-2153	<i>Space Heating for Veterans Administration Medical Center, Marlin, Texas (subcontractor report)</i>
21.	EGG-2154	<i>District Heating for Subdivision in Castle Rock, Colorado (subcontractor report)</i>
22.	EGG-2155	<i>Space Heating for Twin Lakes School Near Gallup, New Mexico (subcontractor report)</i>
23.	EGG-2156	<i>Pumping Tests of Well Campbell Et Al. No. 2, Gila Hot Springs, Grant County, New Mexico (subcontractor report)</i>
24.	*EGG-GTH-5739	<i>Geothermal Deicing of Bridge Structures</i>
25.	*EGG-GTH-5740	<i>Assessment of a Geothermal Application at Tucson, Arizona</i>

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29.	EGG-GTH-5812	<i>Design of the Glenwood Springs Downhole Heat Exchanger</i>

*Published as of 3/15/82.

$$\frac{d}{dt} \left(\frac{\partial L}{\partial \dot{x}} \right) = \frac{\partial L}{\partial x}, \quad \text{where } L = T - V, \quad \text{and } T = \frac{1}{2} m \dot{x}^2.$$

Figure 1. The effect of the concentration of the inhibitor on the rate of polymerization of α -methylstyrene in the presence of SnCl_4 at 25°C .

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Figure 1. The effect of the concentration of the *Agaricus bisporus* spores on the growth of *Agaricus bisporus* on the substrate. The concentration of the spores was 10⁴ spores/g (○), 10⁵ spores/g (□), 10⁶ spores/g (△), 10⁷ spores/g (◇), 10⁸ spores/g (×), 10⁹ spores/g (●), 10¹⁰ spores/g (○), 10¹¹ spores/g (□), 10¹² spores/g (△), 10¹³ spores/g (◇), 10¹⁴ spores/g (×), 10¹⁵ spores/g (●).

1. *Phragmites australis* (Cav.) Trin. ex Steud.
 2. *Phragmites australis* (Cav.) Trin. ex Steud.
 3. *Phragmites australis* (Cav.) Trin. ex Steud.
 4. *Phragmites australis* (Cav.) Trin. ex Steud.
 5. *Phragmites australis* (Cav.) Trin. ex Steud.
 6. *Phragmites australis* (Cav.) Trin. ex Steud.
 7. *Phragmites australis* (Cav.) Trin. ex Steud.
 8. *Phragmites australis* (Cav.) Trin. ex Steud.
 9. *Phragmites australis* (Cav.) Trin. ex Steud.
 10. *Phragmites australis* (Cav.) Trin. ex Steud.

**PUMPING TESTS OF
WELL CAMPBELL ET AL. NO. 2**

**GILGIL-HOT-SPRINGS,
GRANT COUNTY, NEW MEXICO**

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Prepared for EG&G Idaho, Inc.

Under Subcontract No. K-7836, Modification No. 1

ABSTRACT

Well Campbell et al. No. 2 near Gila Hot Springs in southwestern New Mexico (Section 5, Township 13 South, Range 13 West) was pumped for a five-step test and a 48-hour constant-rate test during October 1981. Measurements included depth to water in the pumping well and two observation wells, and discharge rates at the pumping well and two springs.

The water level in the pumping well responded during both tests. However, water-level changes in the observation wells were too small for analytical use and discharge rates from the springs showed no change.

Chemical analyses of water samples collected from two springs and the pumping well show very similar water chemistries.

Estimates of hydraulic properties show transmissivity from 12,000 to 14,000 gpd/ft and a storativity of 0.05. Combining these parameters with well data gives the first-year optimum discharge rate as 50 gpm with 20 feet of drawdown.

Pumping this well at 50 gpm for forty years should produce only small water-level changes in wells a few hundred feet away. It would diminish the flow of the springs, and for planning purposes the combined discharge of the springs and well should be considered constant.

ACKNOWLEDGMENTS

We wish to express our appreciation to the entire Campbell family for their help during these tests. Collectively, the Campbells provided extra workers, assorted test equipment and support equipment, delicious food, and comfortable lodging, all of which made this project much easier for us to carry out. We especially thank Doc, Ida, Allen, and Angus Campbell for their constant assistance.

Lynn Brandvold of the New Mexico Bureau of Mines and Mineral Resources graciously consented to provide complete chemical analyses of water samples collected during this test program.

We also gratefully acknowledge the help of Dennis Fedor of the New Mexico Energy and Minerals Department, and Ivar Engen and M.C. Stone of EG&G Idaho, Inc. with the administrative details that made the project possible.

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PUMPING TESTS OF WELL CAMPBELL ET AL. NO. 2,
GILA HOT SPRINGS, GRANT COUNTY, NEW MEXICO

INTRODUCTION

Background

Well Campbell et al. No. 2 is on the hillside above and east of the spring area at Gila Hot Springs in southwestern New Mexico, in Section 5, Township 13 South, Range 13 West. Appendix A presents a brief history of Well Campbell et al. No. 2, along with a field log, lithologic description, and temperature log of the well. The well was drilled to a total depth of 277 feet on January 20, 1980. Severe caving occurred during drilling from 247 to 277 feet. When the temperature log was run on January 30, 1980, the probe could not be lowered deeper than 265 feet. When D.A. Campbell measured the depth before installing the pump for these tests (October 1981), the total depth was only 250 feet.

The Gila Hot Springs rise along the east bank of the West Fork of the Gila River and discharge about 200 gallons per minute (gpm) into the river from private land that straddles the West Fork of the Gila River. Most land nearby is either federal (National Forest, National Monument, Primitive Area, and Wilderness) or state (New Mexico Fish and Game Department) property (Figure 1).

The Gila Hot Springs discharge water with a maximum temperature of 152°F (67°C). Much of the water discharges from fractures in the rock ten to twenty feet above the Gila River, but some of the water discharges directly into the river.

The Gila Hot Springs are the warmest of several warm and hot springs in the upper part of the Gila River Basin. These thermal springs occur in a volcanic terrain of Tertiary age where some faults may still be active. This setting makes the area an

Figure 1. Map of Gila Hot Springs Area showing the Gila Hot Springs, the Gila River and its tributaries, and land status.

attractive geothermal prospect.

D.A. "Doc" and Ida Campbell have built collectors and divert the water from the hot springs through pipelines and use the water, both for space heating and as the primary water supply for their operations. They presently heat more than 19,000 square feet of homes and commercial buildings.

Well Campbell et al. No. 2 is currently about 250 feet deep and might provide more and warmer water than is obtained from the springs. Water from the well would be used in place of water from the springs, thereby not only simplifying and improving the collection and distribution system, but increasing the amount of space that could be heated.

Purpose and Scope

This report presents data obtained by test pumping Well Campbell et al. No. 2 at Gila Hot Springs in October 1981.

The pumping program was designed to:

1. Learn the hydraulic properties of the rocks in the vicinity of Gila Hot Springs;

2. Estimate the optimum yield of the well;

3. Evaluate the effect of the sustained pumping of the well at the optimum rate on (a) the flow of the

- spring and (b) the water levels in a neighbor's well; and

4. Learn what changes, if any, in the chemistry and temperature of the water discharging from the well and the springs may come about when the well is pumped.

This report includes a lot of information about the area from previous reports prepared for D.A. and Ida Campbell.

Topography and Drainage

Altitudes in the Gila Hot Springs area--the area shown in Figure 2-- range from 5520 feet in the river valley where it leaves the area to 6832 feet on the ridge above the river. The altitude at Well Campbell et al. No. 2 is 5704 feet. The Gila Hot Springs issue through an altitude range from a maximum of about 5600 feet on the hillside down to about 5555 feet in the river bed along the east bank of the West Fork of the Gila River. The West Fork drains part of the western part of the upper Gila River drainage basin. As shown in Figure 1, the Middle Fork of the Gila River joins the West Fork some three miles above Gila Hot Springs, whence the West Fork runs southeast to Gila Hot Springs, then turns south to the confluence with the East Fork, about a mile and a half below Gila Hot Springs. From the junction of the West and East Forks, the Gila River flows southwest toward Arizona.

The upper Gila River drainage basin shows dendritic and linear drainage patterns.

The West, Middle, and East Forks, and the Gila River below the confluence all flow perennially.

Geology

The summary of stratigraphy and structure that follows is our interpretation of the works of many geoscientists. It depends largely on the work of Ratté and his associates (Ratté and Gaskill, 1973¹ and 1975², and Ratté et al, 1979³). Other geoscientists who have contributed to our knowledge of the area are cited in conventional fashion. The work of Ratté and his associates is not cited again.

Geology adapted from Ratté and Gaskill (1975)

Figure 2. Geologic map of the Gila Hot Springs area, Grant and Catron Counties, New Mexico.

Explanation

Qag	Valley Alluvium and Terrace Gravels (Holocene) (Undifferentiated)
QTs	Sedimentary Rocks - Mainly Gila Conglomerate (Holocene, Pleistocene & Pliocene)
Tya	Younger Andesitic and Latitic Lava Flows (Miocene)
Tbc	Bloodgood Canyon Rhyolite Tuff of Elston (1968) Phenocryst-rich densely welded ash-flow tuff (Miocene? or Oligocene?) containing abundant quartz and sanidine phenocrysts.
Tgf(?)	Latitic and Andesitic Lava Flows of Gila Flat. (Oligocene)

Symbols

Contact

Fault - Dashed where approximate or inferred, dotted where concealed.
U=Upthrown, D=Downthrown.

Strike and Dip of Beds

Strike and Dip of Flow Banded Rocks

—|—|A' Cross - Section Line

Figure 2A. Explanation to Figures 2, 3, and 4.

Stratigraphy

Figure 2 shows the distribution of the volcanic and sedimentary rocks that crop out around the Gila Hot Springs. Figures 3 and 4 are cross-sections through the Gila Hot Springs area. Fission track and potassium-argon dates show that the rocks exposed in the Gila Hot Springs area range in age from mid-Tertiary to Holocene.

The volcanic sequence in the area is probably about 3000 feet thick and probably rests on rocks of Paleozoic age. Our preliminary estimate of the thickness of the rocks of Paleozoic age is 3000 feet, so we estimate the depth to the Precambrian basement as 6000 feet.

Tertiary Rocks. Rocks of Tertiary age in the Gila Hot Springs area, as shown in Figures 2-4, appear to include:

1. Latitic and Andesitic Flows of Gila Flats [Tgf(?)];
2. Bloodgood Canyon Rhyolite Tuff of Elston (1968) [Tbc]; and
3. Younger Andesitic and Latitic Flows [Tya].

The Latitic and Andesitic Flows of Gila Flats do not crop out in the Gila Hot Springs area, but are inferred in the subsurface. This unit consists of porphyritic latite and andesite flows which may be as much as 600 feet thick in the Gila Hot Springs area. Biotite and sanidine from this unit yield potassium-argon ages of 29 ± 1.1 million years and 29.3 ± 1.1 million years, respectively.

The Bloodgood Canyon Rhyolite Tuff of Elston (1968) consists of ashflow tuffs with abundant quartz and sanidine phenocrysts. This unit crops out and occurs in the subsurface in the Gila Hot

Figure 3. Geologic cross-section AA' showing isotherms near the Gila Hot Springs.

Figure 4. Geologic cross-section BB' showing isotherms near the Gila Hot Springs.

Springs area. Well Campbell et al. No. 2 penetrated 271 feet of this rhyolitic tuff, from six feet to the total depth of 277 feet. Biotite and sanidine from this unit give potassium-argon ages of 16.5 ± 1.5 million years and 25.3 ± 1.5 million years, respectively, according to Bikerman⁴. In the Gila Hot Springs area this tuff averages about 600 feet in thickness.

The Younger Andesitic and Latitic Flows consist of brecciated andesite and massive latite. These flows crop out in the Gila Hot Springs area and occur in the subsurface. Whole rock potassium-argon ages for this unit range from 20.6 ± 0.5 million years to 25.0 ± 0.5 million years, as reported by Elston et al⁵. These flows probably average 450 feet in thickness in the Gila Hot Springs area.

Tertiary-Quaternary Rocks. The Gila Conglomerate may span the period from mid-Tertiary to mid-Quaternary time or may be entirely of Tertiary age. The Gila Conglomerate consists mainly of a boulder conglomerate with pebbles, cobbles, and large boulders from local sources, and contains some basalt flows interspersed with sedimentary rocks in the upper part of the unit. The Gila Conglomerate crops out in the Gila Hot Springs area, and its thickness ranges from about 50 to 400 feet. Damon⁶ reports a whole rock potassium-argon age of 20.6 ± 0.5 million years for andesitic flows beneath the Gila Conglomerate along Sapillo Creek. Elston⁷ reports a whole rock potassium-argon age of 6.3 ± 0.4 million years for alkali olivine basalt near the top of the Gila Conglomerate along the Mimbres River southeast of the Hot Springs area.

Quaternary and Holocene Rocks. Terrace gravels and valley alluvium comprise the youngest rocks in the Gila Hot Springs area. The terrace gravels of Holocene age consist of poorly sorted boulders, pebbles, and sand with some silt and clay, deposited in terraces from ten to a hundred feet above the present Gila River bed. The valley alluvium consists of modern gravels, sands, and

silts in the present Gila River bed and its modern flood deposits. Reported alluvial thicknesses range up to 30 feet at the Gila Cliff Dwellings National Monument headquarters⁸ and 60 feet at the highway bridge near the confluence⁹.

Structure

Numerous normal faults characterize the structure of the Gila Hot Springs area. Most of these faults show dips greater than 70°, strike in a northwesterly direction, and have stratigraphic throws of about 50 to 400 feet.

The Gila Cliff Dwellings Caldera or the Bursum Caldera, both northwest of Gila Hot Springs might either one be the source of the Bloodgood Canyon Rhyolite Tuff of Elston (1968)⁷.

The Gila Hot Springs graben (Figure 5) encompasses all the observation points measured during the pumping tests of Well Campbell et al. No. 2. This slightly arcuate structural depression trends north-northwest.

Figure 5 also shows two geophysical anomalies. The magnetic high east of the Gila Hot Springs shows about 75 gammas relief, and may represent an intrusive body about 1150 to 1300 feet deep.

The broad, low-amplitude residual gravity high has a closure of about ten milligals. Its axis parallels the Gila Hot Springs graben and the anomaly center roughly follows the faulted northern margin of the graben.

Water-Bearing Properties of the Rocks

Based on their water-bearing properties, the rocks in the Gila Hot Springs area can be divided into three categories:

1. Unconsolidated sedimentary rocks;

Geophysical Anomalies from Plate 2,
Ratté et al (1979)

Figure 5. Map showing the spatial relations among grabens, caldera, geophysical anomalies, and hot springs in the region around the Gila Hot Springs.

2. Semi-consolidated to consolidated sedimentary rocks;
and

3. Volcanic rocks.

The unconsolidated rocks include the alluvial terrace deposits, and the modern alluvium. Water (or any other fluid) moves through these rocks by moving through the void spaces between grains. Locally, the rocks are thick enough and saturated enough to yield water to drive points or shallow wells.

The semi-consolidated to consolidated sedimentary rocks include the Gila Conglomerate, some older volcanic-related clastic units, and the underlying rocks of Paleozoic age. The Gila Conglomerate is a major water-yielding rock of southwestern New Mexico. Its hydraulic conductivity, according to Trauger¹⁰, ranges from 1 to 10 ft³/ft²/d in the upper poorly-cemented part and 0.0001 to 0.7 ft³/ft²/d in the lower well-cemented part.

The sedimentary rocks older than the Gila Conglomerate are probably all well cemented. Their hydraulic conductivity depends primarily on fractures.

To the best of our knowledge, the hydraulic conductivity of the volcanic rocks depends entirely upon fractures; however, permeable interflow zones may be discovered in deeper wells or test holes.

In essence then--except for the upper part of the Gila Conglomerate and the alluvial gravels--the hydraulic conductivity of the entire rock mass depends upon the size, frequency, and distribution of fractures. So, wells that intersect only a few fractures have lower yields than wells that intersect extensively fractured zones.

INSTRUMENTATION

Discharge Measurements

Flow Meter

A totaling flow meter with a needle-type flow-rate indicator was used to measure discharge from Well Campbell et al. No. 2 during both these pumping tests. We used the rate shown by the needle for field reference, but determined actual discharge rates by recording the metered volume at several times and calculating the rate.

Tables C-2 and D-1 contain the meter readings and calculated discharge values for the step test and the constant-rate test, respectively. The "incremental" discharge rates in these tables suggest that some recorded meter readings may not be correct, but the averages determined for each step and for the constant-rate test probably are correct.

We believe this meter is accurate to $\pm 2\%$ of the recorded discharge rate.

Flumes

We set two modified Parshall flumes to measure the discharge of springs. These flumes were designed to measure flows from about 1 to 500 gpm. One flume is aluminum, the other plastic, but both are constructed to the same specifications. For maximum accuracy such a flume should be installed in the straight part of a stream with the upper surface of the flume level both perpendicular and parallel to the direction of flow. Properly installed, these flumes are accurate to about ± 0.5 gpm at the discharge rate of flume-site 1A and to about ± 0.7 gpm at the discharge rate of flume-site 2.

Depth-to-Water Measurements

Two steel tapes and two water-level monitors were used to measure the depth to water in the pumping well (Well Campbell et al. No. 2) and two observation wells (North Well and South Well).

During the step test one water-level monitor and one steel tape were used at the pumping well while the other water-level monitor was used in one observation well (South Well) and the other steel tape was used at both observation wells.

During pre-test measurements for the constant-rate test, the water-level monitor in use at the pumping well failed, so the other water-level monitor was removed from the South Well and used in the pumping well. After that change, the same steel tape was used for all measurements in both observation wells.

Steel Tapes

Two steel tapes were used for depth-to-water measurements. These are both surveyors tapes graduated in feet, tenths of feet, and hundredths of feet.

The steel tape used at the pumping well is about 300 feet long, with numbered markings every foot and one foot marked in tenths and hundredths of a foot every hundred feet. A wooden folding rule fully graduated in tenths and hundredths of feet was used to increase the accuracy of measurements with this tape.

The tape used at the two observation wells is only about 75 feet long, but is fully graduated in tenths and hundredths of feet.

To measure water level with a steel tape, one first assigns a measuring point (commonly a mark on the exposed top rim of the well casing) from which all measurements are made. (Noting the

height of this measuring point, above or below the land surface, allows calculation of water level altitude if the land surface altitude is known.) Next one lowers the tape into the well until the lower end is below the water surface. (This may require a few tries, but becomes easier with successive measurements.) After noting the time and exact footage mark that corresponds to the assigned measuring point when the tape's end is wet, the tape is reeled up until the wet end is visible. One then notes the exact footage wet and calculates the depth to water by subtracting the footage of wet tape from the total footage lowered into the well.

For example: if the mark for 30.00 feet is lowered to the measuring point at 1003 hours and the tape is wet to 10.43 feet after immediate retrieval, the depth to water from the measuring point was 19.57 feet at 1003 hours.

The chalked-tape method of measurement was used with the steel tapes at all wells. This method uses blue carpenter's chalk (readily available in easy-to-hold hemispherical pieces). The chalk is rubbed over the lower few feet of the tape before the tape is unreeled into the well. The chalk changes from pale blue to dark blue when wet, making the exact line to which the tape was wetted more distinct.

Under ideal conditions, we expect precision of ± 0.02 feet and accuracy of the same level from chalked steel tape measurements of depth to water.

If a steel tape gets hung up but reaches the water surface the depth to water determined from that measurement will be too large. Sometimes a steel tape stored on a reel retains some curvature when unreeled; when this happens the depth to water measured with that particular steel tape will be slightly larger than the actual depth to water.

If the tape rubs something within the well, such as the

electrical cable for the pump, the pump column, or the side of the hole, that will smear the mark. If the interfering object is wet, it may create a false mark that results in an apparent depth to water which is too small (is shallower than the actual depth to water.) Water cascading into a well, whether from fractures in the wall of an open hole or from slots in casing, can also wet the tape before it reaches the true water level, thus producing a depth-to-water measurement that is too small.

If surging occurs in a well, the actual water surface will rise and fall with the surges and may fluctuate wildly within a very short period of time.

Observation of the discharge just before turning the pumps off during the constant-rate test (47.5 hours into the 48 hours of pumping) suggested that surging was occurring - at least at the end of the discharge pipe. If any of the people who saw the discharge between 100 minutes and 2850 minutes into the constant-rate test noticed surging, they did not mention it. Therefore, we cannot clearly relate the phenomena to variations in the depth-to-water measurements. Similarly no one noted surging during the step test. Meter readings may record fluctuating discharge rates that often accompany surging; they could also reflect the difficulty of reading the turning dials of the meter.

Figure 6 illustrates steel-tape measurements under ideal conditions, and with some problems. For comparison, the diagrams show a properly-installed water-level monitor probe in the same well.

All three people who made steel-tape measurements in Well Campbell et al. No. 2 during these pumping tests mentioned hang-ups. The variability of steel-tape depths to water (Appendix C, Tables C-3 and C-4; Appendix D, Tables D-2 and D-3) indicates that some hang-ups probably escaped notice at the time of the measurement.

Figure 6. Diagrammatic illustration of some problems encountered during depth-to-water measurements.

Many marks were smeared during these tests (Tables C-3 and C-4, D-2 and D-3) and these measurements may be quite inaccurate.

Water-Level Monitors

The water-level monitor uses a pressure-sensitive transducer to determine the height of the column of water above a probe lowered into the well. The probe is left at that same depth throughout the measurement period. Electrical cable carries a signal from the transducer to components that convert the pressure sensed by the transducer to equivalent feet of water above the probe. At the surface, a small box-like device with a digital display shows the reading as feet of water to the nearest tenth of a foot. Knowing the total distance from the probe to the measuring point, the depth to water can be determined by subtracting the feet of water above the probe from the depth to the probe.

For example, if the total distance from the probe to the measuring point is 227.83 feet and the water-level monitor shows 101.5 at 1500 hours, the depth to water from the measuring point is 126.3 feet at 1500 hours.

Since these instruments require at least two hours to adjust to well conditions, the pre-test measurements include intermittent measurements made with chalked steel tapes at the same time we recorded the readings from the water-level monitors. These measurements allow the operator to separate instrument drift from water-level changes.

Under ideal conditions, the water-level monitor could give precision of ± 0.1 foot. As far as we can determine, ideal conditions never persist throughout an entire test.

As mentioned above, this monitor uses a pressure-sensitive transducer. The transducer neither knows nor cares what causes

the pressure on it to change. An increase or decrease in atmospheric pressure will cause a corresponding increase or decrease in the water-level monitor reading. Under stable weather conditions, or during short-term tests with rapidly changing depth to water, apparent water-level changes due to changing atmospheric pressure will be very small compared to actual changes of depth to water. However, during unsettled weather, or during long-term constant-rate tests with gradually changing depth to water, apparent water-level changes due to changing atmospheric pressure might significantly affect data interpretation.

The water-level monitors are powered by dry-cell batteries, and batteries commonly deliver slightly different voltages at different temperatures, so atmospheric temperature extremes can create aberrant readings because of variation in power supply. Batteries also discharge more rapidly when cold, which allows the rate of change in the power supply to vary. New Mexico's typical 30°F to 40°F diurnal temperature range creates a need for intermittent calibration measurements with some other instrument to allow correction of the water-level-monitor reading for the effects of environmental temperature changes.

Electronic components respond to temperature also: some conduct more readily at elevated temperatures, some conduct less readily at elevated temperatures, and some apparently show little change with temperature unless the temperature remains elevated (or depressed) for a long time.

We use the term "drift" to refer to apparent water-level changes that result from water-level monitor responses to stimuli other than changing depth to water.

Cross-Checks

When both a water-level monitor reading and a steel-tape measurement are made simultaneously in a well, one determines both the depth to water (steel tape) and the depth of water above the water-level monitor probe at that time. The sum of these

measurements equals the depth of the water-level monitor probe below the measuring point. Because the water-level monitor probe remains at the same depth during an entire test, the sum of these measurements should be constant throughout the test. (Any change in the depth to water changes the value of each measurement, but the changes balance each other and the sum of the measurements remains constant.) Therefore, use of simultaneous measurements allows correction of the water-level monitor readings without requiring detailed knowledge of temperature and pressure changes experienced or exact effects of those changes upon the water-level monitor.

During these tests of Well Campbell et al. No. 2, the sum of steel tape and water-level monitor readings did not remain constant at Well Campbell et al. No. 2. This shows that inaccuracies exist in one or both types of measurements. (On the other hand the sum of steel tape and water-level monitor readings remained nearly constant at the South Well during the step test, showing that both types of measurements there were relatively accurate.)

After studying all available data, we believe that all the problems with depth-to-water measurements mentioned in preceding paragraphs occurred during the pumping tests of Well Campbell et al. No. 2. The depths to water computed in Appendices C and D represent our best attempt to correct the water-level monitor readings for drift by correlating them with the most plausible (least suspect) of the steel-tape measurements.

Water Temperature and Chemistry

Temperature

Water temperature was measured with two thermometers. One is liquid (presumably alcohol) in glass with two-degrees Fahrenheit graduations. The other is mercury in glass, marked with both one-degree Celsius graduations and two-degrees Fahrenheit grad-

uations.

The Fahrenheit-only thermometer was kept at Well Campbell et al. No. 2 throughout the tests and used for routine temperature measurements there.

The Celsius-Fahrenheit thermometer was used for in-situ temperature measurements at some of the hot springs, for two check measurements at Well Campbell et al. No. 2, and for measurements with field chemical analyses.

After water samples had cooled below 50°C, we also made temperature measurements with the thermometer that is built into the specific conductance probe. We used that temperature to adjust the instrument and to convert the specific conductance measured to the standard reference temperature of 25°C.

Measurements of the temperature of well water made with the two liquid-in-glass thermometers were the same. Their accuracy is about $\pm 0.5^{\circ}\text{C}$.

During pumping, temperatures of the discharging water from Well Campbell et al. No. 2 were measured with a thermometer inserted into the plastic discharge pipe through a drilled hole just large enough to admit the thermometer.

During the step test, and during the first few hours of the constant-rate test, the thermometer was constantly in place in the discharge line. Later in the constant-rate test, the line showed evidence of collapsing, so the thermometer was removed. This allowed air to enter the line freely and thereby reduced the suction that was collapsing the pipe. To measure the temperature, the observer then had to insert the thermometer, wait for it to stabilize, read the temperature, and remove the thermometer again before the line collapsed. This measurement operation required judgement by the operator to determine how long the thermometer

needed to remain in the line. Some temperatures may be about one degree Celsius too low because of this measurement procedure.

Specific Conductance

Specific Conductance was measured with a YSI Model 33 salinity-conductivity-temperature meter. In the range of measurements made during this test, the precision of this instrument is about ± 10 umhos/cm at 25°C.

Silica

Field determinations of silica employed a Hach Chemical Co. "Engineers Portable Water Laboratory" Model DR-EL colorimeter and used the silicomolybdate powder method of analysis. Silica determinations with this instrument and method tend to be about 30 percent lower than when the same sample is analysed at the same time by atomic absorption flame spectrophotometer techniques.

Carbonate and Bicarbonate

Field determinations of carbonate and bicarbonate were made by titrating a measured volume of water with 0.02 N sulfuric acid to a pH of 4.5. Accuracy of these measurements is about ± 1 mg/l at the concentrations measured.

pH

Field determinations of pH were made with a Cole-Parmer Digisense portable pH meter. This instrument has a digital display which allows the operator to read pH to the nearest 0.01 pH unit. This battery-operated instrument with sealed combination electrode does require more attention from the operator than a typical laboratory model, but we believe these determinations are accurate to ± 0.1 pH unit.

TEST PUMPING PROGRAM

Program Summary

The test pumping program includes:

1. Pre-test measurements;
2. A 5-step test;
3. A 48-hour constant-rate test with 60 hours of recovery; and
4. Collection of water samples for detailed chemical analysis.

Pre-test Measurements

Pre-test measurements included measurements of depth to water in Well Campbell et al. No. 2 and the North and South observation wells, and measurements of spring discharge at two sites.

D.A. Campbell's crew installed the pump in Well Campbell et al. No. 2 on October 6, 1981 before installation of the water-level monitor. They also ran about 350 feet of discharge pipe down the canyon to reduce the chances of water discharged from the well flowing via fractures and/or interstitial pores from the surface to the water table and being repumped.

One water-level monitor was installed in Well Campbell et al. No. 2, and another in the South Well. The water-level monitor uses a pressure-sensitive transducer to determine the height of the column of water above a probe which is lowered into the well and left at that same depth throughout the measurement period. Since these instruments require at least two hours to adjust to

well conditions, the pre-test measurements include intermittent check measurements made with chalked steel tapes at the same time the water-level monitors were read.

Two sites were chosen at which to monitor spring discharge during the pumping tests. Since flumes were to be used to measure discharge, these sites had to have water flowing on the ground rather than "collected" to flow through a box or pipe into the domestic supply system. These sites were also chosen at opposite ends of the line of springs to give geographic distribution and temperature variation. Ideally, these same sites would have been used to collect samples of spring water for chemical analysis, but the sites most suitable for properly setting a flume were not those most suitable for sample collection. Therefore, a sample was collected from the most suitable sample point of similar temperature near each of the two flume sites.

After Doc Campbell discussed the discharge arrangement with us we moved one flume out of the drainage downhill from the well's discharge to a site with lower flow but less apt to be influenced by runoff from the test's discharge. (Appendix B, Tables 1, 2, and 3, present all flume measurements made before and during these pumping tests.)

As mentioned earlier, water samples were collected from two springs, one near each flume, before pumping began for the step test. Sample bottles were placed near each flume so that another sample could be quickly collected if the spring flow decreased during the test. Table 1 presents all field analyses of water samples collected for these pumping tests.

Figure 7 is a sketch showing the points at which measurements were made before and during the pumping test of Well Campbell et al. No. 2. This is not a detailed map: it shows only a few of the many hot springs, a few of the man-made additions, and no trees, shrubs, boggy areas, or steep slopes.

Figure 7. Sketch showing relative locations of Well Campbell et al. No. 2 and observation points used during October 1981 pumping tests.

The distance from Well Campbell et al. No. 2 to the North Well is 482 feet; and to the South Well is 496 feet. The distance between the North and South Wells is 30 feet.

Step Test

The step test of Well Campbell et al. No. 2 consisted of five pumping steps, each of thirty minutes duration, preceded by background measurements from the time of pump installation until turn on, and followed by measurements of recovery from the time the pump was turned off until time to prepare for the next test.

Besides measurements of depth to water, discharge rate, and temperature of the discharging water at the pumping well, we measured depth to water in two observation wells about 500 feet from the pumping well, and measured the discharge rate of the springs at two locations.

We used a pressure-sensitive transducer to measure the water level at the pumping well, and another one at the South observation well. At the North observation well, we measured the depth to water with a chalked steel tape.

We used two modified Parshall flumes placed in small streams carrying runoff from one or more springs of the Gila Hot Springs. We placed the flumes as close as practical to the two springs that we sampled before the test began.

The frequency of measurements varied with the expected response: we measured the pumping well more frequently than the observation wells, and the observation wells more frequently than the flumes.

During the pumping period, measurements at the pumping well were made 15 seconds apart immediately following turn-on and immediately following each increase in discharge, and were contin-

ued at less frequent intervals throughout pumping. Immediately after the pump was turned off, we again made measurements of depth to water at 15-second intervals, then gradually increased the time between measurements until the total time since pump off was equal to twice the pumping time, at which hour we reduced the frequency of measurements to once every four hours.

At the two observation wells, we measured the depth to water every two minutes from the time the pump turned on until 30 minutes after the pump was turned off. We then gradually decreased the frequency of measurements until the elapsed time since pump off was equal to twice the total pumping time, at which hour we further reduced the frequency of measurements to once every four hours.

At each of the two flumes we recorded the height of water in the flume throat every five minutes during pumping and for the length of one step (30 minutes) after turning the pump off. We then gradually increased the time between measurements until the elapsed time since pump off equaled twice the pumping period, at which point we switched to measuring the flumes once every four hours.

Data collected at the wells during the step test are tabulated in Appendix C, Tables C-1 through C-11. Data from the flumes appear in Appendix B, Tables B-2 and B-3. For the sake of brevity, these tables omit some measurements of depth to water, especially those recorded from the water-level monitors when the numbers did not change for several consecutive readings. All flume readings, and all flow-meter readings, have been included in the appropriate tables.

Constant-Rate Test

Before pumping Well Campbell et al. No. 2 for the constant-rate test, we attempted to increase the maximum discharge rate

possible by installing a centrifugal pump in the discharge line. D.A. Campbell has used two centrifugal pumps in tandem to increase the discharge rate, and we hoped that using the centrifugal pump would decrease the effective back-pressure against the submersible pump and allow the two pumps to deliver at a slightly greater rate than was possible with the submersible alone. No increase in discharge resulted from this experiment.

Background measurements of depth-to-water in the observation wells and the pumping well, and of discharge through the flumes from springs, preceded the constant-rate test, which ran for 48 hours at maximum discharge for the pumps and plumbing in use.

Measurements of depth to water in the pumping well initially were recorded every 15 seconds, then with gradually decreasing frequency until the interval between readings was 30 minutes. When we turned the pump off, we again made frequent measurements while the depth to water was changing rapidly, then measured less frequently as the depth to water approached a steady state. The last measurements were made at four-hour intervals, the final measurements being made 60 hours after the pump was turned off.

Measurements at the observation wells and flumes were made once every half hour during the first 1000 minutes of pumping, then once every hour until about 12 hours after the pumps were turned off, then once every two hours until about 22 hours after the pumps were turned off, then once every four hours until 60 hours after the pumps were turned off.

Flow-meter readings were recorded during pumping.

Appendix D, Tables D-1 through D-10 show the measurements and calculations made for the constant-rate test.

Water Samples

Collection of water samples began with two springs, as mentioned before. These springs were chosen to provide contrasts in temperature and location, and to be easily sampled.

One was toward the northern end of the spring area, the other toward the southern end. The sample at the southern end was collected from a pipe discharging from a box-like collector in the northwest corner of the old army bathhouse (#14). The sample at the northern end was collected from an open discharge point in the plastic piping from a cemented-crevice collector (#41). The collector is on the east bank of a tiny stream that discharges to the West Fork Gila River through a tile culvert north of the generator house. (See Figure 7 for locations.)

Five other samples were all collected from Well Campbell et al. No. 2 during the constant-rate pumping test. We spaced collection of these samples throughout the test to document any chemical change that might occur. The first of these samples was collected after 15 minutes of pumping, the second after 100 minutes, the third after 1000 minutes, the fourth after 1500 minutes, and the fifth and last, after 2850 minutes. (Test duration was 2880 minutes.)

When time and personnel allowed, partial chemical analyses were performed in the field on samples collected from the same place at the same time as those submitted for detailed analysis. These field analyses for the two spring samples and the first two well samples appear in Table 1.

If either flume showed a significant response to pumping, another sample would have been collected from the spring nearest the responding flume. Since neither flume showed a response, neither spring has a second sample.

TABLE 1. FIELD MEASUREMENTS FOR WATER SAMPLES
COLLECTED DURING PUMPING TESTS OF WELL CAMPBELL ET AL. NO. 2

Sample Identification	Sample Time		Temperature when sampled (°C)	Specific Conductance (umhos/cm at 25°C)	pH	SiO ₂	CO ₃ ⁼	HCO ₃ ⁼
	Date	Hour				(mg/l)	(mg/l)	(mg/l)
Spring No. 14, southern	10-6-81	0920	66	640	7.75	65	0	109
Spring No. 41, northern	10-6-81	0929	58	560	7.85	56	0	104
Well ^a , first	10-7-81	1445	61	620	7.97	66	0	102
Well ^a , second	10-7-81	1610	62	590	7.97	68	0	102
Well ^a , third	10-7-81	2252	60					
Well ^a , fourth	10-8-81	0711	61					
Well ^a , fifth	10-9-81	1400	62	550	7.72	63	0	99

a. Well Campbell et al. No. 2, 13S.13W.5.212; temperature measured in discharge line at well site.

Appendix E, Tables E-1 to E-7 present detailed chemical analyses of the seven water samples collected during this project. The New Mexico Bureau of Mines and Mineral Resources performed these analyses following normal procedures for water analysis.

In general, these analyses fall within the range historically reported (Reference 8). Analytical variation could account for all the differences seen. Sodium, with the lowest value in the last well sample, might be showing a response to pumping, but this single anomalous result also might be a measure of the precision of the analytical method or variation due to analytical technique of the operator. Silica, with the lowest value for the well in the earliest sample and the highest value for the well in the last sample, might also be construed to show a response to pumping. However, neither the partial analyses we ran nor the intermediate laboratory analyses show such a trend in silica content, and all the analyses of both the well and spring samples are within the range of analytical precision.

Test Results

Data Interpretation

Two problems with the field measurements at Well Campbell et al. No. 2 made data analysis difficult:

1. The hot water seemed to have an effect upon the down-hole electronic equipment which could not be readily separated from the effects of atmospheric temperature and pressure changes upon water-level-monitor readings, and
2. Numerous hang-ups in the well caused smeared marks on the chalked steel tape to be the normal condition rather than the exception.

Overview

Figure 8 shows the relationship of drawdown, discharge, and temperature of discharging water at Well Campbell et al. No. 2 during the period from 1500 hours on October 5, 1981 to 0230 hours on October 12, 1981.

Step Test

Figure 9 plots data from the step test pumping of Well Campbell et al. No. 2 on October 6, 1981 with specific drawdown (s/Q) or specific drawdown adjusted for Jacob's correction (s'/Q)¹¹ versus the logarithm of adjusted time¹² or Harrill's argument¹³. (See Appendix H for more details.) From this plot we calculated a transmissivity (T) of 13,900 gallons per day per foot (gpd/ft), which gives a hydraulic conductivity (K) of about 80 gpd/ft² if we assume a thickness of 170 feet (the depth of open hole below the pre-pumping water surface during this test).

Figure 10 shows specific drawdown adjusted for Jacob's correction versus discharge for Well Campbell et al. No. 2 during the step test on October 6, 1981. As shown, the five points fit a straight line with a slope of 0.0047 ft/gpm². The slope of this line is called C , the well's coefficient of inefficiency.

Appendix B, Tables B-2 and B-3, and Appendix C, Tables C-6 through C-11, present data for the observation points during the step-test pumping of Well Campbell et al. No. 2.

Constant-Rate Test

Figure 11 plots s'/Q or s/Q versus the logarithm of elapsed time (during pumping) or t/t' (during recovery) for the 48-hour constant-rate pumping test of Well Campbell et al. No. 2. By drawing a straight line through the data for 100 to 1500 minutes of elapsed pumping time, we obtain a T of 13,900 gpd/ft, the same

Figure 8. Drawdown, discharge, and temperature of discharging water at Well Campbell et al. No. 2, October 5 to October 12, 1981.

Figure 9. Well Campbell et al. No. 2 step test, s'/Q or s/Q versus adjusted time or Harrill's argument.

Figure 10. Well Campbell et al. No. 2 step test, s'/Q versus Q .

Figure 11. Campbell et al. No. 2 constant-rate test, s'/Q or s/Q versus elapsed time and t/t' .

as obtained from the step test. Measurements from the middle period of recovery after the 48 hours of pumping show $T = 12000$ gpd/ft. Later or earlier times during pumping and recovery could be construed to indicate T 's from 6600 to 17600 gpd/ft.

None of the observation points showed a significant response to pumping Well Campbell et al. No. 2, either during the step test or the constant-rate test. Although depth-to-water measurements at the North observation well showed an apparent response during the constant-rate pumping test, that change was too small to give any analytic solutions for transmissivity, hydraulic conductivity, or storativity.

Likewise, using the recovery data from the constant-rate test in a log-log plot of s'/Q versus t/t' to try a Theissian type curve fit provided ambiguous results.

Appendix D, Tables D-1 through D-4, present data for Well Campbell et al. No. 2 during the 48-hour constant-rate pumping test.

Appendix B, Tables B-2 and B-3, and Appendix D, Tables D-5 through D-10, present data for the observation points during the 48-hour constant-rate pumping test of Well Campbell et al. No. 2.

Temperature

Table 2 presents measurements of the temperature of water discharging from Well Campbell et al. No. 2 during these pumping tests.

Temperature measurements during the step test on October 6, 1981 show that the maximum temperature (62.2°C) was reached about 75 minutes after pumping began and remained at that level for about 45 minutes, then decreased slightly (to 61.7°C) during the later pumping (about 30 minutes duration).

TABLE 2. TEMPERATURE OF WATER DISCHARGING FROM
WELL CAMPBELL ET AL. NO. 2 DURING
PUMPING TESTS, OCTOBER 1981.

Left Column			Right Column		
Date	Hour	Temperature (°C) ^a	Date	Hour	Temperature (°C) ^a
October 1981			October 1981		
6	1426	60.0	7	1438	60.0
	1429	60.0		1440	61.1
	1435	60.6		1446	60.8
	1437	61.1		1451	61.1
	1439	61.1		1500	61.7
	1443	61.1		1510	61.7
	1449	61.1		1540	61.9
	1452	61.1		1550	61.7
	1459	61.1		1600	61.9
	1508	61.7		1630	61.7
	1521	61.7		1650	61.7
	1530	62.2		1710	61.7
	1535	62.2		1730	61.7
	1547.5	62.2		1750	61.7
	1553	62.2		1810	61.7
	1602	62.2		1830	61.7
	1607	62.2		1850	61.7
	1614.5	62.2		1915	61.7
	1617.5	61.7		1930	61.7
	1630	61.7		1950	61.7
	1640	61.7		2010	61.7
7	1432	60.0	7	2030	61.7
	1435	60.6		2355	60.0

TABLE 2. (continued)

Date	Hour	Temperature (°C) ^a	Date	Hour	Temperature (°C) ^a
October 1981			October 1981		
8	0143	60.0	9	1133	61.4
	0603	61.1		1407	62.2
	0634	61.1		1423	62.2
	0706	61.1			
	0734	61.1			
	0744	61.1			
	0804	61.1			
	0840	61.4			
	0920	61.1			
	1020	61.7			
	1120	61.7			
	1220	61.9			
	1320	62.2			
	1720	61.7			
	2020	61.7			
	2140	61.7			
9	0200	61.1			
	0430	61.1			
	0630	61.1			
	0830	61.1			
	1005	61.4			

a. Temperatures were measured with a Fahrenheit thermometer and converted to Celsius for this report.

During the constant-rate test, water temperature appears to show diurnal variation, with lowest temperatures reached between about 2100 and about 0900 each night. Maximums were reached between about 1300 and 1600 each day. These temperatures may document actual changes in the water temperature, or may reflect the combined effects of measurement in an un-insulated pipe and variation in worker's perception of the time required for the thermometer to equilibrate to the water temperature.

Comparison of measured water temperatures with the temperature log in Appendix A shows that the discharging water commonly exceeded the bottom-hole temperature recorded during logging in spite of the fact that the measured total depth before these pumping tests was 15 feet less than the total depth measured during the temperature log.

D.A. Campbell reported that during the 10 minutes of pumping after the pump was installed (1730 to 1740 on October 5, 1981), the first water discharged at a temperature of 58.9°C (138°F). The first recorded temperature in each test was 60.0°C (140°F). Thus, the maximum variation in recorded water temperature is 2.2°C ; the maximum variation in observed water temperature is 3.3°C for Well Campbell et al. No. 2.

Temperature changes should cause the column of water in a well to expand or contract. From (a) the volume of water in Well Campbell et al. No. 2 below the initial water level and (b) the relative volumes of water at 58.9°C and at 62.2°C (derived from Reference 14), expansion and contraction could cause a maximum change in water level of 0.31 feet. Such a water-level change could appear as a decrease in depth to water when the temperature of water in the well increased (as during initial pumping), or as an increase in the depth to water when the temperature of water in the well decreased (as during late recovery). Under ideal conditions, such an apparent change in depth to water could be measured during pumping tests. As mentioned elsewhere, several prob-

lems combined to effectively reduce the accuracy of depth-to-water measurements in Well Campbell et al. No. 2 during these tests and any changes caused by increase or decrease of water volume due to temperature variation cannot be separated from these other effects.

DISCUSSION

The text that follows addresses four questions:

1. Why didn't the observation wells respond more during pumping and why didn't the flow of the springs diminish?
2. What is the instantaneous optimum yield of this well and what are its first-year and forty-year yields?
3. What changes in head would occur if the well were to be pumped to its forty-year yield capacity?
4. How much would the flow of the springs change if the well were to be pumped to its forty-year yield capacity?

We could discuss the relationship of the well to the groundwater flow system and the consequent discharge-drawdown relationships in terms of many conceptual models. Figure 12 illustrates cross-sections of the four conceptual models that we will consider here.

Three of these models are as follows:

1. The well fully penetrates a horizontal layer of saturated homogeneous, isotropic, water-yielding rocks of uniform thickness in which all heads are initially identical (Theissian condition) (Figure 12a);

Figure 12. Profiles of the ground water flow system showing the relation of the pumping well, observation wells, and the Gila River or Gila Hot Springs before pumping begins according to selected conceptual models.

2. The well fully penetrates a horizontal layer of saturated homogeneous, isotropic, water-yielding rocks of uniform thickness in which, initially, all heads are identical and a stream fully penetrates the layer at a distance of 600 feet from the pumping well (Theissian conditions with constant-head boundary) (Figure 12b); and
3. The well fully penetrates a layer of saturated, homogeneous, isotropic, water-yielding rocks of uniform thickness which slopes toward a distant discharge area (Theissian conditions with sloping water table) (Figure 12c).

Contrast these three simplified conceptual models with the fourth which represents our concept of the "actual" system, in which the following seem to be true (Figure 12d):

1. The well partially penetrates the water-yielding rocks;
2. The thickness of the water-yielding rocks that deliver water to the well is unknown;
3. The rocks are neither homogeneous nor isotropic;
4. The hydraulic conductivity is controlled by fractures and probably is not only directional but also varies radically within the area influenced by the well;
5. The river penetrates the water yielding rocks only a few feet, but is a point of regional ground-water discharge; and
6. The head varies not only with the slope of the water table, but also with depth in the saturated rock.

Our model of an "actual" system is itself incomplete because: (a) The hydraulic conductivity varies with water temperature; so even if the intrinsic permeability of the rocks were isotropic, the hydraulic conductivity could vary by a factor of 2 or 3. (b) The role of faults as hydraulic boundaries has been ignored. The faults not only increase the number of fractures locally, but also cause rocks with different fracture densities to abut. (c) The reason for the springs' existence (which we don't know) has been ignored. (d) The reason the springs discharge hot water has been ignored.

Figure 13, a through d, illustrates the head distribution around the pumping well for each conceptual model. At best we can use conceptual models 1-3 to make crude estimates of the parameters and of the yield of the well. To use the "actual" model would require a numerical simulation (computer model) of the three dimensional system and we lack sufficient data for this exercise. However, if we assume that the water levels observed in the wells near the Gila Hot Springs represent an "averaging" of head (which varies with depth, as discussed in Appendix F) and if we assume that models 1-3 provide estimates of the "vertically-averaged" head obtained from model 4, then models 1-3 can be used with discretion to estimate the optimum and first-year yield of Well Campbell et al. No. 2 and to estimate the impact of that discharge on water levels around the well and on the flow of the springs.

Observation Wells and Springs

The South Well has only four feet of casing. However, water appears to flow from the well and discharge continually into fractures that are tapped by a collection pipe. During the pumping test the water level did not change. We believe the discharge diminished about ten percent, but we do not have sufficient measurements to support our observations.

The measured depth to water in the North Well suggests that the water-level change due to pumping Well Campbell et al. No. 2 might be as large as 0.2 foot.

The flume measurements, which are accurate to about one gallon per minute, showed no change in the flow of the two springs we monitored.

Four explanations can be called upon to explain these observations:

1. The rocks have a large specific yield,
 2. Part of the water discharged derived from sources other than storage in the water-yielding rocks,
 3. The anisotropism of the system, and
 4. The short-term effects of partial penetration of the pumping well and observation wells.
- Specific Yield

If we assume Theissian conditions and determine the values of S for which $s \leq 0.2$ in the observation well because Well Campbell et al. No. 2 -- 500 feet away -- pumped 50 gpm for 2 days, we see that S must be 0.035 or larger.

If we assume Theissian conditions with a constant head boundary and determine the value of S for which the effect of pumping Well Campbell et al. No. 2 at 50 gpm for 2 days would be to reduce the flow of the springs by less than 10 percent at the end of two days, we see that S must be larger than 0.05. This leads to two conclusions:

1. Values of S of this magnitude suggest that $S_x = S_y$

and that the water derived from porosity storage rather than elastic storage; and

2. Setting $S = 0.05$ will produce better estimates of discharge and drawdown (under Theissian conditions) than would be produced if S were assigned a smaller value.

Water not from Storage

Water not derived from storage could include (a) water from a constant-head source (conceptual model 2), or (b) water moving through the rock toward the river is intercepted by the well (conceptual model 3).

Assuming a constant-head boundary at the river the discharge rate attributable to the constant-head source at the end of pumping 50 gpm for forty years would be about 50 gpm. That is, after forty years of continuous pumping, the constant-head conceptual model calls for all the water to come from the constant-head source. We could interpret this to mean that the groundwater discharge to the river would be diminished by the amount of discharge of the well.

The sloping water-table model (Figure 13c) assumes that water is moving through the rocks at a rate determined by the slope of the water table and the transmissivity of the rocks, that is

$$Q \times 1440 = TIL \quad (1)$$

where

Q is the volume of water in gpm that passes through a vertical section of rock L feet wide under the hydraulic gradient I .

So if we assume that the hydraulic gradient in the vicinity of Well Campbell et al. No. 2 is equal to 26/5280 (or the gradient of the Gila River at the springs), then

$$L = (50 \times 1440 \times 5280) / (13000 \times 26) = 1125 \text{ feet} \quad (2)$$

However if we base the gradient on the water-level altitude differences between Well Campbell et al. No. 2 and the North Well, the gradient would be about 25 feet in 500 feet or 0.05 ft/ft. So

$$L = (50 \times 1440) / (13000 \times 0.05) = 111 \text{ feet} \quad (3)$$

That is, (a) the total volume of water discharge from the well is water that would have discharged eventually to either the springs or to the Gila River some place down gradient from the well and (b) in the vicinity of the well the water moves through a strip of rocks that is either 111 feet or 1125 feet wide. In either case some water would actually have had to come from storage to change the flow system in the vicinity of the well and the water-level change in the observation well would be less accordingly. The flow of the springs or of the river would diminish (eventually) by the amount of water intercepted by the well, but would not necessarily show a measureable decrease in the flow of the springs during the test period.

Anisotropism

Because the rocks are fractured, the possibility exists that the dominant fractures parallel the river so that the impact of pumping would be felt much later at the observation wells than we would expect if the rocks were isotropic.

Partial Penetration

In complex ground-water flow systems, pumping a deep well

may have little influence on shallow wells until pumping has gone on for many days. The predicted "vertically-averaged" head change may be a relatively large number; whereas the head change observed in a shallow well may be negligible. Because the head change at depth may be substantial the predicted "vertically-averaged" head change may actually occur at only one point along the axis of the observation well extended downward.

Postscript

We can account for the lack of response in the observation wells and the undiminished flow of the springs when Well Campbell et al. No. 2 was pumped in several other ways than those cited above. Some preceptions of the relation of the well to the flow system automatically dictate that the flow of the springs will diminish -- some more than others.

Still other preceptions can be entertained in which the discharge of the springs would be unaffected by the discharge of the well.

We argue that we are more conservative, if we predict more effect on the springs than will actually occur, because the effects of overestimating are correctible -- those of underestimating are not.

Optimum Instantaneous Discharge and "First-year" Yield

Appendix G presents the formulation for calculating the optimum yield of a well.

Based on test results and our knowledge of Well Campbell et al. No. 2 ($T = 13000$ gpd/ft, $C = 0.0047$ ft/gpm², $a = 0.0074$, and $S' = 0.05$) we determined the optimum discharge at the end of the first year of pumping for this well is 50 gpm with 20 feet drawdown. Based on the same values for parameters, the optimum

discharge at the end of forty years would be 49 gpm with 22 feet of drawdown. The sustained yield for the first year and for forty years would be 91 and 3624 acre-feet respectively (90.6 ac-ft/yr).

If the well were to be enlarged and deepened, so that $r = 0.5$ and $H_0 = 340$ feet and if we were able to improve the well efficiency factor to 0.00047 ft/ gpm² and a to 0.01, then we would have the following:

Elapsed Time (days)	Optimum	Drawdown	Yield	
	Instantaneous Discharge		Total (ac-ft)	Average (ac-ft/yr)
1	141	25	0.6	226
365	138	32	223	223
14600 (40yrs)	137	36	8846	221

Head Changes

The discussion of head changes of necessity falls into two parts:

1. A discussion of the changes that we can expect in the pumping well at various pumping rates, and
2. A discussion of the change that we can expect in the vicinity of the pumping well.

In Pumping Well

Because Well Campbell et al. No. 2 is relatively inefficient, the water-level change we can expect will be much more than we would predict for an efficient well at the same site.

Tables 3 and 4 compare the total drawdown and drawdown due to well inefficiency in Well Campbell et al. No. 2 at the end of

TABLE 3. DRAWDOWN DUE TO WELL INEFFICIENCY AND TOTAL DRAWDOWN IN WELL CAMPBELL ET AL. NO. 2 AT END OF ONE YEAR, BASED ON T = 13,900 gpd/ft.

<u>Discharge Rate (gpm)</u>	<u>Drawdown due to Well Inefficiency (feet)</u>	<u>Total Drawdown (feet)</u>
10	0.47	2.35
20	1.88	5.60
30	4.23	9.81
40	7.52	15.0
50	11.8	21.1
75	26.4	40.4
100	47.0	65.6
125	73.4	96.7
150	106	134
170	136	168

TABLE 4. DRAWDOWN DUE TO WELL INEFFICIENCY AND TOTAL DRAWDOWN EXPECTED IN WELL CAMPBELL ET AL. NO. 2 BASED ON T = 12,000 gpd/ft.

<u>Discharge Rate (gpm)</u>	<u>Drawdown due to Well Inefficiency (feet)</u>	<u>Total Drawdown (feet)</u>
10	0.47	2.61
20	1.88	6.16
30	4.23	10.7
40	7.52	16.1
50	11.8	22.5
75	26.4	42.5
100	47.0	68.4
125	73.4	100
150	106	133
170	136	172

one year based on transmissivity values of 13,900 gpd/ft and 12,000 gpd/ft respectively.

Drawdown due to well inefficiency increases rapidly as the discharge rate increases. The percentage of drawdown due to well inefficiency varies with the values of transmissivity, storativity, well diameter, coefficient of inefficiency, and elapsed time used to calculate drawdown (as well as the particular method of calculation used). Tables 2 and 3 show that, for the present conditions, inefficiency accounts for about half the drawdown in Well Campbell et al. No. 2 at 40 gpm, and a bit more than half at 50 gpm. However, if we increased the discharge to 170 gpm to draw the water level down to the bottom of the well, about 80 percent of that drawdown would be caused by well inefficiency.

Around the Pumping Well

The amount of water-level change that we would predict for wells in the vicinity of Well Campbell et al. No. 2 depends upon the model we choose. For example, the drawdown predicted by our three conceptual models for the North observation well due to pumping Well Campbell et al. No. 2 at 50 gpm are:

Model	Predicted Water-level Change (ft)	Elapsed Time
1. Theissian conditions	5.1	1000 years
2. Theissian conditions with constant head boundary	0.2	Equilibrium
3. Theissian conditions, sloping water table		
River gradient	4.4-4.5	Equilibrium
Well gradient	2.4-2.6	Equilibrium

For long-term planning purposes the estimate of 2.4 to 2.6 feet of change at the North Well is probably the most realistic. For short-term planning purposes the relative water-level change at the North Well could be taken as 50 to 75 percent of the equilibrium estimate (roughly 1 to 2 feet).

Changing the pumping rate will alter the water-level change prediction in proportion to the change in pumping rate. That is, doubling the pumping rate will double the estimated water-level change.

CONCLUSIONS

Impact on the Springs

The estimated impact of pumping Well Campbell et al. No. 2 on the flow of the Gila Hot Springs also depends upon the conceptualization we choose. Some effect seems inevitable. The worst-case estimate is that pumping the well for a long period of time will reduce the flow of the springs by the amount pumped. Until we know more about the head distribution and the distribution of hydraulic conductivity of the rocks around the springs, the wisest course would be to use this worst-case assessment.

Maximum Temperature

The temperature log of Well Campbell et al. No. 2 (in Appendix A) does not show a uniform rate of temperature increase with depth. Therefore, the amount of temperature increase that can reasonably be expected to result from deepening Well Campbell et al. No. 2 is a moot point. Based on the entire logged interval, deepening Well Campbell et al. No. 2 to 420 feet should increase the temperature at the total depth to 83°C (181°F); based on the temperature log from 165.6 feet to 265.0 feet, the temperature at 420 feet should be 70°C (158°F); and based on the temperature log from 212.2 feet to 265.0 feet, the temperature at 420 feet should be 66°C (151°F).

Figure 13 (d) shows possible flow paths for water entering Well Campbell et al. No. 2. Figures 3 and 4 show possible isotherms based on available temperature data. These diagrams show that the small increase in temperature experienced during these tests probably results from the manner in which the well intercepts water more laterally than vertically. Thus, deepening the well should have a greater impact on the temperature of water discharged than would enlarging or developing the well to increase the discharge rate.

CONCLUSIONS

Well Campbell et al. No. 2 taps rocks that show an effective transmissivity in the range of 12,000 to 14,000 gpd/ft, which indicates a hydraulic conductivity in the range of 70 to 80 gpd/ft².

In its present condition, Well Campbell et al. No. 2 should be pumped at a discharge rate of 50 gpm or less to avoid wasting energy fighting well inefficiency.

The relatively small values of drawdown compared to the depth of water available in this well indicates that the optimum yield is controlled by factors related to well configuration and efficiency more than by the water-yielding properties of the rocks.

Enlarging Well Campbell et al. No. 2, cleaning or developing the well to increase its efficiency, or deepening it should significantly increase the optimum discharge rate.

Pumping Well Campbell et al. No. 2 for forty years at 50 gpm will have a trivial effect on water levels in wells a few hundred feet distant. It will diminish the flow of the springs, and for planning purposes the flow of the springs plus the discharge of the well should be considered a constant.

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APPENDIX A

Well Campbell et al. No. 2

Langdon Drilling Company drilled Well Campbell et al. No. 2. The rig was moved from Well Campbell et al. No. 1 to Well Campbell et al. No. 2 on January 16, 1980. Drilling began January 16 and continued to January 20 when the final depth of 177 feet was reached.

The drilling rig was a Frank-K-50 with a WSK compressor. The rig was 120 feet. Drilling fluid was air and Gulf-Tor. No mud was used. The proposed location required construction of a pad and grading of an existing road. No equipment was needed to move the rig on location, though help was required to move drill pipe and other up to the site.

Construction of Well Campbell et al. No. 2 began by drilling

to 15 feet with a 7 1/2 inch 43.4 foot of 8-5/8 inch

to 15 feet was changed into the hole with four sections of concrete.

**APPENDIX A
WELL CAMPBELL ET AL NO. 2**

Drilling continued with a 5 1/4 inch diameter bit until reaching

drilling problems at 177 feet were encountered. We didn't develop

this well due to severe casing problems below 147 feet.

APPENDIX A

Well Campbell et al. No. 2

Larjon Drilling Company drilled Well Campbell et al. No. 2. The rig was moved from Well Campbell et al. No. 1 to Well Campbell et al. No. 2 on January 16, 1980. Drilling began January 16 and continued to January 20 when the final depth of 277 feet was reached.

The drilling rig was a Franks KF-50 with a WBK compressor (500 cfm at 150 psi). Drilling fluid was air and Quik-foam. To move to the proposed location required construction of a pad and grading of an existing road. No equipment was needed to move the rig on location, though help was required to move drill pipe and water up to the site.

Construction of Well Campbell et al. No. 2 began by drilling to 13 feet with a 7 7/8 inch rock bit; 13.4 feet of 6 5/8 inch O.D. casing was cemented into the hole with four sacks of concrete. Drilling continued with a 5 1/4 inch hammer bit until severe caving problems at 277 feet were encountered. We didn't develop this well due to severe caving problems below 247 feet.

FIELD LOG: Well Campbell et al. No. 2, (NE $\frac{1}{4}$, NW $\frac{1}{4}$, NE $\frac{1}{4}$, Sec. 5,
T. 13 S., R. 13 W.) Grant County, New Mexico
By: R.M. Colpitts, Jr., January 1980

Depth (ft)		Rock type and Description
From	To	
0	1	Sand and Gravel - brown, fill from cut bank.
1	2	Sand, Gravel, and Clayey Sand - brown to dark brown, dry and dusty.
2	4	Weathered Andesite and Caliche.
4	6	Andesite - brown to purple brown, medium hard, drills easily with rock bit.
6	118	Rhyolitic Tuff - gray to gray-brown, hard drilling but not fractured. Cuttings damp at 81 feet and are moist at 98 feet. 1 - 2 gpm at 118 feet.
118	277	Rhyolitic Tuff - gray, welded, hard but steady drilling. Additional 10 gpm at 167 feet; temperature of water is 110°F. Fractured at 204 feet with an additional 5 gpm; water temperature is 120°F. Very fractured, 219 to 247 feet. Red clay layer - 247-248.5 feet; additional 3-5 gpm here. Very soft and loose 248.5 to 267 feet with an additional 60-100 gpm flow of water; water temperature is 135°F. Very soft 275-277 feet with an additional 50 gpm here. Severe caving zone 247-277 feet.
TD = 277		

LITHOLOGIC DESCRIPTION: Well Campbell et al. No. 2, (NE $\frac{1}{4}$, NW $\frac{1}{4}$, NE $\frac{1}{4}$, Sec. 5, T.13S., R.13W.) Grant County, New Mexico
By: R.M. Colpitts, Jr., January 1980
(Air Rotary Samples)

Depth (ft)		Rock type and Description
From	To	
0	10	Rubble - brown, composed of pebbles of latite and andesite in a matrix of clay and sand.
10	60	Rhyolitic tuff - brownish gray, composed of 50% sanidine, 33% glass, 15% quartz, and 2% golden-brown biotite.
60	120	Rhyolitic tuff - light brownish gray, welded, composed of 50 % sanidine, 25% quartz, 20% glass, 5% golden-brown biotite and a trace of lithic fragments.
120	140	Rhyolitic tuff - gray, welded, porphyritic, composed of 55% sanidine, 30% glass, 12% quartz, 2% yellow sphene, 1% golden-brown biotite and a trace of augite. Hydrothermal alteration of rocks increases with depth.
140	250	Rhyolitic tuff - brownish-gray, porphyritic, welded, composed of 55% sanidine, 27% glass, 15% quartz, 2% golden-brown biotite, and 1% augite.
250	277	Rhyolitic tuff - brownish-gray, very welded, porphyritic with abundant hydrothermal alteration of feldspar and tuff present. Composed of 55% sanidine, 15% quartz, 25% glass and alteration minerals (sericite[?]), 2% golden-brown biotite, 2% unknown dark minerals and 1% augite.

TD = 277

TEMPERATURE LOG: Well Campbell et al. No. 2, NE $\frac{1}{4}$, NW $\frac{1}{4}$, NE $\frac{1}{4}$,
 Sec. 5, R.13S., R.13W., Grant County, New Mexico
 By: D. Gambill and A. Kron (LASL) and R.M.
 Colpitts, Jr., January 30, 1980

Depth (ft)	°C	°F	Depth (ft)	°C	°F
0	--	--	170.8	56.0	132.8
52.0	30.8	87.4	175.9	56.8	134.2
72.4	35.2	95.4	181.1	57.4	135.3
81.8	39.6	103.3	186.3	57.7	135.9
82.8	39.8	103.6	191.5	58.2	136.8
88.0	40.4	104.7	196.6	58.5	137.3
93.2	41.3	106.3	201.8	58.8	137.8
98.3	42.3	108.1	207.0	59.1	138.4
103.5	43.1	109.6	212.2	59.3	138.7
108.7	44.2	111.6	217.3	59.5	139.1
113.8	44.8	112.6	222.5	59.7	139.5
119.0	45.9	114.6	227.7	59.9	139.8
124.2	46.7	116.1	232.9	60.2	140.4
129.4	47.8	118.0	238.0	60.4	140.7
134.5	48.9	120.0	243.2	60.6	141.1
139.7	50.0	122.0	248.4	60.7	141.3
144.9	51.1	124.0	253.6	60.8	141.4
150.1	52.2	126.0	258.7	60.9	141.6
155.2	53.2	127.8	263.9	60.9	141.6
160.4	54.3	129.7	265.0	61.0	141.8
165.6	55.1	131.2	TD = 265		

APPENDIX B

DISCHARGE MEASUREMENTS OF FLUMES DURING TESTS OF WELL CAMPBELL ET AL. NO. 2

APPENDIX B

TABLE B-1. DISCHARGE MEASUREMENTS AT FLUME NO. 1, GILA HOT SPRINGS, NEW MEXICO, IN OCTOBER 1981

Date	Hour	Water Height (ft)	Discharge Rate (gpm)	Remarks
Oct. 5	1612	0.06	5.8	Set flume at 1549.
	1714	0.06	5.8	
	2051	0.06	5.8	
Oct. 6	0012	0.06	5.8	
	0332	0.06	5.8	
	0905	0.06	5.8	
	1105	0.06	5.8	
	1135			Changed location of flume because discharge might interfere-new location is flume 1-A

APPENDIX B

TABLE B-2. DISCHARGE MEASUREMENTS AT FLUME NO. 1-A, GILA HOT SPRINGS, NEW MEXICO, IN OCTOBER 1981

Date	Hour	Water Height (ft)	Discharge Rate (gpm)	Remarks
Oct. 6	1205	0.03	2.0	Set flume at 1135. Light rain
	1357	0.03	2.0	
	1400	0.03	2.0	Sunny
	1405	0.03	2.0	
	1410	0.03	2.0	
	1415	0.03	2.0	Pump on at 1415
	1420	0.03	2.0	
	1425	0.03	2.0	
	1430	0.03	2.0	
	1435	0.03	2.0	
	1440	0.03	2.0	
	1445	0.03	2.0	
	1450	0.03	2.0	
	1455	0.03	2.0	
	1500	0.03	2.0	
	1505	0.03	2.0	
	1510	0.03	2.0	
	1515	0.03	2.0	
	1520	0.03	2.0	
	1525	0.03	2.0	
	1530	0.03	2.0	
	1535	0.03	2.0	
	1540	0.03	2.0	
	1545	0.03	2.0	
	1550	0.03	2.0	
	1555	0.03	2.0	
	1600	0.03	2.0	
	1605	0.03	2.0	
	1610	0.03	2.0	
	1615	0.03	2.0	

TABLE B-2 (continued)

Date	Hour	Water Height (ft)	Discharge Rate (gpm)	Remarks	Discharge Rate (gpm)	Water Height (ft)	Remarks
Oct. 6	1620	0.03	2.0	0.5	20.0	0.03	0.03
	1625	0.03	2.0	0.5	20.0	0.03	0.03
	1630	0.03	2.0	0.5	20.0	0.03	0.03
	1635	0.03	2.0	0.5	20.0	0.03	0.03
	1640	0.03	2.0	0.5	20.0	0.03	0.03
	1645	0.03	2.0	0.5	20.0	0.03	0.03
	1650	0.03	2.0	0.5	20.0	0.03	0.03
	1655	0.03	2.0	0.5	20.0	0.03	0.03
	1700	0.03	2.0	0.5	20.0	0.03	0.03
	1705	0.03	2.0	0.5	20.0	0.03	0.03
	1710	0.03	2.0	0.5	20.0	0.03	0.03
	1715	0.03	2.0	0.5	20.0	0.03	0.03
	1725	0.03	2.0	0.5	20.0	0.03	0.03
	1735	0.03	2.0	0.5	20.0	0.03	0.03
	1745	0.03	2.0	0.5	20.0	0.03	0.03
	1800	0.03	2.0	0.5	20.0	0.03	0.03
	1832	0.03	2.0	0.5	20.0	0.03	0.03
	1900	0.03	2.0	0.5	20.0	0.03	0.03
	1957	0.03	2.0	0.5	20.0	0.03	0.03
	2050	0.03	2.0	0.5	20.0	0.03	0.03
	2139	0.03	2.0	0.5	20.0	0.03	0.03
	2253	0.03	2.0	0.5	20.0	0.03	0.03
Oct. 7	0010	0.03	2.0	0.5	20.0	0.03	0.03
	0423	0.03	2.0	0.5	20.0	0.03	0.03
	0824	0.03	2.0	0.5	20.0	0.03	0.03
	1037	0.03	2.0	0.5	20.0	0.03	0.03
	1229	0.03	2.0	0.5	20.0	0.03	0.03
	1407	0.03	2.0	0.5	20.0	0.03	0.03
	1436	0.03	2.0	0.5	20.0	0.03	0.03
	1506	0.03	2.0	0.5	20.0	0.03	0.03

TABLE B-2(continued).

<u>.Date</u>	<u>Hour</u>	<u>Water Height (ft)</u>	<u>Discharge Rate (gpm)</u>	<u>Remarks</u>
Oct. 7	1523	0.03	2.0	
	1537	0.03	2.0	
	1605	0.03	2.0	
	1634	0.03	2.0	
	1700	0.03	2.0	
	1736	0.03	2.0	
	1807	0.03	2.0	
	1835	0.03	2.0	
	1909	0.03	2.0	
	1934	0.03	2.0	
	2008	0.03	2.0	
	2040	0.03	2.0	
	2106	0.03	2.0	
	2138	0.03	2.0	
	2207	0.03	2.0	
	2234	0.03	2.0	
	2304	0.03	2.0	Level checked - OK
	2331	0.03	2.0	
	2359	0.03	2.0	
Oct. 8	0035	0.03	2.0	
	0100	0.03	2.0	
	0120	0.03	2.0	
	0200	0.03	2.0	
	0233	0.03	2.0	
	0300	0.03	2.0	
	0330	0.03	2.0	
	0400	0.03	2.0	
	0430	0.03	2.0	
	0500	0.03	2.0	
	0532	0.03	2.0	

TABLE B-2(continued).

Date	Hour	Water Height (ft)	Discharge Rate (gpm)	Remarks	Water Level (ft)	Water Level (ft)	Water Level (ft)
Oct. 8	0602	0.03	2.0	Level OK	20.0	0000	0.000
	0631	0.03	2.0	0.5	20.0	0000	0.000
	0700	0.03	2.0	0.5	20.0	0000	0.000
	0800	0.03	2.0	0.5	20.0	0000	0.000
	0900	0.03	2.0	0.5	20.0	0000	0.000
	1000	0.03	2.0	0.5	20.0	0000	0.000
	1101	0.03	2.0	0.5	20.0	0000	0.000
	1201	0.03	2.0	0.5	20.0	0000	0.000
	1300	0.03	2.0	0.5	20.0	0000	0.000
	1405	0.03	2.0	0.5	20.0	0000	0.000
	1505	0.03	2.0	0.5	20.0	0000	0.000
	1604	0.03	2.0	0.5	20.0	0000	0.000
	1705	0.03	2.0	0.5	20.0	0000	0.000
	1808	0.03	2.0	0.5	20.0	0000	0.000
	1904	0.03	2.0	0.5	20.0	0000	0.000
	2008	0.03	2.0	0.5	20.0	0000	0.000
	2100	0.03	2.0	0.5	20.0	0000	0.000
	2200	0.03	2.0	0.5	20.0	0000	0.000
	2300	0.03	2.0	0.5	20.0	0000	0.000
	0000	0.03	2.0	0.5	20.0	0000	0.000
Oct. 9	0100	0.03	2.0	0.5	20.0	0000	0.000
	0200	0.03	2.0	0.5	20.0	0000	0.000
	0300	0.03	2.0	0.5	20.0	0000	0.000
	0400	0.03	2.0	0.5	20.0	0000	0.000
	0500	0.03	2.0	0.5	20.0	0000	0.000
	0600	0.03	2.0	0.5	20.0	0000	0.000
	0700	0.03	2.0	0.5	20.0	0000	0.000
	0800	0.03	2.0	0.5	20.0	0000	0.000
	0900	0.03	2.0	0.5	20.0	0000	0.000
	1000	0.03	2.0	0.5	20.0	0000	0.000
	1100	0.03	2.0	0.5	20.0	0000	0.000

TABLE B-2(continued).

Date	Hour	Water Height (ft)	Discharge Rate (gpm)	Remarks
Oct. 9	1200	0.03	2.0	
	1300	0.03	2.0	
	1405	0.03	2.0	
	1437	0.03	2.0	
	1508	0.03	2.0	
	1604	0.03	2.0	
	1707	0.03	2.0	
	1812	0.03	2.0	
	1900	0.03	2.0	
	2000	0.03	2.0	
	2100	0.03	2.0	
	2150	0.03	2.0	
	2310	0.03	2.0	
Oct. 10	0007	0.03	2.0	Clear-cool
	0117	0.03	2.0	
	0200	0.03	2.0	
	0400	0.03	2.0	
	0600	0.03	2.0	
	0812	0.03	2.0	
	1011	0.02	1.1	No leaks
	1200	0.03	2.0	
Oct. 11	1600	0.03	2.0	
	2005	0.03	2.0	
	0013	0.03	2.0	
	0422	0.03	2.0	
	0817	0.03	2.0	
	1213	0.03	2.0	
Oct. 12	1614	0.03	2.0	
	2014	0.03	2.0	
	0025	0.03	2.0	
	0256	0.03	2.0	Pulled flume

APPENDIX B

TABLE B-3. DISCHARGE MEASUREMENTS AT FLUME NO. 2, GILA HOT SPRINGS,
NEW MEXICO, IN OCTOBER 1981

Date	Hour	Water Height (ft)	Discharge Rate (gpm)	Remarks
Oct. 5	1609	0.05	4.5	Set flume at 1602.
	1748	0.05	4.5	
	2054	0.05	4.5	Hear house pump running.
Oct. 6	0015	0.05	4.5	
	0336	0.05	4.5	
	0902	0.05	4.5	
	1110	0.05	4.5	Light rain
	1210	0.05	4.5	
	1350	0.05	4.5	
	1355	0.05	4.5	
	1400	0.05	4.5	
	1405	0.05	4.5	
	1410	0.05	4.5	
	1415	0.05	4.5	
	1420	0.05	4.5	
	1425	0.05	4.5	
	1430	0.05	4.5	
	1435	0.05	4.5	
	1440	0.05	4.5	
	1445	0.05	4.5	
	1450	0.05	4.5	
	1455	0.05	4.5	
	1500	0.05	4.5	
	1505	0.05	4.5	
	1510	0.05	4.5	
	1515	0.05	4.5	
	1520	0.05	4.5	
	1525	0.05	4.5	
	1530	0.05	4.5	
	1535	0.05	4.5	

TABLE B-3(continued).

Date	Hour	Water Height (ft)	Discharge Rate (gpm)	Remarks
Oct. 6	1540	0.05	4.5	
	1545	0.05	4.5	
	1550	0.05	4.5	
	1555	0.05	4.5	
	1600	0.05	4.5	
	1605	0.05	4.5	
	1610	0.05	4.5	
	1615	0.05	4.5	
	1620	0.05	4.5	
	1625	0.05	4.5	
	1630	0.05	4.5	
	1635	0.05	4.5	
	1640	0.05	4.5	
	1645	0.05	4.5	
	1650	0.05	4.5	
	1655	0.05	4.5	
	1700	0.05	4.5	
	1705	0.05	4.5	
	1710	0.05	4.5	
	1715	0.05	4.5	
	1725	0.05	4.5	
	1735	0.05	4.5	
	1745	0.05	4.5	
	1800	0.05	4.5	
	1825	0.05	4.5	
	1855	0.05	4.5	
	1955	0.05	4.5	
	2045	0.05	4.5	
	2145	0.05	4.5	
	2300	0.05	4.5	
Oct. 7	0012	0.05	4.5	

TABLE B-3(continued).

Date	Hour	Water Height (ft)	Discharge Rate (gpm)	Remarks	Water Level (ft)	Water Level (ft)	Water Level (ft)
Oct. 7	0426	0.05	4.5		20.0	20.0	20.0
	0826	0.05	4.5		20.0	20.0	20.0
	1039	0.05	4.5		20.0	20.0	20.0
	1229	0.05	4.5		20.0	20.0	20.0
	1405	0.05	4.5		20.0	20.0	20.0
	1438	0.05	4.5		20.0	20.0	20.0
	1509	0.05	4.5		20.0	20.0	20.0
	1519	0.05	4.5		20.0	20.0	20.0
	1539	0.05	4.5		20.0	20.0	20.0
	1607	0.05	4.5		20.0	20.0	20.0
	1635	0.05	4.5		20.0	20.0	20.0
	1705	0.05	4.5		20.0	20.0	20.0
	1739	0.05	4.5		20.0	20.0	20.0
	1810	0.05	4.5		20.0	20.0	20.0
	1836	0.05	4.5		20.0	20.0	20.0
	1910	0.05	4.5		20.0	20.0	20.0
	1936	0.05	4.5		20.0	20.0	20.0
	2009	0.05	4.5		20.0	20.0	20.0
	2042	0.05	4.5		20.0	20.0	20.0
	2109	0.05	4.5		20.0	20.0	20.0
	2140	0.05	4.5		20.0	20.0	20.0
	2209	0.05	4.5		20.0	20.0	20.0
	2236	0.05	4.5		20.0	20.0	20.0
	2306	0.05	4.5		20.0	20.0	20.0
	2332	0.05	4.5		20.0	20.0	20.0
Oct. 8	0001	0.05	4.5		20.0	20.0	20.0
	0036	0.05	4.5		20.0	20.0	20.0
	0102	0.05	4.5		20.0	20.0	20.0
	0132	0.05	4.5		20.0	20.0	20.0
	0201	0.05	4.5		20.0	20.0	20.0
	0235	0.05	4.5		20.0	20.0	20.0

TABLE B-3(continued).

Date	Hour	Water Height (ft)	Discharge Rate (gpm)	Remarks
Oct. 8	0302	0.05	4.5	
	0332	0.05	4.5	
	0402	0.05	4.5	
	0432	0.05	4.5	
	0502	0.05	4.5	
	0535	0.05	4.5	
	0605	0.05	4.5	Level OK.
	0633	0.05	4.5	
	0702	0.05	4.5	
	0802	0.05	4.5	
	0902	0.05	4.5	
	1002	0.05	4.5	
	1103	0.05	4.5	
	1202	0.05	4.5	
	1302	0.05	4.5	
	1408	0.05	4.5	
	1506	0.05	4.5	
	1606	0.05	4.5	
	1708	0.05	4.5	
	1805	0.05	4.5	
	1907	0.05	4.5	
	2005	0.05	4.5	
	2102	0.05	4.5	
	2202	0.05	4.5	
	2302	0.05	4.5	
Oct. 9	0002	0.05	4.5	
	0102	0.05	4.5	
	0202	0.05	4.5	
	0302	0.05	4.5	
	0402	0.05	4.5	
	0403	0.05	4.5	

TABLE B-3(continued).

Date	Hour	Water Height (ft)	Discharge Rate (gpm)	Remarks
Oct. 9	0506	0.05	4.5	
	0700	0.05	4.5	
	0800	0.05	4.5	
	0900	0.05	4.5	
	1000	0.05	4.5	
	1100	0.05	4.5	
	1200	0.05	4.5	
	1300	0.05	4.5	
	1407	0.05	4.5	
	1439	0.05	4.5	
	1510	0.05	4.5	
	1606	0.05	4.5	
	1710	0.05	4.5	
	1805	0.05	4.5	
	1905	0.06	5.8	
	2002	0.06	5.8	
	2102	0.06	5.8	
	2152	0.05	4.5	
	2309	0.05	4.5	
Oct. 10	0010	0.05	4.5	Clear-cool
	0115	0.05	4.5	
	0200	0.05	4.5	
	0400	0.05	4.5	
	0600	0.05	4.5	
	0809	0.05	4.5	
	1008	0.05	4.5	
	1158	0.05	4.5	
	1602	0.05	4.5	
Oct. 11	2007	0.05	4.5	
	0009	0.05	4.5	
	0420	0.05	4.5	

TABLE B-3(continued).

<u>Date</u>	<u>Hour</u>	<u>Water Height (ft)</u>	<u>Discharge Rate (gpm)</u>	<u>Remarks</u>
Oct. 11	0815	0.05	4.5	
	1210	0.05	4.5	
	1611	0.05	4.5	
	2008	0.05	4.5	
Oct. 12	0022	0.05	4.5	
	0254	0.05	4.5	Pulled flume

STEP TEST DATA FROM
WELL CAMPBELL ET AL. NO. 2 AND
NORTH AND SOUTH OBSERVATION WELLS

APPENDIX C

TABLE C-1. Campbell et al. #2 -- average discharge by steps

STEP	DATE		ELAPSED TIME (MIN)	AVERAGE DISCHARGE (GPM)
	OCT 81	HOUR		
1	6	14:15.0	0.0	17.5
		14:45.0	30.0	
2		14:45.0	30.0	29.9
		15:15.0	60.0	
3		15:15.0	60.0	35.8
		15:45.0	90.0	
4		15:45.0	90.0	41.3
		16:15.0	120.0	
5		16:15.0	120.0	50.9
		16:45.0	150.0	

APPENDIX C

TABLE C-2 Cambell et al. #2 step test -- metered discharge

DATE		ELAPSED	METER	TOTAL	RUNNING	INCREMENTAL		
OCT	HOUR	TIME	READING	DISCHARGE	AVERAGE	V	V/T	
1981	(MDT)	(T1, MIN)		(V, GAL)	(V/T1, GPM)	(GAL)	(MIN)	(GPM)
6	14:15.0	0.0	4053					
	14:19.0	4.0	4164	111	27.6	111	4.0	27.6
	14:24.0	9.0	4258	205	22.8	95	5.0	18.9
	14:29.0	14.0	4351	298	21.3	93	5.0	18.6
	14:35.0	20.0	4455	402	20.1	104	6.0	17.3
	14:41.0	26.0	4557	504	19.4	102	6.0	17.0
	14:44.0	29.0	4607	554	19.1	51	3.0	16.8
	14:48.0	33.0	4710	657	19.9	103	4.0	25.7
	14:54.0	39.0	4892	839	21.5	182	6.0	30.3
	15: 4.0	49.0	5192	1139	23.2	300	10.0	30.0
	15: 9.0	54.0	5340	1287	23.8	149	5.0	29.7
	15:14.0	59.0	5489	1436	24.3	149	5.0	29.8
	15:20.0	65.0	5693	1640	25.2	204	6.0	33.9
	15:25.0	70.0	5872	1819	26.0	180	5.0	35.9
	15:30.0	75.0	6052	1999	26.7	180	5.0	35.9
	15:35.0	80.0	6231	2178	27.2	179	5.0	35.7
	15:40.0	85.0	6409	2356	27.7	179	5.0	35.7
	15:44.0	89.0	6552	2499	28.1	143	4.0	35.7
	15:51.0	96.0	6832	2779	28.9	280	7.0	40.0
	15:55.0	100.0	6997	2944	29.4	165	4.0	41.3
	16: 0.0	105.0	7203	3150	30.0	207	5.0	41.4
	16: 5.0	110.0	7410	3357	30.5	206	5.0	41.2
	16:10.0	115.0	7617	3564	31.0	207	5.0	41.4
	16:14.0	119.0	7782	3729	31.3	165	4.0	41.3
	16:20.0	125.0	8089	4036	32.3	307	6.0	51.2
	16:25.0	130.0	8334	4281	32.9	245	5.0	49.1

TABLE C-2 (continued)

Campbell et al. #2 step test -- metered discharge

---DATE---		ELAPSED	METER READING	TOTAL	RUNNING	---INCREMENTAL---		
OCT	HOUR	TIME		DISCHARGE	AVERAGE	V	V/T	
1981	(MDT)	(T1, MIN)		(V, GAL)	(V/T1, GPM)	(GAL)	(MIN)	(GPM)
6	16:30.0	135.0	8589	4536	33.6	255	5.0	50.9
	16:40.0	145.0	9099	5046	34.8	510	10.0	51.0
	16:45.0	150.0	9353	5300	35.3	254	5.0	50.7

APPENDIX C

TABLE C-3. Campbell et al. #2 stop test -- water level data

DATE	ELAPSED TIME	WATER LEVEL	TYPE OF*	REMARKS
OCT 81	HOUR:MIN (MINUTES)	READING#	READING	
5	15: 0.0	-1395.0	80.85 STEEL	TAPE HANGING @268'
	15: 6.0	-1389.0	77.98 STEEL	GOOD READING
	15:10.0	-1385.0	77.98 STEEL	WELL PUMPED FOR
	18:20.0	-1195.0	78.40 STEEL	10 MIN AT 48 GPM
	18:25.0	-1190.0	77.96 STEEL	SLIGHTLY SMEARED
	18:29.0	-1186.0	77.94 STEEL	
	21:12.0	-1023.0	78.04 STEEL	
	23:56.0	-859.0	78.94 STEEL	? SLIGHTLY SMEARED
6	0: 0.0	-855.0	78.10 STEEL	SLIGHTLY SMEARED
	4: 1.0	-614.0	78.03 STEEL	
	8:59.0	-316.0	78.20 STEEL	
	9:45.0	-270.0	86.40 TRANS	
	9:55.0	-260.0	78.14 STEEL	
	9:55.0	-260.0	85.70 TRANS	
	10: 8.0	-247.0	84.60 TRANS	
	11:28.0	-167.0	78.17 STEEL	
	11:28.0	-167.0	84.30 TRANS	
	13:54.0	-21.0	86.60 TRANS	
	13:55.0	-20.0	78.17 STEEL	
	13:55.0	-20.0	86.70 TRANS	
	14: 0.0	-15.0	86.50 TRANS	
	14: 5.0	-10.0	88.20 TRANS	
	14:10.0	-5.0	88.30 TRANS	
	14:15.0	0.0	88.30 TRANS	PUMP ON
	14:15.5	0.5	80.20 TRANS	ADJUSTING VALVE
	14:16.0	1.0	79.90 TRANS	
	14:17.0	2.0	83.40 TRANS	
	14:18.0	3.0	85.00 TRANS	
	14:19.0	4.0	85.30 TRANS	
	14:19.5	4.5	85.30 TRANS	
	14:20.0	5.0	85.30 TRANS	
	14:21.0	6.0	85.30 TRANS	
	14:22.0	7.0	85.40 TRANS	
	14:23.0	8.0	85.30 TRANS	
	14:24.0	9.0	85.30 TRANS	
	14:25.0	10.0	85.30 TRANS	FLOW RATE ABOUT
	14:26.0	11.0	85.20 TRANS	18.9 GPM
	14:27.0	12.0	85.20 TRANS	TEMP 140 F
	14:28.0	13.0	85.00 TRANS	
	14:29.0	14.0	85.50 TRANS	
	14:30.0	15.0	85.50 TRANS	
	14:31.0	16.0	85.50 TRANS	
	14:32.0	17.0	85.70 TRANS	
	14:33.0	18.0	85.50 TRANS	
	14:34.0	19.0	85.50 TRANS	
	14:35.0	20.0	85.60 TRANS	TEMP 141 F
	14:36.0	21.0	85.50 TRANS	
	14:37.0	22.0	85.50 TRANS	TEMP 142 F
	14:38.0	23.0	85.50 TRANS	
	14:39.0	24.0	85.40 TRANS	
	14:40.0	25.0	85.50 TRANS	

TABLE C-3 (continued)

Campbell et al. #2 step test -- water level data

=====					
DATE	ELAPSED TIME	WATER LEVEL	TYPE OF*		
OCT 81	HOUR	(MINUTES)	READING#	READING	REMARKS

6	14:41.0	26.0	85.50	TRANS	
	14:42.0	27.0	85.50	TRANS	
	14:43.0	28.0	85.50	TRANS	
	14:44.0	29.0	85.40	TRANS	
	14:45.0	30.0	85.50	TRANS	BEGIN STEP 2
	14:45.5	30.5	83.80	TRANS	
	14:46.0	31.0	83.00	TRANS	
	14:46.5	31.5	82.90	TRANS	
	14:47.0	32.0	82.50	TRANS	
	14:47.5	32.5	82.30	TRANS	
	14:48.0	33.0	82.20	TRANS	
	14:49.0	34.0	82.10	TRANS	
	14:50.0	35.0	82.10	TRANS	
	14:51.0	36.0	82.10	TRANS	
	14:52.0	37.0	82.10	TRANS	
	14:53.0	38.0	82.10	TRANS	
	14:54.0	39.0	82.10	TRANS	
	14:59.0	44.0	82.00	TRANS	
	15: 3.0	48.0	82.10	TRANS	
	15: 7.0	52.0	82.10	TRANS	
	15: 8.0	53.0	82.10	TRANS	TEMP 143 F
	15:10.0	55.0	82.10	TRANS	
	15:15.0	60.0	82.10	TRANS	BEGIN STEP 3
	15:16.0	61.0	81.20	TRANS	
	15:16.5	61.5	80.90	TRANS	
	15:17.5	62.5	80.60	TRANS	
	15:18.0	63.0	80.40	TRANS	
	15:18.5	63.5	80.40	TRANS	
	15:19.0	64.0	80.20	TRANS	
	15:20.0	65.0	80.20	TRANS	
	15:21.0	66.0	80.20	TRANS	
	15:23.0	68.0	80.20	TRANS	
	15:25.0	70.0	80.10	TRANS	
	15:28.0	73.0	80.10	TRANS	
	15:31.0	76.0	80.10	TRANS	TEMP 144 F
	15:35.0	80.0	80.10	TRANS	
	15:40.0	85.0	80.10	TRANS	
	15:45.0	90.0	80.10	TRANS	BEGIN STEP 4
	15:45.5	90.5	79.20	TRANS	
	15:46.0	91.0	78.80	TRANS	
	15:46.5	91.5	78.50	TRANS	
	15:47.0	92.0	78.40	TRANS	
	15:47.5	92.5	78.40	TRANS	
	15:48.0	93.0	78.30	TRANS	
	15:49.0	94.0	78.20	TRANS	
	15:51.0	96.0	78.20	TRANS	
	15:53.0	98.0	78.10	TRANS	
	15:55.0	100.0	78.00	TRANS	
	16: 0.0	105.0	78.00	TRANS	
	16: 5.0	110.0	78.00	TRANS	
	16:10.0	115.0	77.90	TRANS	

TABLE C-3 (continued)

Campbell et al. #2 step test -- water level data

DATE	ELAPSED TIME	WATER LEVEL	TYPE OF*	
OCT 81	HOUR (MINUTES)	READING#	READING	
			REMARKS	
6	16:15.0	120.0	77.80 TRANS	BEGIN STEP 5
	16:15.5	120.5	75.40 TRANS	
	16:16.0	121.0	74.60 TRANS	
	16:16.5	121.5	74.30 TRANS	
	16:17.0	122.0	74.20 TRANS	
	16:17.5	122.5	74.10 TRANS	TEMP 143 F
	16:18.0	123.0	74.10 TRANS	
	16:19.0	124.0	74.00 TRANS	
	16:20.0	125.0	74.00 TRANS	
	16:21.0	126.0	74.00 TRANS	
	16:23.0	128.0	73.90 TRANS	
	16:25.0	130.0	73.90 TRANS	
	16:30.0	135.0	73.80 TRANS	
	16:35.0	140.0	73.80 TRANS	
	16:40.0	145.0	73.80 TRANS	
	16:45.0	150.0	73.70 TRANS	PUMP OFF
	16:45.3	150.3	81.20 TRANS	
	16:45.5	150.5	85.10 TRANS	
	16:45.8	150.8	86.00 TRANS	
	16:46.0	151.0	86.50 TRANS	
	16:46.3	151.3	86.60 TRANS	
	16:46.5	151.5	86.60 TRANS	
	16:47.0	152.0	86.60 TRANS	
	16:47.5	152.5	86.70 TRANS	
	16:48.0	153.0	86.70 TRANS	
	16:49.0	154.0	86.70 TRANS	
	16:50.0	155.0	86.70 TRANS	
	16:51.0	156.0	86.80 TRANS	
	16:53.0	158.0	86.80 TRANS	
	16:55.0	160.0	86.80 TRANS	
	17: 0.0	165.0	86.90 TRANS	
	17: 4.0	169.0	86.80 TRANS	
	17:10.0	175.0	87.10 TRANS	
	17:20.0	185.0	87.10 TRANS	
	17:30.0	195.0	87.20 TRANS	
	17:40.0	205.0	87.30 TRANS	
	17:50.0	215.0	87.30 TRANS	
	18: 0.0	225.0	87.30 TRANS	
	18:10.0	235.0	78.90 STEEL	
	18:10.0	235.0	87.20 TRANS	
	18:20.0	245.0	87.20 TRANS	
	18:25.0	250.0	78.08 STEEL	
	18:30.0	255.0	78.46 STEEL	
	18:30.0	255.0	87.00 TRANS	
	18:40.0	265.0	87.00 TRANS	
	18:55.0	280.0	86.80 TRANS	
	18:59.0	284.0	78.02 STEEL	
	19: 4.0	289.0	78.00 STEEL	
	19: 5.0	290.0	87.00 TRANS	
	19:15.0	300.0	78.09 STEEL	SMEARED
	19:15.0	300.0	86.90 TRANS	

TABLE C-3 (continued)

Campbell et al. #2 step test -- water level data

DATE		ELAPSED TIME	WATER LEVEL	TYPE OF*	REMARKS
OCT 81	HOUR	(MINUTES)	READING#	READING	
6	19:30.0	315.0	78.03	STEEL	SMEARED
	19:30.0	315.0	86.80	TRANS	
	19:45.0	330.0	78.98	STEEL	SMEARED
	19:45.0	330.0	86.70	TRANS	
	20: 0.0	345.0	86.60	TRANS	
	20:30.0	375.0	78.10	STEEL	
	20:30.0	375.0	86.70	TRANS	
	21: 0.0	405.0	78.10	STEEL	
	21: 0.0	405.0	86.70	TRANS	
	21:30.0	435.0	86.60	TRANS	
	22: 0.0	465.0	78.98	STEEL	SMEARED
	22: 0.0	465.0	86.50	TRANS	
	22: 3.0	468.0	78.10	STEEL	SLIGHTLY SMEARED
	22:30.0	495.0	86.70	TRANS	
	22:32.0	497.0	79.39	STEEL	SLIGHTLY SMEARED
	22:36.0	501.0	78.10	STEEL	
	22:40.0	505.0	78.08	STEEL	
	23:10.0	535.0	86.70	TRANS	
7	0: 0.0	585.0	86.80	TRANS	
	4:38.0	863.0	86.40	TRANS	
	8:42.0	1107.0	78.20	STEEL	
	8:42.0	1107.0	85.00	TRANS	
	11: 7.0	1252.0	78.10	STEEL	SMEARED
	11:10.0	1255.0	78.13	STEEL	SLIGHTLY SMEARED

*THE TYPE OF READING DENOTES THE TYPE OF DEPTH TO WATER MEASUREMENT MADE. THESE MAY BE ANY OF THE FOLLOWING:

TRANS= MEASUREMENT MADE BY A TRANSDUCER IN THE WELL. THE MEASUREMENT IS THE HEIGHT OF THE WATER COLUMN ABOVE THE SENSOR.

STEEL= MEASUREMENT MADE BY A STEEL TAPE.

AIR= MEASUREMENT MADE BY AN AIRLINE.

AIRTRAN=MEASUREMENT MADE BY AN AIRLINE COUPLED WITH A TRANSDUCER.

ELECT= MEASUREMENT MADE BY AN ELECTRIC TAPE.

ABSOL= ALL MEASUREMENTS HAVE BEEN CHANGED TO ABSOLUTE DEPTH-TO-WATER MEASUREMENTS.

#THE WATER LEVEL READING IS THE INSTRUMENT READING MADE TO FIND THE DEPTH TO WATER.

ELAPSED TIME IS TAKEN FROM TO AT 1415 ON 6 - OCT - 81

APPENDIX C

TABLE C-4.

Campbell et al. #2 step test -- depth to water computations

DATE	ELAPSED TIME	DEPTH TO#	TYPE OF*		
OCT 81	HOUR	(MINUTES)	WATER(FT)	READING	REMARKS
5	15: 0.0	-1395.0	80.85	STEEL	TAPE HANGING @268'
	15: 6.0	-1389.0	77.98	STEEL	GOOD READING
	15:10.0	-1385.0	77.98	STEEL	WELL PUMPED FOR
	18:20.0	-1195.0	78.40	STEEL	10 MIN AT 48 GPM
	18:25.0	-1190.0	77.96	STEEL	SLIGHTLY SMEARED
	18:29.0	-1186.0	77.94	STEEL	
	21:12.0	-1023.0	78.04	STEEL	
	23:56.0	-859.0	78.94	STEEL	? SLIGHTLY SMEARED
6	0: 0.0	-855.0	78.10	STEEL	SLIGHTLY SMEARED
	4: 1.0	-614.0	78.03	STEEL	
	8:59.0	-316.0	78.20	STEEL	
	9:45.0	-270.0	77.96	TRANS	
	9:55.0	-260.0	78.14	STEEL	
	9:55.0	-260.0	78.68	TRANS	
	10: 8.0	-247.0	79.81	TRANS	
	11:28.0	-167.0	78.17	STEEL	
	11:28.0	-167.0	80.29	TRANS	
	13:54.0	-21.0	78.31	TRANS	
	13:55.0	-20.0	78.17	STEEL	
	13:55.0	-20.0	78.21	TRANS	
	14: 0.0	-15.0	78.42	TRANS	
	14: 5.0	-10.0	76.74	TRANS	
	14:10.0	-5.0	76.65	TRANS	
	14:15.0	0.0	76.66	TRANS	PUMP ON
	14:15.5	0.5	84.76	TRANS	ADJUSTING VALVE
	14:16.0	1.0	85.06	TRANS	
	14:17.0	2.0	81.56	TRANS	
	14:18.0	3.0	79.96	TRANS	
	14:19.0	4.0	79.67	TRANS	
	14:19.5	4.5	79.67	TRANS	
	14:20.0	5.0	79.67	TRANS	
	14:21.0	6.0	79.67	TRANS	
	14:22.0	7.0	79.57	TRANS	
	14:23.0	8.0	79.68	TRANS	
	14:24.0	9.0	79.68	TRANS	
	14:25.0	10.0	79.68	TRANS	FLOW RATE ABOUT
	14:26.0	11.0	79.78	TRANS	18.9 GPM
	14:27.0	12.0	79.78	TRANS	TEMP 140 F
	14:28.0	13.0	79.99	TRANS	
	14:29.0	14.0	79.49	TRANS	
	14:30.0	15.0	79.49	TRANS	
	14:31.0	16.0	79.49	TRANS	
	14:32.0	17.0	79.30	TRANS	
	14:33.0	18.0	79.50	TRANS	
	14:34.0	19.0	79.50	TRANS	
	14:35.0	20.0	79.40	TRANS	TEMP 141 F
	14:36.0	21.0	79.50	TRANS	
	14:37.0	22.0	79.51	TRANS	TEMP 142 F
	14:38.0	23.0	79.51	TRANS	
	14:39.0	24.0	79.61	TRANS	
	14:40.0	25.0	79.51	TRANS	

TABLE C-4 (continued)

Cambell et al. #2 step test -- depth to water computations

OCT 81	DATE	ELAPSED TIME	DEPTH TO#	TYPE OF*	REMARKS
	HOUR	(MINUTES)	WATER(FT)	READING	
6	14:41.0	26.0	79.51	TRANS	
	14:42.0	27.0	79.52	TRANS	
	14:43.0	28.0	79.52	TRANS	
	14:44.0	29.0	79.62	TRANS	
	14:45.0	30.0	79.52	TRANS	BEGIN STEP 2
	14:45.5	30.5	81.22	TRANS	
	14:46.0	31.0	82.03	TRANS	
	14:46.5	31.5	82.13	TRANS	
	14:47.0	32.0	82.53	TRANS	
	14:47.5	32.5	82.73	TRANS	
	14:48.0	33.0	82.83	TRANS	
	14:49.0	34.0	82.93	TRANS	
	14:50.0	35.0	82.93	TRANS	
	14:51.0	36.0	82.94	TRANS	
	14:52.0	37.0	82.94	TRANS	
	14:53.0	38.0	82.94	TRANS	
	14:54.0	39.0	82.94	TRANS	
	14:59.0	44.0	83.05	TRANS	
	15: 3.0	48.0	82.96	TRANS	
	15: 7.0	52.0	82.97	TRANS	
	15: 8.0	53.0	82.97	TRANS	TEMP 143 F
	15:10.0	55.0	82.98	TRANS	
	15:15.0	60.0	82.99	TRANS	BEGIN STEP 3
	15:16.0	61.0	83.89	TRANS	
	15:16.5	61.5	84.19	TRANS	
	15:17.5	62.5	84.50	TRANS	
	15:18.0	63.0	84.70	TRANS	
	15:18.5	63.5	84.70	TRANS	
	15:19.0	64.0	84.90	TRANS	
	15:20.0	65.0	84.90	TRANS	
	15:21.0	66.0	84.90	TRANS	
	15:23.0	68.0	84.91	TRANS	
	15:25.0	70.0	85.01	TRANS	
	15:28.0	73.0	85.02	TRANS	
	15:31.0	76.0	85.03	TRANS	TEMP 144 F
	15:35.0	80.0	85.03	TRANS	
	15:40.0	85.0	85.05	TRANS	
	15:45.0	90.0	85.06	TRANS	BEGIN STEP 4
	15:45.5	90.5	85.96	TRANS	
	15:46.0	91.0	86.36	TRANS	
	15:46.5	91.5	86.66	TRANS	
	15:47.0	92.0	86.76	TRANS	
	15:47.5	92.5	86.76	TRANS	
	15:48.0	93.0	86.86	TRANS	
	15:49.0	94.0	86.97	TRANS	
	15:51.0	96.0	86.97	TRANS	
	15:53.0	98.0	87.07	TRANS	
	15:55.0	100.0	87.18	TRANS	
	16: 0.0	105.0	87.19	TRANS	
	16: 5.0	110.0	87.20	TRANS	
	16:10.0	115.0	87.31	TRANS	

TABLE C-4 (continued)

Campbell et al. #2 step test -- depth to water computations

OCT 81	DATE	ELAPSED TIME	DEPTH TO#	TYPE OF*	
	HOUR	(MINUTES)	WATER(FT)	READING	REMARKS
6	16:15.0	120.0	87.42	TRANS	BEGIN STEP 5
	16:15.5	120.5	89.82	TRANS	
	16:16.0	121.0	90.63	TRANS	
	16:16.5	121.5	90.93	TRANS	
	16:17.0	122.0	91.03	TRANS	
	16:17.5	122.5	91.13	TRANS	TEMP 143 F
	16:18.0	123.0	91.13	TRANS	
	16:19.0	124.0	91.23	TRANS	
	16:20.0	125.0	91.23	TRANS	
	16:21.0	126.0	91.24	TRANS	
	16:23.0	128.0	91.34	TRANS	
	16:25.0	130.0	91.35	TRANS	
	16:30.0	135.0	91.46	TRANS	
	16:35.0	140.0	91.47	TRANS	
	16:40.0	145.0	91.48	TRANS	
	16:45.0	150.0	91.59	TRANS	PUMP OFF
	16:45.3	150.3	84.09	TRANS	
	16:45.5	150.5	80.19	TRANS	
	16:45.8	150.8	79.29	TRANS	
	16:46.0	151.0	78.79	TRANS	
	16:46.3	151.3	78.69	TRANS	
	16:46.5	151.5	78.69	TRANS	
	16:47.0	152.0	78.69	TRANS	
	16:47.5	152.5	78.60	TRANS	
	16:48.0	153.0	78.60	TRANS	
	16:49.0	154.0	78.60	TRANS	
	16:50.0	155.0	78.60	TRANS	
	16:51.0	156.0	78.50	TRANS	
	16:53.0	158.0	78.51	TRANS	
	16:55.0	160.0	78.51	TRANS	
	17: 0.0	165.0	78.42	TRANS	
	17: 4.0	169.0	78.53	TRANS	
	17:10.0	175.0	78.25	TRANS	
	17:20.0	185.0	78.27	TRANS	
	17:30.0	195.0	78.19	TRANS	
	17:40.0	205.0	78.11	TRANS	
	17:50.0	215.0	78.13	TRANS	
	18: 0.0	225.0	78.16	TRANS	
	18:10.0	235.0	78.90	STEEL	
	18:10.0	235.0	78.28	TRANS	
	18:20.0	245.0	78.30	TRANS	
	18:25.0	250.0	78.08	STEEL	
	18:30.0	255.0	78.46	STEEL	
	18:30.0	255.0	78.52	TRANS	
	18:40.0	265.0	78.55	TRANS	
	18:55.0	280.0	78.78	TRANS	
	18:59.0	284.0	78.02	STEEL	
	19: 4.0	289.0	78.00	STEEL	
	19: 5.0	290.0	78.60	TRANS	
	19:15.0	300.0	78.09	STEEL	SMEARED
	19:15.0	300.0	78.72	TRANS	

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TABLE C-4. (continued)

Campbell et al. #2 ster test -- depth to water computations

OCT 81	DATE	ELAPSED TIME	DEPTH TO#	TYPE OF*	REMARKS
	HOUR	(MINUTES)	WATER (FT)	READING	
6	19:30.0	315.0	78.03	STEEL	SMEARED
	19:30.0	315.0	78.86	TRANS	
	19:45.0	330.0	78.98	STEEL	SMEARED
	19:45.0	330.0	78.99	TRANS	
	20: 0.0	345.0	79.12	TRANS	
	20:30.0	375.0	78.10	STEEL	
	20:30.0	375.0	79.09	TRANS	
	21: 0.0	405.0	78.10	STEEL	
	21: 0.0	405.0	79.16	TRANS	
	21:30.0	435.0	79.32	TRANS	
	22: 0.0	465.0	78.98	STEEL	SMEARED
	22: 0.0	465.0	79.49	TRANS	
	22: 3.0	468.0	78.10	STEEL	SLIGHTLY SMEARED
	22:30.0	495.0	79.36	TRANS	
	22:32.0	497.0	79.39	STEEL	SLIGHTLY SMEARED
	22:36.0	501.0	78.10	STEEL	
	22:40.0	505.0	78.08	STEEL	
	23:10.0	535.0	79.44	TRANS	
7	0: 0.0	585.0	79.46	TRANS	
	4:39.0	863.0	80.47	TRANS	
	8:42.0	1107.0	78.20	STEEL	
	8:42.0	1107.0	82.41	TRANS	
	11: 7.0	1252.0	78.10	STEEL	SMEARED
	11:10.0	1255.0	78.13	STEEL	SLIGHTLY SMEARED

*THE TYPE OF READING DENOTES THE TYPE OF DEPTH TO WATER MEASUREMENT MADE. THESE MAY BE ANY OF THE FOLLOWING:

TRANS= MEASUREMENT MADE BY A TRANSDUCER IN THE WELL.
THE MEASUREMENT IS THE HEIGHT OF THE WATER COLUMN ABOVE THE SENSOR.

STEEL= MEASUREMENT MADE BY A STEEL TAPE.

AIR= MEASUREMENT MADE BY AN AIRLINE.

AIRTRAN= MEASUREMENT MADE BY AN AIRLINE COUPLED WITH A TRANSDUCER.

ELECT= MEASUREMENT MADE BY AN ELECTRIC TAPE.

ABSOL= ALL MEASUREMENTS HAVE BEEN CHANGED TO ABSOLUTE DEPTH-TO-WATER MEASUREMENTS.

#THE DEPTH TO WATER IS THE CALCULATED DEPTH TO WATER FROM THE TOP OF THE WELL CASING, .43 FEET ABOVE THE LAND SURFACE.

THE DEPTH TO WATER BELOW THE TOP OF THE CASING IS COMPUTED BY THE FORMULA,

FOR TRANS, DEPTH TO WATER = 165 - WATER LEVEL READING

FOR STEEL, DEPTH TO WATER = WATER LEVEL READING

APPENDIX C

TABLE C-5.

Campbell et al. #2 step test --

calculated adjusted time, Harrill's argument, drawdown, specific draw-down (s/q) and specific drawdown adjusted for Jacob's correction (s'/q)

DATE		ELAPSED	ADJUSTED**	HARRILLS*	DRAW-	S/Q	S'/Q#
OCT 81	HOUR	TIME(MIN)	TIME	ARGUMENT	DOWN(FT)	(FT/GPM)	
5	15:	6.0			0.32		
	15:	10.0			0.32		
	18:	20.0			0.74		
	18:	25.0			0.30		
	18:	29.0			0.28		
	21:	12.0			0.38		
	23:	56.0			1.28		
6	0:	0.0			0.44		
	4:	1.0			0.37		
	8:	59.0			0.54		
	9:	45.0			0.30		
	9:	55.0			0.48		
	9:	55.0			1.02		
	10:	8.0			2.15		
	11:	28.0			0.51		
	11:	28.0			2.63		
	13:	54.0			0.65		
	13:	55.0			0.51		
	13:	55.0			0.55		
	14:	0.0			0.76		
	14:	5.0			-0.92		
	14:	10.0			-1.01		
	14:	15.0			-1.00		
	14:	15.5	0.5	5.0000E-01	7.10	0.406	0.398
	14:	16.0	1.0	1.0000E+00	7.40	0.423	0.414
	14:	17.0	2.0	2.0000E+00	3.90	0.223	0.220
	14:	18.0	3.0	3.0000E+00	2.30	0.131	0.131
	14:	19.0	4.0	4.0000E+00	2.01	0.115	0.114
	14:	19.5	4.5	4.5000E+00	2.01	0.115	0.114
	14:	20.0	5.0	5.0000E+00	2.01	0.115	0.114
	14:	21.0	6.0	6.0000E+00	2.01	0.115	0.114
	14:	22.0	7.0	7.0000E+00	1.91	0.109	0.109
	14:	23.0	8.0	8.0000E+00	2.02	0.115	0.115
	14:	24.0	9.0	9.0000E+00	2.02	0.115	0.115
	14:	25.0	10.0	1.0000E+01	2.02	0.115	0.115
	14:	26.0	11.0	1.1000E+01	2.12	0.121	0.120
	14:	27.0	12.0	1.2000E+01	2.12	0.121	0.120
	14:	28.0	13.0	1.3000E+01	2.33	0.133	0.132
	14:	29.0	14.0	1.4000E+01	1.83	0.105	0.104
	14:	30.0	15.0	1.5000E+01	1.83	0.105	0.104
	14:	31.0	16.0	1.6000E+01	1.83	0.105	0.104
	14:	32.0	17.0	1.7000E+01	1.64	0.094	0.093
	14:	33.0	18.0	1.8000E+01	1.84	0.105	0.105
	14:	34.0	19.0	1.9000E+01	1.84	0.105	0.105
	14:	35.0	20.0	2.0000E+01	1.74	0.099	0.099
	14:	36.0	21.0	2.1000E+01	1.84	0.105	0.105
	14:	37.0	22.0	2.2000E+01	1.85	0.106	0.105
	14:	38.0	23.0	2.3000E+01	1.85	0.106	0.105
	14:	39.0	24.0	2.4000E+01	1.95	0.111	0.111
	14:	40.0	25.0	2.5000E+01	1.85	0.106	0.105
	14:	41.0	26.0	2.6000E+01	1.85	0.106	0.105

TABLE C-5. (continued) Campbell et al. #2 step test --
calculated adjusted time, Harrill's argument, drawdown, specific draw-
down (s/a) and specific drawdown adjusted for Jacob's correction (s'/a)

	DATE	ELAPSED	ADJUSTED**	HARRILLS*	DRAW-	S/Q	S'/Q#
	OCT 81	HOUR TIME(MIN)	TIME	ARGUMENT	DOWN(FT)	(FT/GPM)	
6	14:42.0	27.0	2.7000E+01		1.86	0.106	0.106
	14:43.0	28.0	2.8000E+01		1.86	0.106	0.106
	14:44.0	29.0	2.9000E+01		1.96	0.112	0.111
	14:45.0	30.0	3.0000E+01		1.86	0.106	0.106
	14:45.5	30.5	5.5449E+00		3.56	0.119	0.118
	14:46.0	31.0	7.4623E+00		4.37	0.146	0.144
	14:46.5	31.5	8.9118E+00		4.47	0.149	0.148
	14:47.0	32.0	1.0134E+01		4.87	0.163	0.161
	14:47.5	32.5	1.1218E+01		5.07	0.170	0.167
	14:48.0	33.0	1.2208E+01		5.17	0.173	0.170
	14:49.0	34.0	1.3997E+01		5.27	0.176	0.174
	14:50.0	35.0	1.5617E+01		5.27	0.176	0.174
	14:51.0	36.0	1.7123E+01		5.28	0.177	0.174
	14:52.0	37.0	1.8549E+01		5.28	0.177	0.174
	14:53.0	38.0	1.9914E+01		5.28	0.177	0.174
	14:54.0	39.0	2.1231E+01		5.28	0.177	0.174
	14:59.0	44.0	2.7366E+01		5.39	0.180	0.178
15: 3.0	48.0	3.1958E+01			5.30	0.177	0.175
15: 7.0	52.0	3.6398E+01			5.31	0.178	0.175
15: 8.0	53.0	3.7491E+01			5.31	0.178	0.175
15:10.0	55.0	3.9660E+01			5.32	0.178	0.175
15:15.0	60.0	4.5010E+01			5.33	0.178	0.176
15:16.0	61.0	2.4506E+01			6.23	0.174	0.171
15:16.5	61.5	2.6451E+01			6.53	0.182	0.179
15:17.5	62.5	2.9317E+01			6.84	0.191	0.187
15:18.0	63.0	3.0490E+01			7.04	0.197	0.193
15:18.5	63.5	3.1560E+01			7.04	0.197	0.193
15:19.0	64.0	3.2553E+01			7.24	0.202	0.198
15:20.0	65.0	3.4372E+01			7.24	0.202	0.198
15:21.0	66.0	3.6036E+01			7.24	0.202	0.198
15:23.0	68.0	3.9066E+01			7.25	0.203	0.198
15:25.0	70.0	4.1845E+01			7.35	0.205	0.201
15:28.0	73.0	4.5731E+01			7.36	0.206	0.201
15:31.0	76.0	4.9404E+01			7.37	0.206	0.202
15:35.0	80.0	5.4096E+01			7.37	0.206	0.202
15:40.0	85.0	5.9751E+01			7.39	0.206	0.202
15:45.0	90.0	6.5256E+01			7.40	0.207	0.202
15:45.5	90.5	3.4356E+01			8.30	0.201	0.196
15:46.0	91.0	3.7948E+01			8.70	0.211	0.206
15:46.5	91.5	4.0337E+01			9.00	0.218	0.212
15:47.0	92.0	4.2206E+01			9.10	0.220	0.215
15:47.5	92.5	4.3781E+01			9.10	0.220	0.215
15:48.0	93.0	4.5166E+01			9.20	0.223	0.217
15:49.0	94.0	4.7569E+01			9.31	0.225	0.220
15:51.0	96.0	5.1547E+01			9.31	0.225	0.220
15:53.0	98.0	5.4940E+01			9.41	0.228	0.222
15:55.0	100.0	5.8006E+01			9.52	0.231	0.224
16: 0.0	105.0	6.4894E+01			9.53	0.231	0.225
16: 5.0	110.0	7.1180E+01			9.54	0.231	0.225
16:10.0	115.0	7.7136E+01			9.65	0.234	0.227
16:15.0	120.0	8.2887E+01			9.76	0.236	0.230

TABLE C-5. (continued) Campbell et al. #2 step test --

calculated adjusted time, Harrill's argument, drawdown, specific draw-down (s/g) and specific drawdown adjusted for Jacob's correction (s'/g)

=====							
OCT 81	DATE	ELAPSED	ADJUSTED**	HARRILLS*	DRAW-	S/Q	S'/Q#
	HOUR	TIME(MIN)	TIME	ARGUMENT	DOWN(FT)	(FT/GPM)	

6	16:15.5	120.5	3.1789E+01		12.16	0.239	0.231
	16:16.0	121.0	3.6428E+01		12.97	0.255	0.246
	16:16.5	121.5	3.9537E+01		13.27	0.261	0.251
	16:17.0	122.0	4.1966E+01		13.37	0.263	0.253
	16:17.5	122.5	4.4004E+01		13.47	0.265	0.255
	16:18.0	123.0	4.5785E+01		13.47	0.265	0.255
	16:19.0	124.0	4.8845E+01		13.57	0.267	0.257
	16:20.0	125.0	5.1471E+01		13.57	0.267	0.257
	16:21.0	126.0	5.3812E+01		13.58	0.267	0.257
	16:23.0	128.0	5.7945E+01		13.68	0.269	0.259
	16:25.0	130.0	6.1605E+01		13.69	0.269	0.259
	16:30.0	135.0	6.9602E+01		13.80	0.271	0.261
	16:35.0	140.0	7.6689E+01		13.81	0.271	0.261
	16:40.0	145.0	8.3268E+01		13.82	0.272	0.261
	16:45.0	150.0	8.9524E+01		13.93	0.274	0.263
	16:45.3	150.3		2.9964E+02	6.43	0.126	
	16:45.5	150.5		1.8027E+02	2.53	0.050	
	16:45.8	150.8		1.1313E+02	1.63	0.032	
	16:46.0	151.0		9.0746E+01	1.13	0.022	
	16:46.3	151.3		7.0085E+01	1.03	0.020	
	16:46.5	151.5		6.0902E+01	1.03	0.020	
	16:47.0	152.0		4.5980E+01	1.03	0.020	
	16:47.5	152.5		3.7025E+01	0.94	0.018	
	16:48.0	153.0		3.1055E+01	0.94	0.018	
	16:49.0	154.0		2.3591E+01	0.94	0.018	
	16:50.0	155.0		1.9111E+01	0.94	0.018	
	16:51.0	156.0		1.6124E+01	0.84	0.017	
	16:53.0	158.0		1.2387E+01	0.85	0.017	
	16:55.0	160.0		1.0143E+01	0.85	0.017	
	17: 0.0	165.0		7.1447E+00	0.76	0.015	
	17: 4.0	169.0		5.8787E+00	0.87	0.017	
	17:10.0	175.0		4.7356E+00	0.59	0.012	
	17:20.0	185.0		3.6957E+00	0.61	0.012	
	17:30.0	195.0		3.1140E+00	0.53	0.010	
	17:40.0	205.0		2.7415E+00	0.45	0.009	
	17:50.0	215.0		2.4820E+00	0.47	0.009	
	18: 0.0	225.0		2.2907E+00	0.50	0.010	
	18:10.0	235.0		2.1437E+00	1.24	0.024	
	18:10.0	235.0		2.1437E+00	0.62	0.012	
	18:20.0	245.0		2.0271E+00	0.64	0.013	
	18:25.0	250.0		1.9774E+00	0.42	0.008	
	18:30.0	255.0		1.9323E+00	0.80	0.016	
	18:30.0	255.0		1.9323E+00	0.86	0.017	
	18:40.0	265.0		1.8537E+00	0.89	0.017	
	18:55.0	280.0		1.7581E+00	1.12	0.022	
	18:59.0	284.0		1.7362E+00	0.36	0.007	
	19: 4.0	289.0		1.7105E+00	0.34	0.007	
	19: 5.0	290.0		1.7055E+00	0.94	0.018	
	19:15.0	300.0		1.6599E+00	0.43	0.008	
	19:15.0	300.0		1.6599E+00	1.06	0.021	
	19:30.0	315.0		1.6015E+00	0.37	0.007	

TABLE C-5. (continued) Campbell et al. #2 step test --
calculated adjusted time, Harrill's argument, drawdown, specific draw-
down (s/a) and specific drawdown adjusted for Jacob's correction (s'/a)

OCT 81	DATE	ELAPSED	ADJUSTED**	HARRILL*	DRAW-	S/Q	S'/Q#
	HOUR	TIME(MIN)	TIME	ARGUMENT	DOWN(FT)	(FT/GPM)	
6	19:30.0	315.0	1.6015E+00		1.20	0.024	
	19:45.0	330.0	1.5527E+00		1.32	0.026	
	19:45.0	330.0	1.5527E+00		1.33	0.026	
	20: 0.0	345.0	1.5113E+00		1.46	0.029	
	20:30.0	375.0	1.4447E+00		0.44	0.009	
	20:30.0	375.0	1.4447E+00		1.43	0.028	
	21: 0.0	405.0	1.3936E+00		0.44	0.009	
	21: 0.0	405.0	1.3936E+00		1.50	0.029	
	21:30.0	435.0	1.3530E+00		1.66	0.033	
	22: 0.0	465.0	1.3200E+00		1.32	0.026	
	22: 0.0	465.0	1.3200E+00		1.83	0.036	
	22: 3.0	468.0	1.3171E+00		0.44	0.009	
	22:30.0	495.0	1.2927E+00		1.70	0.033	
	22:32.0	497.0	1.2911E+00		1.73	0.034	
	22:36.0	501.0	1.2878E+00		0.44	0.009	
	22:40.0	505.0	1.2846E+00		0.42	0.008	
	23:10.0	535.0	1.2628E+00		1.78	0.035	
7	0: 0.0	585.0	1.2331E+00		1.80	0.035	
	4:38.0	863.0	1.1432E+00		2.81	0.055	
	8:42.0	1107.0	1.1070E+00		0.54	0.011	
	8:42.0	1107.0	1.1070E+00		4.75	0.093	
	11: 7.0	1252.0	1.0930E+00		0.44	0.009	
	11:10.0	1255.0	1.0928E+00		0.47	0.009	

*HARRILL, J. R., 1971, DETERMINING TRANSMISSIVITY FROM WATER-LEVEL RECOVERY OF A STEP-DRAWDOWN TEST; U. S. GEOL. SURV., PROF. PAPER 700-C, P. C212-213.

**ADJUSTED TIME, A GENERALIZED HARRILL'S ARGUMENT;
BIRSOY, Y. K. & SUMMERS, W. K., 1980, DETERMINATION OF AQUIFER PARAMETERS FROM STEP TESTS AND INTERMITTENT PUMPING DATA; GROUND WATER, V18, #2 PP137-146.

#S' IS THE JACOB CORRECTION, $S' = S - S^2/2D$.

THE DRAWDOWN S AT ELAPSED TIME T IS CALCULATED FROM THE EQUATION:

$$S = (\text{OBSERVED DEPTH TO WATER AT TIME T}) - (\text{TREND} + \text{INITIAL DEPTH TO WATER})$$

WHERE TREND = 0 * ELAPSED TIME.

THE LENGTH OF THE CONTRIBUTING INTERVAL OF THE WELL IS 180 FEET.

THE DEPTH FROM THE TOP OF CASING TO THE SCREEN IS 77 FEET.

APPENDIX C

TABLE C-6. North Observation well step test -- water level data

DATE		ELAPSED TIME	WATER LEVEL	TYPE OF*	
OCT 81	HOUR	(MINUTES)	READING#	READING	REMARKS
6	11:53.0	-142.0	5.24	STEEL	smeared
	12: 0.0	-135.0	5.21	STEEL	slightly smeared
	13:57.0	-18.0	5.19	STEEL	
	14: 1.0	-14.0	5.17	STEEL	
	14: 3.0	-12.0	5.18	STEEL	
	14: 5.0	-10.0	5.21	STEEL	
	14: 8.0	-7.0	4.21	STEEL	???
	14: 9.0	-6.0	4.21	STEEL	? slightly smeared
	14:11.0	-4.0	5.22	STEEL	
	14:13.0	-2.0	5.23	STEEL	Pump on at Campbell #2
	14:15.0	0.0			PUMP ON
	14:16.0	1.0	5.23	STEEL	at 1415
	14:17.0	2.0	5.24	STEEL	
	14:19.0	4.0	5.18	STEEL	slightly smeared
	14:21.0	6.0	5.23	STEEL	
6	14:23.0	8.0	5.26	STEEL	slightly smeared
	14:24.0	9.0	5.26	STEEL	slightly smeared
	14:25.0	10.0	5.24	STEEL	slightly smeared
	14:27.0	12.0	5.24	STEEL	
	14:29.0	14.0	5.25	STEEL	
	14:31.0	16.0	5.29	STEEL	?
	14:33.0	18.0	5.24	STEEL	
	14:35.0	20.0	5.26	STEEL	
	14:37.0	22.0	5.25	STEEL	
	14:39.0	24.0	5.44	STEEL	
	14:40.0	25.0	5.28	STEEL	
	14:41.0	26.0	5.24	STEEL	
	14:43.0	28.0	5.25	STEEL	
	14:45.0	30.0	5.25	STEEL	
	14:47.0	32.0	5.25	STEEL	
	14:49.0	34.0	5.26	STEEL	slightly smeared
	14:51.0	36.0	5.27	STEEL	slightly smeared
	14:53.0	38.0	5.27	STEEL	slightly smeared
	14:55.0	40.0	5.29	STEEL	
	14:58.0	43.0	5.30	STEEL	
	14:59.0	44.0	5.32	STEEL	
	15: 1.0	46.0	5.32	STEEL	
	15: 3.0	48.0	5.32	STEEL	
	15: 5.0	50.0	5.30	STEEL	
	15: 7.0	52.0	5.29	STEEL	
	15: 9.0	54.0	5.30	STEEL	
	15:11.0	56.0	5.28	STEEL	
	15:13.0	58.0	5.28	STEEL	
	15:15.0	60.0	5.33	STEEL	
	15:17.0	62.0	5.32	STEEL	slightly smeared
	15:19.0	64.0	5.33	STEEL	
	15:21.0	66.0	5.32	STEEL	
	15:23.0	68.0	5.32	STEEL	
	15:25.0	70.0	5.32	STEEL	
	15:27.0	72.0	5.30	STEEL	
	15:29.0	74.0	5.33	STEEL	slightly smeared

TABLE C-6. (continued)

North Observation well step test -- water level data

DATE	ELAPSED TIME	WATER LEVEL	TYPE OF*
OCT 81	HOUR (MINUTES)	READING#	READING
			REMARKS
6	15:33.0	78.0	5.37
	15:35.0	80.0	5.32
	15:37.0	82.0	5.32
	15:39.0	84.0	5.33
	15:41.0	86.0	5.33
	15:43.0	88.0	5.33
	15:45.0	90.0	5.33
	15:47.0	92.0	5.32
	15:49.0	94.0	5.33
	15:51.0	96.0	5.37
	15:54.0	99.0	5.38
	15:55.0	100.0	5.34
	15:58.0	103.0	5.37
	15:59.0	104.0	5.37
	16: 1.0	106.0	5.35
	16: 3.0	108.0	5.34
	16: 5.0	110.0	5.39
	16: 7.0	112.0	5.36
	16: 9.0	114.0	5.39
	16:11.0	116.0	5.37
	16:13.0	118.0	5.35
	16:15.0	120.0	5.37
	16:17.0	122.0	5.39
	16:19.0	124.0	5.39
	16:21.0	126.0	5.39
	16:23.0	128.0	5.38
	16:25.0	130.0	5.39
	16:27.0	132.0	5.38
	16:29.0	134.0	5.39
	16:31.0	136.0	5.39
	16:33.0	138.0	5.40
	16:35.0	140.0	5.42
	16:36.0	141.0	5.38
	16:37.0	142.0	5.40
	16:39.0	144.0	5.38
	16:41.0	146.0	5.39
	16:43.0	148.0	5.42
	16:45.0	150.0	5.41
	16:47.0	152.0	5.41
	16:49.0	154.0	5.41
	16:51.0	156.0	5.36
	16:53.0	158.0	5.35
	16:55.0	160.0	5.33
	16:57.0	162.0	5.33
	16:59.0	164.0	5.34
	17: 1.0	166.0	5.30
	17: 3.0	168.0	5.33
	17: 5.0	170.0	5.28
	17: 7.0	172.0	5.28
	17: 9.0	174.0	5.28
	17:11.0	176.0	5.30

slightly smeared

slightly smeared

slightly smeared

slightly smeared

smeared

slightly smeared

slightly smeared

slightly smeared

Pump off at Campbell

#2 at 1645.

slightly smeared

slightly smeared

TABLE C-6. (continued)

North Observation well step test -- water level data

=====					
DATE	ELAPSED TIME	WATER LEVEL	TYPE OF*		
OCT 81	HOUR	(MINUTES)	READING#	READING	REMARKS

6	17:13.0	178.0	5.27	STEEL	
	17:15.0	180.0	5.29	STEEL	
	17:20.0	185.0	5.28	STEEL	
	17:25.0	190.0	5.30	STEEL	
	17:30.0	195.0	5.38	STEEL	
	17:31.0	196.0	5.26	STEEL	
	17:35.0	200.0	5.25	STEEL	slightly smeared
	17:40.0	205.0	5.28	STEEL	slightly smeared
	17:46.0	211.0	5.28	STEEL	
	17:55.0	220.0	5.27	STEEL	
	18: 5.0	230.0	5.27	STEEL	
	18:15.0	240.0	5.22	STEEL	slightly smeared
	18:29.0	254.0	5.27	STEEL	
	18:44.0	269.0	5.30	STEEL	
	18:58.0	283.0	5.25	STEEL	
	19:37.0	322.0	5.28	STEEL	smeared
	19:59.0	344.0	5.28	STEEL	
	20:38.0	383.0	5.40	STEEL	
	21:44.0	449.0	5.29	STEEL	
	21:46.0	451.0	5.27	STEEL	
	22:45.0	510.0	5.26	STEEL	slightly smeared
7	0: 6.0	591.0	5.29	STEEL	smeared
	4:32.0	857.0	5.28	STEEL	slightly smeared
	8:30.0	1095.0	5.25	STEEL	smeared

*THE TYPE OF READING DENOTES THE TYPE OF DEPTH TO WATER MEASUREMENT MADE. THESE MAY BE ANY OF THE FOLLOWING:

TRANS= MEASUREMENT MADE BY A TRANSDUCER IN THE WELL.
THE MEASUREMENT IS THE HEIGHT OF THE WATER COLUMN ABOVE THE SENSOR.

STEEL= MEASUREMENT MADE BY A STEEL TAPE.

AIR= MEASUREMENT MADE BY AN AIRLINE.

AIRTRAN=MEASUREMENT MADE BY AN AIRLINE COUPLED WITH A TRANSDUCER.

ELECT= MEASUREMENT MADE BY AN ELECTRIC TAPE.

ABSOL= ALL MEASUREMENTS HAVE BEEN CHANGED TO ABSOLUTE DEPTH-TO-WATER MEASUREMENTS.

#THE WATER LEVEL READING IS THE INSTRUMENT READING MADE TO FIND THE DEPTH TO WATER.

ELAPSED TIME IS TAKEN FROM TO AT 1415 ON 6 - OCT - 81

APPENDIX C

TABLE C-7.

North Observation well step test -- depth to water computations

DATE	ELAPSED TIME	DEPTH TO WATER	TYPE OF*	REMARKS
OCT 81	HOUR (MINUTES)	(FT)	READING	
6	11:53.0	-142.0	STEEL	smeared
	12:00.0	-135.0	STEEL	slightly smeared
	13:57.0	-18.0	STEEL	
	14:04.0	-14.0	STEEL	
	14:03.0	-12.0	STEEL	
	14:05.0	-10.0	STEEL	
	14:08.0	-7.0	STEEL	???
	14:09.0	-6.0	STEEL	? slightly smeared
	14:11.0	-4.0	STEEL	
	14:13.0	-2.0	STEEL	Pump on at Campbell #2
6	14:15.0	0.0	PUMP ON	
	14:16.0	1.0	STEEL	at 1415
	14:17.0	2.0	STEEL	
	14:19.0	4.0	STEEL	slightly smeared
	14:21.0	6.0	STEEL	
	14:23.0	8.0	STEEL	slightly smeared
	14:24.0	9.0	STEEL	slightly smeared
	14:25.0	10.0	STEEL	slightly smeared
	14:27.0	12.0	STEEL	
	14:29.0	14.0	STEEL	
	14:31.0	16.0	STEEL	?
	14:33.0	18.0	STEEL	
	14:35.0	20.0	STEEL	
	14:37.0	22.0	STEEL	
	14:39.0	24.0	STEEL	
	14:40.0	25.0	STEEL	
	14:41.0	26.0	STEEL	
	14:43.0	28.0	STEEL	
	14:45.0	30.0	STEEL	
	14:47.0	32.0	STEEL	
	14:49.0	34.0	STEEL	slightly smeared
	14:51.0	36.0	STEEL	slightly smeared
	14:53.0	38.0	STEEL	slightly smeared
	14:55.0	40.0	STEEL	
	14:58.0	43.0	STEEL	
	14:59.0	44.0	STEEL	
	15:01.0	46.0	STEEL	
	15:03.0	48.0	STEEL	
	15:05.0	50.0	STEEL	
	15:07.0	52.0	STEEL	
	15:09.0	54.0	STEEL	
	15:11.0	56.0	STEEL	
	15:13.0	58.0	STEEL	
	15:15.0	60.0	STEEL	
	15:17.0	62.0	STEEL	slightly smeared
	15:19.0	64.0	STEEL	
	15:21.0	66.0	STEEL	
	15:23.0	68.0	STEEL	
	15:25.0	70.0	STEEL	
	15:27.0	72.0	STEEL	
	15:29.0	74.0	STEEL	slightly smeared

TABLE C-7. (continued)

North Observation well step test -- depth to water computations

DATE		ELAPSED TIME	DEPTH TO*	TYPE OF*	REMARKS
OCT 81	HOUR	(MINUTES)	WATER (FT)	READING	
6	15:33.0	78.0	5.37	STEEL	
	15:35.0	80.0	5.32	STEEL	slightly smeared
	15:37.0	82.0	5.32	STEEL	
	15:39.0	84.0	5.33	STEEL	slightly smeared
	15:41.0	86.0	5.33	STEEL	slightly smeared
	15:43.0	88.0	5.33	STEEL	
	15:45.0	90.0	5.33	STEEL	slightly smeared
	15:47.0	92.0	5.32	STEEL	
	15:49.0	94.0	5.33	STEEL	
	15:51.0	96.0	5.37	STEEL	smeared
	15:54.0	99.0	5.38	STEEL	
	15:55.0	100.0	5.34	STEEL	
	15:58.0	103.0	5.37	STEEL	
	15:59.0	104.0	5.37	STEEL	
	16: 1.0	106.0	5.35	STEEL	
	16: 3.0	108.0	5.34	STEEL	
	16: 5.0	110.0	5.39	STEEL	slightly smeared
	16: 7.0	112.0	5.36	STEEL	
	16: 9.0	114.0	5.39	STEEL	
	16:11.0	116.0	5.37	STEEL	
	16:13.0	118.0	5.35	STEEL	
	16:15.0	120.0	5.37	STEEL	
	16:17.0	122.0	5.39	STEEL	
	16:19.0	124.0	5.39	STEEL	
	16:21.0	126.0	5.39	STEEL	
	16:23.0	128.0	5.38	STEEL	
	16:25.0	130.0	5.39	STEEL	
	16:27.0	132.0	5.38	STEEL	
	16:29.0	134.0	5.39	STEEL	
	16:31.0	136.0	5.39	STEEL	
	16:33.0	138.0	5.40	STEEL	
	16:35.0	140.0	5.42	STEEL	slightly smeared
	16:36.0	141.0	5.38	STEEL	
	16:37.0	142.0	5.40	STEEL	
	16:39.0	144.0	5.38	STEEL	
	16:41.0	146.0	5.39	STEEL	
	16:43.0	148.0	5.42	STEEL	slightly smeared
	16:45.0	150.0	5.41	STEEL	PUMP off at Campbell
	16:47.0	152.0	5.41	STEEL	#2 at 1645.
	16:49.0	154.0	5.41	STEEL	
	16:51.0	156.0	5.36	STEEL	
	16:53.0	158.0	5.35	STEEL	
	16:55.0	160.0	5.33	STEEL	slightly smeared
	16:57.0	162.0	5.33	STEEL	
	16:59.0	164.0	5.34	STEEL	
	17: 1.0	166.0	5.30	STEEL	slightly smeared
	17: 3.0	168.0	5.33	STEEL	
	17: 5.0	170.0	5.28	STEEL	
	17: 7.0	172.0	5.28	STEEL	
	17: 9.0	174.0	5.28	STEEL	
	17:11.0	176.0	5.30	STEEL	

TABLE C-7. (continued)

North Observation well step test -- depth to water computations

DATE	ELAPSED TIME	DEPTH TO	TYPE OF*	
OCT 81	(HOUR : MINUTES)	WATER (FT)	READING	REMARKS
6	17:13.0	178.0	5.27	STEEL
	17:15.0	180.0	5.29	STEEL
	17:20.0	185.0	5.28	STEEL
	17:25.0	190.0	5.30	STEEL
	17:30.0	195.0	5.38	STEEL
	17:31.0	196.0	5.26	STEEL
	17:35.0	200.0	5.25	STEEL slightly smeared
	17:40.0	205.0	5.28	STEEL slightly smeared
	17:46.0	211.0	5.28	STEEL
	17:55.0	220.0	5.27	STEEL
	18: 5.0	230.0	5.27	STEEL
	18:15.0	240.0	5.22	STEEL slightly smeared
	18:29.0	254.0	5.27	STEEL
	18:44.0	269.0	5.30	STEEL
	18:58.0	283.0	5.25	STEEL
	19:37.0	322.0	5.28	STEEL smeared
	19:59.0	344.0	5.28	STEEL
	20:38.0	383.0	5.40	STEEL
	21:44.0	449.0	5.29	STEEL
	21:46.0	451.0	5.27	STEEL
	22:45.0	510.0	5.26	STEEL slightly smeared
	0: 6.0	591.0	5.29	STEEL smeared
	4:32.0	857.0	5.28	STEEL slightly smeared
	8:30.0	1095.0	5.25	STEEL smeared

*THE TYPE OF READING DENOTES THE TYPE OF

DEPTH TO WATER MEASUREMENT MADE. THESE MAY

BE ANY OF THE FOLLOWING:

TRANS= MEASUREMENT MADE BY A TRANSDUCER IN THE WELL.

THE MEASUREMENT IS THE HEIGHT OF THE WATER COLUMN

ABOVE THE SENSOR.

STEEL= MEASUREMENT MADE BY A STEEL TAPE.

AIR= MEASUREMENT MADE BY AN AIRLINE.

AIRTRAN= MEASUREMENT MADE BY AN AIRLINE COUPLED WITH A

TRANSDUCER.

ELECT= MEASUREMENT MADE BY AN ELECTRIC TAPE.

ABSOL= CALL MEASUREMENTS HAVE BEEN CHANGED TO ABSOLUTE DEPTH-

TO-WATER MEASUREMENTS.

†THE DEPTH TO WATER IS THE CALCULATED DEPTH TO WATER

FROM THE TOP OF THE WELL CASING, .35 FEET ABOVE THE

LAND SURFACE.

THE DEPTH TO WATER BELOW THE TOP OF THE CASING IS COMPUTED BY
THE FORMULA,

FOR STEEL, DEPTH TO WATER = WATER LEVEL READING

ELAPSED TIME IS TAKEN FROM TO AT 1415 ON 6 - OCT - 81

APPENDIX C

TABLE C-8. North Observation well step test --
calculated adjusted time, Harrill's argument, drawdown, specific draw-
down (s/q) and specific drawdown adjusted for Jacob's correction (s'/q)

OCT 81	DATE	ELAPSED	ADJUSTED**	HARRILLS*	DRAW-	S/Q	S'/Q#
	HOUR	TIME(MIN)	TIME	ARGUMENT	DOWN(FT)	(FT/GPM)	
6	12:	0.0			-0.02		
	13:	57.0			-0.04		
	14:	1.0			-0.06		
	14:	3.0			-0.05		
	14:	5.0			-0.02		
	14:	8.0			-1.02		
	14:	9.0			-1.02		
	14:	11.0			-0.01		
	14:	13.0			0.00		
	14:	16.0	1.0	1.0000E+00	0.00	0.000	0.000
	14:	17.0	2.0	2.0000E+00	0.01	0.001	0.001
	14:	19.0	4.0	4.0000E+00	-0.05	-0.003	-0.003
	14:	21.0	6.0	6.0000E+00	0.00	0.000	0.000
	14:	23.0	8.0	8.0000E+00	0.03	0.002	0.002
	14:	24.0	9.0	9.0000E+00	0.03	0.002	0.002
	14:	25.0	10.0	1.0000E+01	0.01	0.001	0.001
	14:	27.0	12.0	1.2000E+01	0.01	0.001	0.001
	14:	29.0	14.0	1.4000E+01	0.02	0.001	0.001
	14:	31.0	16.0	1.6000E+01	0.06	0.003	0.003
	14:	33.0	18.0	1.8000E+01	0.01	0.001	0.001
	14:	35.0	20.0	2.0000E+01	0.03	0.002	0.002
	14:	37.0	22.0	2.2000E+01	0.02	0.001	0.001
	14:	39.0	24.0	2.4000E+01	0.21	0.012	0.012
	14:	40.0	25.0	2.5000E+01	0.05	0.003	0.003
	14:	41.0	26.0	2.6000E+01	0.01	0.001	0.001
	14:	43.0	28.0	2.8000E+01	0.02	0.001	0.001
	14:	45.0	30.0	3.0000E+01	0.02	0.001	0.001
	14:	47.0	32.0	1.0134E+01	0.02	0.001	0.001
	14:	49.0	34.0	1.3997E+01	0.03	0.001	0.001
	14:	51.0	36.0	1.7123E+01	0.04	0.001	0.001
	14:	53.0	38.0	1.9914E+01	0.04	0.001	0.001
	14:	55.0	40.0	2.2510E+01	0.06	0.002	0.002
	14:	58.0	43.0	2.6183E+01	0.07	0.002	0.002
	14:	59.0	44.0	2.7366E+01	0.09	0.003	0.003
	15:	1.0	46.0	2.9686E+01	0.09	0.003	0.003
	15:	3.0	48.0	3.1958E+01	0.09	0.003	0.003
	15:	5.0	50.0	3.4193E+01	0.07	0.002	0.002
	15:	7.0	52.0	3.6398E+01	0.06	0.002	0.002
	15:	9.0	54.0	3.8578E+01	0.07	0.002	0.002
	15:	11.0	56.0	4.0738E+01	0.05	0.002	0.002
	15:	13.0	58.0	4.2881E+01	0.05	0.002	0.002
	15:	15.0	60.0	4.5010E+01	0.10	0.003	0.003
	15:	17.0	62.0	2.7997E+01	0.09	0.003	0.003
	15:	19.0	64.0	3.2553E+01	0.10	0.003	0.003
	15:	21.0	66.0	3.6036E+01	0.09	0.003	0.003
	15:	23.0	68.0	3.9066E+01	0.09	0.003	0.003
	15:	25.0	70.0	4.1845E+01	0.09	0.003	0.003
	15:	27.0	72.0	4.4464E+01	0.07	0.002	0.002
	15:	29.0	74.0	4.6974E+01	0.10	0.003	0.003
	15:	33.0	78.0	5.1774E+01	0.14	0.004	0.004
	15:	35.0	80.0	5.4096E+01	0.09	0.003	0.003

TABLE C-8. (continued)

North Observation well step test --
 calculated adjusted time, Harrill's argument, drawdown, specific draw-
 down (s/a) and specific drawdown adjusted for Jacob's correction (s'/Q#)

OCT 81	DATE	ELAPSED	ADJUSTED**	HARRILLS*	DRAW-	S/Q	S'/Q#
	HOUR	TIME(MIN)	TIME	ARGUMENT	DOWN(FT)	(FT/GPM)	
6	15:37.0	82.0	5.6381E+01		0.09	0.003	0.003
	15:39.0	84.0	5.8634E+01		0.10	0.003	0.003
	15:41.0	86.0	6.0862E+01		0.10	0.003	0.003
	15:43.0	88.0	6.3068E+01		0.10	0.003	0.003
	15:45.0	90.0	6.5256E+01		0.10	0.003	0.003
	15:47.0	92.0	4.2206E+01		0.09	0.002	0.002
	15:49.0	94.0	4.7569E+01		0.10	0.002	0.002
	15:51.0	96.0	5.1547E+01		0.14	0.003	0.003
	15:54.0	99.0	5.6504E+01		0.15	0.004	0.004
	15:55.0	100.0	5.8006E+01		0.11	0.003	0.003
	15:58.0	103.0	6.2236E+01		0.14	0.003	0.003
	15:59.0	104.0	6.3578E+01		0.14	0.003	0.003
	16: 1.0	106.0	6.6187E+01		0.12	0.003	0.003
	16: 3.0	108.0	6.8715E+01		0.11	0.003	0.003
	16: 5.0	110.0	7.1180E+01		0.16	0.004	0.004
	16: 7.0	112.0	7.3593E+01		0.13	0.003	0.003
	16: 9.0	114.0	7.5964E+01		0.16	0.004	0.004
	16:11.0	116.0	7.8300E+01		0.14	0.003	0.003
	16:13.0	118.0	8.0607E+01		0.12	0.003	0.003
	16:15.0	120.0	8.2887E+01		0.14	0.003	0.003
	16:17.0	122.0	4.1966E+01		0.16	0.003	0.003
	16:19.0	124.0	4.8845E+01		0.16	0.003	0.003
	16:21.0	126.0	5.3812E+01		0.16	0.003	0.003
	16:23.0	128.0	5.7945E+01		0.15	0.003	0.003
	16:25.0	130.0	6.1605E+01		0.16	0.003	0.003
	16:27.0	132.0	6.4958E+01		0.15	0.003	0.003
	16:29.0	134.0	6.8096E+01		0.16	0.003	0.003
	16:31.0	136.0	7.1075E+01		0.16	0.003	0.003
	16:33.0	138.0	7.3931E+01		0.17	0.003	0.003
	16:35.0	140.0	7.6689E+01		0.19	0.004	0.004
	16:36.0	141.0	7.8038E+01		0.15	0.003	0.003
	16:37.0	142.0	7.9369E+01		0.17	0.003	0.003
	16:39.0	144.0	8.1982E+01		0.15	0.003	0.003
	16:41.0	146.0	8.4541E+01		0.16	0.003	0.003
	16:43.0	148.0	8.7053E+01		0.19	0.004	0.004
	16:45.0	150.0	8.9524E+01		0.18	0.004	0.004
	16:47.0	152.0	4.5980E+01		0.18	0.004	
	16:49.0	154.0	2.3591E+01		0.18	0.004	
	16:51.0	156.0	1.6124E+01		0.13	0.003	
	16:53.0	158.0	1.2387E+01		0.12	0.002	
	16:55.0	160.0	1.0143E+01		0.10	0.002	
	16:57.0	162.0	8.6447E+00		0.10	0.002	
	16:59.0	164.0	7.5736E+00		0.11	0.002	
	17: 1.0	166.0	6.7692E+00		0.07	0.001	
	17: 3.0	168.0	6.1428E+00		0.10	0.002	
	17: 5.0	170.0	5.6409E+00		0.05	0.001	
	17: 7.0	172.0	5.2298E+00		0.05	0.001	
	17: 9.0	174.0	4.8867E+00		0.05	0.001	
	17:11.0	176.0	4.5960E+00		0.07	0.001	
	17:13.0	178.0	4.3464E+00		0.04	0.001	
	17:15.0	180.0	4.1299E+00		0.06	0.001	

TABLE C-8. (continued)

North Observation well step test --
calculated adjusted time, Harrill's argument, drawdown, specific draw-
down (s/a) and specific drawdown adjusted for Jacob's correction (s'/a)

	DATE	ELAPSED	ADJUSTED**	HARRILLS*	DRAW-	S/Q	S'/Q†
	OCT 81	HOUR TIME(MIN)	TIME	ARGUMENT	DOWN(FT)	(FT/GPM)	
6	17:20.0	185.0	3.6957E+00		0.05	0.001	
	17:25.0	190.0	3.3690E+00		0.07	0.001	
	17:30.0	195.0	3.1140E+00		0.15	0.003	
	17:31.0	196.0	3.0696E+00		0.03	0.001	
	17:35.0	200.0	2.9094E+00		0.02	0.000	
	17:40.0	205.0	2.7415E+00		0.05	0.001	
	17:46.0	211.0	2.5757E+00		0.05	0.001	
	17:55.0	220.0	2.3796E+00		0.04	0.001	
	18: 5.0	230.0	2.2127E+00		0.04	0.001	
	18:15.0	240.0	2.0822E+00		-0.01	-0.000	
	18:29.0	254.0	1.9410E+00		0.04	0.001	
	18:44.0	269.0	1.8259E+00		0.07	0.001	
	18:58.0	283.0	1.7415E+00		0.02	0.000	
	19:37.0	322.0	1.5777E+00		0.05	0.001	
	19:59.0	344.0	1.5138E+00		0.05	0.001	
	20:38.0	383.0	1.4298E+00		0.17	0.003	
	21:44.0	449.0	1.3368E+00		0.06	0.001	
	21:46.0	451.0	1.3346E+00		0.04	0.001	
	22:45.0	510.0	1.2808E+00		0.03	0.001	
7	0: 6.0	591.0	1.2300E+00		0.06	0.001	
	4:32.0	857.0	1.1444E+00		0.05	0.001	
	8:30.0	1095.0	1.1083E+00		0.02	0.000	

*HARRILL, J. R., 1971, DETERMINING TRANSMISSIVITY FROM WATER-LEVEL RECOVERY OF A STEP-DRAWDOWN TEST; U. S. GEOL. SURV., PROF. PAPER 700-C,P.C212-213.

**ADJUSTED TIME, A GENERALIZED HARRILL'S ARGUMENT,

BIRSOY, Y. K. & SUMMERS, W. K., 1980, DETERMINATION OF AQUIFER PARAMETERS FROM STEP TESTS AND INTERMITTENT PUMPING DATA; GROUND WATER, V18, #2 PP137-146.

†S' IS THE JACOB CORRECTION, $S' = S - S^2/2D$.

THE DRAWDOWN S AT ELAPSED TIME T IS CALCULATED FROM THE EQUATION:

$$S = (\text{OBSERVED DEPTH TO WATER AT TIME T}) - (\text{TREND} + \text{INITIAL DEPTH TO WATER})$$

WHERE TREND = 0 * ELAPSED TIME.

THE LENGTH OF THE CONTRIBUTING INTERVAL OF THE WELL IS 34 FEET.
THE DEPTH FROM THE TOP OF CASING TO THE SCREEN IS 4 FEET.

APPENDIX C

TABLE C-9. South Observation well step test -- water level data

DATE	ELAPSED TIME	WATER LEVEL	TYPE OF*	REMARKS
OCT 81	HOUR (MINUTES)	READING	READING	
5	18: 3.0	-1212.0	6.49	STEEL smeared
	18: 5.0	-1210.0	6.44	STEEL smeared
	18: 7.0	-1208.0	6.54	STEEL slightly smeared
	18: 8.0	-1207.0	6.45	STEEL
	18:10.0	-1205.0	6.47	STEEL smeared
	21: 4.0	-1031.0	6.49	STEEL slightly smeared
6	0: 6.0	-849.0	6.50	STEEL smeared
	3:48.0	-627.0	6.50	STEEL
	6:58.0	-317.0	6.47	STEEL good mark
	11:14.0	-181.0	6.43	STEEL
	11:55.0	-140.0	57.70	TRANS
	11:59.0	-136.0	6.45	STEEL
	11:59.0	-136.0	57.40	TRANS
	12: 1.0	-134.0	6.48	STEEL slightly smeared
	12: 1.0	-134.0	57.40	TRANS
	13:58.0	-17.0	6.48	STEEL
	13:58.0	-17.0	57.10	TRANS
	14: 0.0	-15.0	6.48	STEEL
	14: 0.0	-15.0	57.10	TRANS
	14: 2.0	-13.0	57.10	TRANS
	14: 4.0	-11.0	57.10	TRANS
	14: 6.0	-9.0	57.10	TRANS
	14: 8.0	-7.0	57.10	TRANS
	14:10.0	-5.0	57.10	TRANS
	14:12.0	-3.0	57.10	TRANS
	14:14.0	-1.0	57.10	TRANS
6	14:15.0	0.0		PUMP ON
	14:16.0	1.0	57.10	TRANS at Campbell #2.
	14:20.0	5.0	57.10	TRANS
	14:22.0	7.0	57.10	TRANS
	14:24.0	9.0	57.10	TRANS
	14:26.0	11.0	57.10	TRANS
	14:28.0	13.0	57.10	TRANS
	14:30.0	15.0	6.49	STEEL
	14:30.0	15.0	57.10	TRANS
	14:32.0	17.0	57.10	TRANS
	14:34.0	19.0	57.10	TRANS
	14:36.0	21.0	57.10	TRANS
	14:38.0	23.0	57.10	TRANS
	14:40.0	25.0	57.10	TRANS
	14:42.0	27.0	57.10	TRANS
	14:44.0	29.0	57.10	TRANS
	14:46.0	31.0	57.10	TRANS
	14:48.0	33.0	57.10	TRANS
	14:50.0	35.0	57.10	TRANS
	14:52.0	37.0	57.10	TRANS
	14:54.0	39.0	57.10	TRANS
	14:56.0	41.0	57.10	TRANS
	14:58.0	43.0	57.10	TRANS
	15: 0.0	45.0	6.49	STEEL
	15: 0.0	45.0	57.10	TRANS

TABLE C-9. (continued)

South Observation well step test -- water level data

=====					
OCT 81	DATE	ELAPSED TIME	WATER LEVEL	TYPE OF*	REMARKS
	HOUR	(MINUTES)	READING#	READING	

6	15: 2.0	47.0	57.20	TRANS	
	15: 4.0	49.0	57.10	TRANS	
	15: 6.0	51.0	57.10	TRANS	
	15: 8.0	53.0	57.10	TRANS	
	15:10.0	55.0	57.10	TRANS	
	15:12.0	57.0	57.10	TRANS	
	15:14.0	59.0	57.10	TRANS	
	15:16.0	61.0	57.10	TRANS	
	15:18.0	63.0	57.10	TRANS	
	15:20.0	65.0	57.10	TRANS	
	15:22.0	67.0	57.10	TRANS	
	15:24.0	69.0	57.10	TRANS	
	15:26.0	71.0	57.20	TRANS	
	15:28.0	73.0	57.20	TRANS	
	15:31.0	76.0	6.53	STEEL	
	15:31.0	76.0	57.20	TRANS	
	15:32.0	77.0	57.20	TRANS	
	15:34.0	79.0	57.20	TRANS	
	15:36.0	81.0	57.20	TRANS	
	15:38.0	83.0	57.20	TRANS	
	15:40.0	85.0	57.20	TRANS	
	15:42.0	87.0	57.20	TRANS	
	15:44.0	89.0	57.20	TRANS	
	15:46.0	91.0	57.20	TRANS	
	15:48.0	93.0	57.20	TRANS	
	15:50.0	95.0	57.10	TRANS	
	15:52.0	97.0	57.20	TRANS	
	15:54.0	99.0	57.10	TRANS	
	15:56.0	101.0	57.20	TRANS	
	15:58.0	103.0	57.10	TRANS	
	16: 0.0	105.0	6.46	STEEL	
	16: 0.0	105.0	57.10	TRANS	
	16: 2.0	107.0	57.10	TRANS	
	16: 4.0	109.0	57.10	TRANS	
	16: 6.0	111.0	57.10	TRANS	
	16: 8.0	113.0	57.10	TRANS	
	16:10.0	115.0	57.10	TRANS	
	16:12.0	117.0	57.10	TRANS	
	16:14.0	119.0	57.10	TRANS	
	16:16.0	121.0	57.10	TRANS	
	16:18.0	123.0	57.10	TRANS	
	16:20.0	125.0	57.10	TRANS	
	16:22.0	127.0	57.10	TRANS	
	16:24.0	129.0	57.10	TRANS	
	16:26.0	131.0	57.10	TRANS	
	16:28.0	133.0	57.10	TRANS	
	16:30.0	135.0	57.10	TRANS	
	16:32.0	137.0	57.10	TRANS	
	16:34.0	139.0	57.10	TRANS	
	16:36.0	141.0	57.10	TRANS	
	16:38.0	143.0	57.10	TRANS	

TABLE C-9. (continued)

South Observation well step test -- water level data

DATE		ELAPSED TIME	WATER LEVEL	TYPE OF*	REMARKS
OCT 81	HOUR	(MINUTES)	READING#	READING	
6	16:40.0	145.0	57.10	TRANS	PUMP OFF at Campbell #2.
	16:42.0	147.0	57.10	TRANS	
	16:44.0	149.0	57.10	TRANS	
6	16:45.0	120.0			
	16:46.0	151.0	57.10	TRANS	
	16:48.0	153.0	57.20	TRANS	
	16:50.0	155.0	57.20	TRANS	
	16:52.0	157.0	57.20	TRANS	
	16:54.0	159.0	57.20	TRANS	
	16:57.0	162.0	57.20	TRANS	
	16:58.0	163.0	57.20	TRANS	
	17: 0.0	165.0	6.45	STEEL	
	17: 0.0	165.0	57.20	TRANS	
	17: 2.0	167.0	57.20	TRANS	
	17: 4.0	169.0	57.20	TRANS	
	17: 6.0	171.0	57.20	TRANS	
	17: 8.0	173.0	57.20	TRANS	
	17:10.0	175.0	57.20	TRANS	
	17:12.0	177.0	57.20	TRANS	
	17:14.0	179.0	57.20	TRANS	
	17:16.0	181.0	57.20	TRANS	
	17:22.0	187.0	57.20	TRANS	
	17:26.0	191.0	57.20	TRANS	
	17:34.0	199.0	57.20	TRANS	
	17:36.0	201.0	57.20	TRANS	
	17:41.0	206.0	57.20	TRANS	
	17:46.0	211.0	57.20	TRANS	
	17:54.0	219.0	57.20	TRANS	
	18: 6.0	231.0	57.20	TRANS	
	18:16.0	241.0	57.20	TRANS	
	18:28.0	253.0	57.20	TRANS	
	18:42.0	267.0	57.20	TRANS	
	18:57.0	282.0	57.20	TRANS	
	19:29.0	314.0	57.20	TRANS	
	19:58.0	343.0	57.20	TRANS	
	20:42.0	387.0	57.30	TRANS	
	21:44.0	449.0	57.30	TRANS	
	22:49.0	514.0	57.20	TRANS	
7	0: 4.0	589.0	57.20	TRANS	
	4:30.0	855.0	57.00	TRANS	
	8:28.0	1093.0	56.80	TRANS	
	10:41.0	1226.0	56.70	TRANS	
	11:45.0	1290.0	56.70	TRANS	

*THE TYPE OF READING DENOTES THE TYPE OF
DEPTH TO WATER MEASUREMENT MADE. THESE MAY
BE ANY OF THE FOLLOWING:

TRANS= MEASUREMENT MADE BY A TRANSDUCER IN THE WELL.
THE MEASUREMENT IS THE HEIGHT OF THE WATER COLUMN

TABLE C-9. (continued)

ABOVE THE SENSOR.

STEEL= MEASUREMENT MADE BY A STEEL TAPE.

AIR= MEASUREMENT MADE BY AN AIRLINE.

AIRTRAN=MEASUREMENT MADE BY AN AIRLINE COUPLED WITH A
TRANSDUCER.

ELECT= MEASUREMENT MADE BY AN ELECTRIC TAPE.

ABSOL= ALL MEASUREMENTS HAVE BEEN CHANGED TO ABSOLUTE DEPTH-
TO-WATER MEASUREMENTS.

#THE WATER LEVEL READING IS THE INSTRUMENT READING
MADE TO FIND THE DEPTH TO WATER.

ELAPSED TIME IS TAKEN FROM TO AT 1415 ON 6 - OCT - 81

APPENDIX C

TABLE C-10.

South Observation well step test -- depth to water computations

OCT 81	DATE	ELAPSED TIME	DEPTH TO#	TYPE OF*	REMARKS
	HOUR	(MINUTES)	WATER(FT)	READING	
5	18: 3.0	-1212.0	6.49	STEEL	smeared
	18: 5.0	-1210.0	6.44	STEEL	smeared
	18: 7.0	-1208.0	6.54	STEEL	slightly smeared
	18: 8.0	-1207.0	6.45	STEEL	
	18:10.0	-1205.0	6.47	STEEL	smeared
	21: 4.0	-1031.0	6.49	STEEL	slightly smeared
6	0: 6.0	-849.0	6.50	STEEL	smeared
	3:48.0	-627.0	6.50	STEEL	
	8:58.0	-317.0	6.47	STEEL	good mark
	11:14.0	-181.0	6.43	STEEL	
	11:55.0	-140.0	5.90	TRANS	
	11:59.0	-136.0	6.45	STEEL	
	11:59.0	-136.0	6.20	TRANS	
	12: 1.0	-134.0	6.48	STEEL	slightly smeared
	12: 1.0	-134.0	6.20	TRANS	
	13:58.0	-17.0	6.48	STEEL	
	13:58.0	-17.0	6.50	TRANS	
	14: 0.0	-15.0	6.48	STEEL	
	14: 0.0	-15.0	6.50	TRANS	
	14: 2.0	-13.0	6.50	TRANS	
	14: 4.0	-11.0	6.50	TRANS	
	14: 6.0	-9.0	6.50	TRANS	
	14: 8.0	-7.0	6.50	TRANS	
	14:10.0	-5.0	6.50	TRANS	
	14:12.0	-3.0	6.50	TRANS	
	14:14.0	-1.0	6.50	TRANS	
6	14:15.0	0.0		PUMP ON	
	14:16.0	1.0	6.50	TRANS	
	14:20.0	5.0	6.50	TRANS	
	14:22.0	7.0	6.50	TRANS	
	14:24.0	9.0	6.50	TRANS	
	14:26.0	11.0	6.50	TRANS	
	14:28.0	13.0	6.50	TRANS	
	14:30.0	15.0	6.49	STEEL	
	14:30.0	15.0	6.50	TRANS	
	14:32.0	17.0	6.50	TRANS	
	14:34.0	19.0	6.50	TRANS	
	14:36.0	21.0	6.50	TRANS	
	14:38.0	23.0	6.50	TRANS	
	14:40.0	25.0	6.50	TRANS	
	14:42.0	27.0	6.50	TRANS	
	14:44.0	29.0	6.50	TRANS	
	14:46.0	31.0	6.50	TRANS	
	14:48.0	33.0	6.50	TRANS	
	14:50.0	35.0	6.50	TRANS	
	14:52.0	37.0	6.50	TRANS	
	14:54.0	39.0	6.50	TRANS	
	14:56.0	41.0	6.50	TRANS	
	14:58.0	43.0	6.50	TRANS	
	15: 0.0	45.0	6.49	STEEL	
	15: 0.0	45.0	6.50	TRANS	

TABLE C-10. (continued)

South Observation well step test -- depth to water computations

DATE		ELAPSED TIME	DEPTH TO*	TYPE OF*	REMARKS
OCT 81	HOUR	(MINUTES)	WATER (FT)	READING	
6	15: 2.0	47.0	6.40	TRANS	
	15: 4.0	49.0	6.50	TRANS	
	15: 6.0	51.0	6.50	TRANS	
	15: 8.0	53.0	6.50	TRANS	
	15:10.0	55.0	6.50	TRANS	
	15:12.0	57.0	6.50	TRANS	
	15:14.0	59.0	6.50	TRANS	
	15:16.0	61.0	6.50	TRANS	
	15:18.0	63.0	6.50	TRANS	
	15:20.0	65.0	6.50	TRANS	
	15:22.0	67.0	6.50	TRANS	
	15:24.0	69.0	6.50	TRANS	
	15:26.0	71.0	6.40	TRANS	
	15:28.0	73.0	6.40	TRANS	
	15:31.0	76.0	6.53	STEEL	
	15:31.0	76.0	6.40	TRANS	
	15:32.0	77.0	6.40	TRANS	
	15:34.0	79.0	6.40	TRANS	
	15:36.0	81.0	6.40	TRANS	
	15:38.0	83.0	6.40	TRANS	
	15:40.0	85.0	6.40	TRANS	
	15:42.0	87.0	6.40	TRANS	
	15:44.0	89.0	6.40	TRANS	
	15:46.0	91.0	6.40	TRANS	
	15:48.0	93.0	6.40	TRANS	
	15:50.0	95.0	6.50	TRANS	
	15:52.0	97.0	6.40	TRANS	
	15:54.0	99.0	6.50	TRANS	
	15:56.0	101.0	6.40	TRANS	
	15:58.0	103.0	6.50	TRANS	
	16: 0.0	105.0	6.46	STEEL	
	16: 0.0	105.0	6.50	TRANS	
	16: 2.0	107.0	6.50	TRANS	
	16: 4.0	109.0	6.50	TRANS	
	16: 6.0	111.0	6.50	TRANS	
	16: 8.0	113.0	6.50	TRANS	
	16:10.0	115.0	6.50	TRANS	
	16:12.0	117.0	6.50	TRANS	
	16:14.0	119.0	6.50	TRANS	
	16:16.0	121.0	6.50	TRANS	
	16:18.0	123.0	6.50	TRANS	
	16:20.0	125.0	6.50	TRANS	
	16:22.0	127.0	6.50	TRANS	
	16:24.0	129.0	6.50	TRANS	
	16:26.0	131.0	6.50	TRANS	
	16:28.0	133.0	6.50	TRANS	
	16:30.0	135.0	6.50	TRANS	
	16:32.0	137.0	6.50	TRANS	
	16:34.0	139.0	6.50	TRANS	
	16:36.0	141.0	6.50	TRANS	
	16:38.0	143.0	6.50	TRANS	

TABLE C-10. (continued)

South Observation well step test -- depth to water computations

DATE	ELAPSED TIME	DEPTH TO#	TYPE OF*	REMARKS
OCT 81	HOUR (MINUTES)	WATER (FT)	READING	
6	16:40.0	145.0	6.50	TRANS
	16:42.0	147.0	6.50	TRANS
	16:44.0	149.0	6.50	TRANS
6	16:45.0	150.0		PUMP OFF
	16:46.0	151.0	6.50	TRANS
	16:48.0	153.0	6.40	TRANS
	16:50.0	155.0	6.40	TRANS
	16:52.0	157.0	6.40	TRANS
	16:54.0	159.0	6.40	TRANS
	16:57.0	162.0	6.40	TRANS
	16:58.0	163.0	6.40	TRANS
	17: 0.0	165.0	6.45	STEEL
	17: 0.0	165.0	6.40	TRANS
	17: 2.0	167.0	6.40	TRANS
	17: 4.0	169.0	6.40	TRANS
	17: 6.0	171.0	6.40	TRANS
	17: 8.0	173.0	6.40	TRANS
	17:10.0	175.0	6.40	TRANS
	17:12.0	177.0	6.40	TRANS
	17:14.0	179.0	6.40	TRANS
	17:16.0	181.0	6.40	TRANS
	17:22.0	187.0	6.40	TRANS
	17:26.0	191.0	6.40	TRANS
	17:34.0	199.0	6.40	TRANS
	17:36.0	201.0	6.40	TRANS
	17:41.0	206.0	6.40	TRANS
	17:46.0	211.0	6.40	TRANS
	17:54.0	219.0	6.40	TRANS
	18: 6.0	231.0	6.40	TRANS
	18:16.0	241.0	6.40	TRANS
	18:28.0	253.0	6.40	TRANS
	18:42.0	267.0	6.40	TRANS
	18:57.0	282.0	6.40	TRANS
	19:29.0	314.0	6.40	TRANS
	19:58.0	343.0	6.40	TRANS
	20:42.0	387.0	6.30	TRANS
	21:44.0	449.0	6.30	TRANS
	22:49.0	514.0	6.40	TRANS
7	0: 4.0	589.0	6.40	TRANS
	4:30.0	855.0	6.60	TRANS
	8:28.0	1093.0	6.80	TRANS
	10:41.0	1226.0	6.90	TRANS
	11:45.0	1290.0	6.90	TRANS

*THE TYPE OF READING DENOTES THE TYPE OF DEPTH TO WATER MEASUREMENT MADE. THESE MAY BE ANY OF THE FOLLOWING:

TRANS= MEASUREMENT MADE BY A TRANSDUCER IN THE WELL.
THE MEASUREMENT IS THE HEIGHT OF THE WATER COLUMN

TABLE C-10. (continued)

ABOVE THE SENSOR.

STEEL= MEASUREMENT MADE BY A STEEL TAPE.

AIR= MEASUREMENT MADE BY AN AIRLINE.

AIRTRAN=MEASUREMENT MADE BY AN AIRLINE COUPLED WITH A
TRANSDUCER.

ELECT= MEASUREMENT MADE BY AN ELECTRIC TAPE.

ABSOL= ALL MEASUREMENTS HAVE BEEN CHANGED TO ABSOLUTE DEPTH-
TO-WATER MEASUREMENTS.

#THE DEPTH TO WATER IS THE CALCULATED DEPTH TO WATER
FROM THE TOP OF THE WELL CASING, .2 FEET ABOVE THE
LAND SURFACE.

THE DEPTH TO WATER BELOW THE TOP OF THE CASING IS COMPUTED BY
THE FORMULA,

FOR TRANS, DEPTH TO WATER = 63.6 - WATER LEVEL READING

FOR STEEL, DEPTH TO WATER = WATER LEVEL READING

ELAPSED TIME IS TAKEN FROM TO AT 1415 ON 6 - OCT - 81

APPENDIX C

TABLE C-11. South Observation well step test --
calculated adjusted time, Harrill's argument, drawdown, specific draw-
down (s/q) and specific drawdown adjusted for Jacob's correction (s'/q)

=====						
DATE	ELAPSED	ADJUSTED**	HARRILL'S*	DRAW-	S/Q	S'/Q#
OCT 81	HOUR TIME (MIN)	TIME	ARGUMENT	DOWN (FT)	(FT/GPM)	

5	18: 5.0	00.0	0.0000E+00	-0.06		
	18: 7.0	00.0	0.0000E+00	0.04		
	18: 8.0	00.0	0.0000E+00	-0.05		
	18:10.0	00.0	0.0000E+00	-0.03		
	21: 4.0	00.0	0.0000E+00	-0.01		
6	0: 6.0	00.0	0.0000E+00	0.00		
	3:48.0	00.0	0.0000E+00	0.00		
	8:58.0	00.0	0.0000E+00	-0.03		
	11:14.0	00.0	0.0000E+00	-0.07		
	11:55.0	00.0	0.0000E+00	-0.60		
	11:59.0	00.0	0.0000E+00	-0.05		
	11:59.0	01.0	0.0000E+00	-0.30		
	12: 1.0	00.0	0.0000E+00	-0.02		
	12: 1.0	01.0	0.0000E+00	-0.30		
	13:58.0	00.0	0.0000E+00	-0.02		
	13:58.0	01.0	0.0000E+00	0.00		
	14: 0.0	01.0	0.0000E+00	-0.02		
	14: 0.0	01.0	0.0000E+00	0.00		
	14: 2.0	01.0	0.0000E+00	0.00		
	14: 4.0	01.0	0.0000E+00	0.00		
	14: 6.0	01.0	0.0000E+00	0.00		
	14: 8.0	01.0	0.0000E+00	0.00		
	14:10.0	01.0	0.0000E+00	0.00		
	14:12.0	01.0	0.0000E+00	0.00		
	14:14.0	01.0	0.0000E+00	0.00		
	14:16.0	1.0	1.0000E+00	0.00	0.000	0.000
	14:20.0	5.0	5.0000E+00	0.00	0.000	0.000
	14:22.0	7.0	7.0000E+00	0.00	0.000	0.000
	14:24.0	9.0	9.0000E+00	0.00	0.000	0.000
	14:26.0	11.0	1.1000E+01	0.00	0.000	0.000
	14:28.0	13.0	1.3000E+01	0.00	0.000	0.000
	14:30.0	15.0	1.5000E+01	-0.01	-0.001	-0.001
	14:30.0	15.0	1.5000E+01	0.00	0.000	0.000
	14:32.0	17.0	1.7000E+01	0.00	0.000	0.000
	14:34.0	19.0	1.9000E+01	0.00	0.000	0.000
	14:36.0	21.0	2.1000E+01	0.00	0.000	0.000
	14:38.0	23.0	2.3000E+01	0.00	0.000	0.000
	14:40.0	25.0	2.5000E+01	0.00	0.000	0.000
	14:42.0	27.0	2.7000E+01	0.00	0.000	0.000
	14:44.0	29.0	2.9000E+01	0.00	0.000	0.000
	14:46.0	31.0	7.4623E+00	0.00	0.000	0.000
	14:48.0	33.0	1.2208E+01	0.00	0.000	0.000
	14:50.0	35.0	1.5617E+01	0.00	0.000	0.000
	14:52.0	37.0	1.8549E+01	0.00	0.000	0.000
	14:54.0	39.0	2.1231E+01	0.00	0.000	0.000
	14:56.0	41.0	2.3758E+01	0.00	0.000	0.000
	14:58.0	43.0	2.6183E+01	0.00	0.000	0.000
	15: 0.0	45.0	2.8533E+01	-0.01	-0.000	-0.000
	15: 0.0	45.0	2.8533E+01	0.00	0.000	0.000
	15: 2.0	47.0	3.0828E+01	-0.10	-0.003	-0.003
	15: 4.0	49.0	3.3080E+01	0.00	0.000	0.000

TABLE C-11. (continued)

South Observation well step test --
 calculated adjusted time, Harrill's argument, drawdown, specific draw-
 down (s/q) and specific drawdown adjusted for Jacob's correction (s'/q)

DATE		ELAPSED	ADJUSTED**	HARRILLS*	DRAW-	S/Q	S'/Q#
OCT 81	HOUR	TIME(MIN)	TIME	ARGUMENT	DOWN(FT)	(FT/GPM)	
6	15: 6.0	51.0	3.5299E+01		0.00	0.000	0.000
	15: 8.0	53.0	3.7491E+01		0.00	0.000	0.000
	15:10.0	55.0	3.9660E+01		0.00	0.000	0.000
	15:12.0	57.0	4.1811E+01		0.00	0.000	0.000
	15:14.0	59.0	4.3947E+01		0.00	0.000	0.000
	15:16.0	61.0	2.4506E+01		0.00	0.000	0.000
	15:18.0	63.0	3.0490E+01		0.00	0.000	0.000
	15:20.0	65.0	3.4372E+01		0.00	0.000	0.000
	15:22.0	67.0	3.7591E+01		0.00	0.000	0.000
	15:24.0	69.0	4.0480E+01		0.00	0.000	0.000
	15:26.0	71.0	4.3171E+01		-0.10	-0.003	-0.003
	15:28.0	73.0	4.5731E+01		-0.10	-0.003	-0.003
	15:31.0	76.0	4.9404E+01		0.03	0.001	0.001
	15:31.0	76.0	4.9404E+01		-0.10	-0.003	-0.003
	15:32.0	77.0	5.0596E+01		-0.10	-0.003	-0.003
	15:34.0	79.0	5.2940E+01		-0.10	-0.003	-0.003
	15:36.0	81.0	5.5243E+01		-0.10	-0.003	-0.003
	15:38.0	83.0	5.7511E+01		-0.10	-0.003	-0.003
	15:40.0	85.0	5.9751E+01		-0.10	-0.003	-0.003
	15:42.0	87.0	6.1968E+01		-0.10	-0.003	-0.003
	15:44.0	89.0	6.4164E+01		-0.10	-0.003	-0.003
	15:46.0	91.0	3.7948E+01		-0.10	-0.002	-0.002
	15:48.0	93.0	4.5166E+01		-0.10	-0.002	-0.002
	15:50.0	95.0	4.9659E+01		0.00	0.000	0.000
	15:52.0	97.0	5.3295E+01		-0.10	-0.002	-0.002
	15:54.0	99.0	5.6504E+01		0.00	0.000	0.000
	15:56.0	101.0	5.9456E+01		-0.10	-0.002	-0.002
	15:58.0	103.0	6.2236E+01		0.00	0.000	0.000
	16: 0.0	105.0	6.4894E+01		-0.04	-0.001	-0.001
	16: 0.0	105.0	6.4894E+01		0.00	0.000	0.000
	16: 2.0	107.0	6.7460E+01		0.00	0.000	0.000
	16: 4.0	109.0	6.9954E+01		0.00	0.000	0.000
	16: 6.0	111.0	7.2392E+01		0.00	0.000	0.000
	16: 8.0	113.0	7.4783E+01		0.00	0.000	0.000
	16:10.0	115.0	7.7136E+01		0.00	0.000	0.000
	16:12.0	117.0	7.9457E+01		0.00	0.000	0.000
	16:14.0	119.0	8.1750E+01		0.00	0.000	0.000
	16:16.0	121.0	3.6428E+01		0.00	0.000	0.000
	16:18.0	123.0	4.5785E+01		0.00	0.000	0.000
	16:20.0	125.0	5.1471E+01		0.00	0.000	0.000
	16:22.0	127.0	5.5954E+01		0.00	0.000	0.000
	16:24.0	129.0	5.9821E+01		0.00	0.000	0.000
	16:26.0	131.0	6.3313E+01		0.00	0.000	0.000
	16:28.0	133.0	6.6550E+01		0.00	0.000	0.000
	16:30.0	135.0	6.9602E+01		0.00	0.000	0.000
	16:32.0	137.0	7.2516E+01		0.00	0.000	0.000
	16:34.0	139.0	7.5321E+01		0.00	0.000	0.000
	16:36.0	141.0	7.8038E+01		0.00	0.000	0.000
	16:38.0	143.0	8.0683E+01		0.00	0.000	0.000
	16:40.0	145.0	8.3268E+01		0.00	0.000	0.000
	16:42.0	147.0	8.5802E+01		0.00	0.000	0.000

TABLE C-11. (continued)

South Observation well step test --
 calculated adjusted time, Harrill's argument, drawdown, specific draw-
 down (s/a) and specific drawdown adjusted for Jacob's correction (s'/a)

DATE	ELAPSED	ADJUSTED**	HARRILLS*	DRAW-	S/Q	S'/Q#
OCT 81 HOUR	TIME(MIN)	TIME	ARGUMENT	DOWN(FT)	(FT/GPM)	
6	16:44.0	149.0	8.8293E+01	0.00	0.000	0.000
	16:46.0	151.0	9.0746E+01	0.00	0.000	
	16:48.0	153.0	3.1055E+01	-0.10	-0.002	
	16:50.0	155.0	1.9111E+01	-0.10	-0.002	
	16:52.0	157.0	1.3989E+01	-0.10	-0.002	
	16:54.0	159.0	1.1140E+01	-0.10	-0.002	
	16:57.0	162.0	8.6447E+00	-0.10	-0.002	
	16:58.0	163.0	8.0681E+00	-0.10	-0.002	
	17: 0.0	165.0	7.1447E+00	-0.05	-0.001	
	17: 0.0	165.0	7.1447E+00	-0.10	-0.002	
	17: 2.0	167.0	6.4377E+00	-0.10	-0.002	
	17: 4.0	169.0	5.8787E+00	-0.10	-0.002	
	17: 6.0	171.0	5.4256E+00	-0.10	-0.002	
	17: 8.0	173.0	5.0508E+00	-0.10	-0.002	
	17:10.0	175.0	4.7356E+00	-0.10	-0.002	
	17:12.0	177.0	4.4666E+00	-0.10	-0.002	
	17:14.0	179.0	4.2344E+00	-0.10	-0.002	
	17:16.0	181.0	4.0319E+00	-0.10	-0.002	
	17:22.0	187.0	3.5545E+00	-0.10	-0.002	
	17:26.0	191.0	3.3131E+00	-0.10	-0.002	
	17:34.0	199.0	2.9470E+00	-0.10	-0.002	
	17:36.0	201.0	2.8732E+00	-0.10	-0.002	
	17:41.0	206.0	2.7114E+00	-0.10	-0.002	
	17:46.0	211.0	2.5757E+00	-0.10	-0.002	
	17:54.0	219.0	2.3989E+00	-0.10	-0.002	
	18: 6.0	231.0	2.1982E+00	-0.10	-0.002	
	18:16.0	241.0	2.0707E+00	-0.10	-0.002	
	18:28.0	253.0	1.9498E+00	-0.10	-0.002	
	18:42.0	267.0	1.8396E+00	-0.10	-0.002	
	18:57.0	282.0	1.7470E+00	-0.10	-0.002	
	19:29.0	314.0	1.6051E+00	-0.10	-0.002	
	19:58.0	343.0	1.5164E+00	-0.10	-0.002	
	20:42.0	387.0	1.4227E+00	-0.20	-0.004	
	21:44.0	449.0	1.3368E+00	-0.20	-0.004	
	22:49.0	514.0	1.2777E+00	-0.10	-0.002	
7	0: 4.0	589.0	1.2310E+00	-0.10	-0.002	
	4:30.0	855.0	1.1448E+00	0.10	0.002	
	8:28.0	1093.0	1.1086E+00	0.30	0.006	
	10:41.0	1226.0	1.0953E+00	0.40	0.008	
	11:45.0	1290.0	1.0899E+00	0.40	0.008	

TABLE C-11. (continued)

*HARRILL, J. R., 1971, DETERMINING TRANSMISSIVITY FROM WATER-LEVEL RECOVERY OF A STEP-DRAWDOWN TEST; U. S. GEOL. SURV., PROF. PAPER 700-C, P. C212-213.

**ADJUSTED TIME, A GENERALIZED HARRILL'S ARGUMENT, BIRSOY, Y. K. & SUMMERS, W. K., 1980, DETERMINATION OF AQUIFER PARAMETERS FROM STEP TESTS AND INTERMITTENT PUMPING DATA; GROUND WATER, V18, #2 PP137-146.

#S' IS THE JACOB CORRECTION, $S' = S - S \cdot 2/20$.

THE DRAWDOWN S AT ELAPSED TIME T IS CALCULATED FROM THE EQUATION:

$$S = (\text{OBSERVED DEPTH TO WATER AT TIME T}) - (\text{TREND} + \text{INITIAL DEPTH TO WATER})$$

WHERE TREND = 0 * ELAPSED TIME.

THE LENGTH OF THE CONTRIBUTING INTERVAL OF THE WELL IS 71 FEET.

THE DEPTH FROM THE TOP OF CASING TO THE SCREEN IS 4 FEET.

APPENDIX D

48-HOUR PUMP TEST DATA
FROM WELL CAMPBELL ET AL. NO. 2 AND
NORTH AND SOUTH OBSERVATION WELLS

APPENDIX D

TABLE D-1. Campbell et al. #2 pump test -- metered discharge

DATE		ELAPSED	METER	TOTAL	RUNNING	INCREMENTAL		
OCT	HOUR	TIME	READING	DISCHARGE	AVERAGE	V	V/T	
1981	(MDT)	(T1, MIN)		(V, GAL)	(V/T1, GPM)	(GAL)	(MIN)	(GPM)
7	14:30.0	0.0	301800					
	14:30.5	0.5	301820	20	40.0	20	0.5	40.0
	14:31.0	1.0	301850	50	50.0	30	0.5	60.0
	14:31.5	1.5	301880	80	53.3	30	0.5	60.0
	14:32.0	2.0	301910	110	55.0	30	0.5	60.0
	14:33.0	3.0	301960	160	53.3	50	1.0	50.0
	14:34.0	4.0	302010	210	52.5	50	1.0	50.0
	14:35.0	5.0	302060	260	52.0	50	1.0	50.0
	14:36.0	6.0	302110	310	51.7	50	1.0	50.0
	14:38.0	8.0	302220	420	52.5	110	2.0	55.0
	14:40.0	10.0	302330	530	53.0	110	2.0	55.0
	14:51.0	21.0	302900	1100	52.4	570	11.0	51.8
	15: 0.0	30.0	303360	1560	52.0	460	9.0	51.1
	15:10.0	40.0	303880	2080	52.0	520	10.0	52.0
	15:40.0	70.0	305460	3660	52.3	1580	30.0	52.7
	15:50.0	80.0	305940	4140	51.8	480	10.0	48.0
	16: 0.0	90.0	306460	4660	51.8	520	10.0	52.0
	16:10.0	100.0	306960	5160	51.6	500	10.0	50.0
	16:30.0	120.0	307990	6190	51.6	1030	20.0	51.5
	16:50.0	140.0	309010	7210	51.5	1020	20.0	51.0
	17:10.0	160.0	310040	8240	51.5	1030	20.0	51.5
	17:30.0	180.0	311060	9260	51.4	1020	20.0	51.0
	17:50.0	200.0	312090	10290	51.5	1030	20.0	51.5
	18:10.0	220.0	313120	11320	51.5	1030	20.0	51.5
	18:30.0	240.0	314170	12370	51.5	1050	20.0	52.5
	18:50.0	260.0	315180	13380	51.5	1010	20.0	50.5

TABLE D-1. (continued)

Camebell et al. #2 pump test -- metered discharge

DATE	ELAPSED	METER	TOTAL	RUNNING	INCREMENTAL			
OCT 1981	TIME	READING	DISCHARGE	AVERAGE	V	V/T		
(HOUR)	(H, MIN)		(V, GAL)	(V/T1, GPM)	(GAL)	(MIN)	(GPM)	
7 19:15.0	285.0	316470	14670	51.5	1290	25.0	51.6	
19:30.0	300.0	317250	15450	51.5	780	15.0	52.0	
19:50.0	320.0	318290	16490	51.5	1040	20.0	52.0	
20:10.0	340.0	319330	17530	51.6	1040	20.0	52.0	
20:30.0	360.0	320370	18570	51.6	1040	20.0	52.0	
20:55.0	385.0	321660	19860	51.6	1290	25.0	51.6	
21:10.0	400.0	322440	20640	51.6	780	15.0	52.0	
21:30.0	420.0	323470	21670	51.6	1030	20.0	51.5	
21:50.0	440.0	324510	22710	51.6	1040	20.0	52.0	
22:10.0	460.0	325540	23740	51.6	1030	20.0	51.5	
22:30.0	480.0	326580	24780	51.6	1040	20.0	52.0	
22:50.0	500.0	327620	25820	51.6	1040	20.0	52.0	
23:10.0	520.0	328660	26860	51.7	1040	20.0	52.0	
23:30.0	540.0	329700	27900	51.7	1040	20.0	52.0	
8 0:10.0	580.0	331790	29990	51.7	2090	40.0	52.3	
0:30.0	600.0	332800	31000	51.7	1010	20.0	50.5	
0:50.0	620.0	333840	32040	51.7	1040	20.0	52.0	
1:10.0	640.0	334880	33080	51.7	1040	20.0	52.0	
1:30.0	660.0	335920	34120	51.7	1040	20.0	52.0	
1:50.0	680.0	336960	35160	51.7	1040	20.0	52.0	
2:10.0	700.0	338000	36200	51.7	1070	20.0	53.5	
2:30.0	720.0	339070	37270	51.8	1010	20.0	50.5	
2:50.0	740.0	340080	38280	51.7	1040	20.0	52.0	
3:10.0	760.0	341120	39320	51.7	1040	20.0	52.0	
3:30.0	780.0	342160	40360	51.7				

TABLE D-1. (continued)

Campbell et al. #2 pump test -- metered discharge

DATE		ELAPSED	METER	TOTAL	RUNNING	INCREMENTAL		
OCT	HOUR	TIME	READING	DISCHARGE	AVERAGE	U	U/T	
1981	(MDT)	(T1, MIN)		(U, GAL)	(U/T1, GPM)	(GAL)	(MIN)	(GPM)
	8	3:50.0	800.0	343190	41390	51.7	1030	20.0 51.5
		4:10.0	820.0	344230	42430	51.7	1040	20.0 52.0
		4:30.0	840.0	345270	43470	51.8	1040	20.0 52.0
		4:50.0	860.0	346310	44510	51.8	1040	20.0 52.0
		5:10.0	880.0	347340	45540	51.8	1030	20.0 51.5
		5:30.0	900.0	348380	46580	51.8	1040	20.0 52.0
		5:50.0	920.0	349440	47640	51.8	1060	20.0 53.0
		6:10.0	940.0	350510	48710	51.8	1070	20.0 53.5
		6:20.0	950.0	350990	49190	51.8	480	10.0 48.0
		6:32.0	962.0	351610	49810	51.8	620	12.0 51.7
		6:40.0	970.0	352020	50220	51.8	410	8.0 51.3
		6:50.0	980.0	352540	50740	51.8	520	10.0 52.0
		7: 4.0	994.0	353260	51460	51.8	720	14.0 51.4
		7:15.0	1005.0	353830	52030	51.8	570	11.0 51.8
		7:20.0	1010.0	354090	52290	51.8	260	5.0 52.0
		7:30.0	1020.0	354610	52810	51.8	520	10.0 52.0
		7:34.0	1024.0	354810	53010	51.8	200	4.0 50.0
		7:44.0	1034.0	355330	53530	51.8	520	10.0 52.0
		7:54.0	1044.0	355850	54050	51.8	520	10.0 52.0
		8: 4.0	1054.0	356370	54570	51.8	520	10.0 52.0
		8:20.0	1070.0	357200	55400	51.8	830	16.0 51.9
		8:40.0	1090.0	358230	56430	51.8	1030	20.0 51.5
		8:41.0	1091.0	358280	56480	51.8	50	1.0 50.0
		9: 3.0	1113.0	359420	57620	51.8	1140	22.0 51.8
		9:20.0	1130.0	360300	58500	51.8	880	17.0 51.8

TABLE D-1. (continued)

Campbell et al. #2 PUMP test -- metered discharge

-----DATE-----		ELAPSED	METER	TOTAL	RUNNING	-----INCREMENTAL-----		
OCT	HOUR	TIME	READING	DISCHARGE	AVERAGE	U	U/T	
1981	(MDT)	(T1, MIN)		(V, GAL)	(V/T1, GPM)	(GAL)	(MIN)	(GPM)
	8	9:40.0	1150.0	361340	59540	51.8	1040	20.0
							1090	21.0
	10:	1.0	1171.0	362430	60630	51.8	980	19.0
								51.6
	10:	20.0	1190.0	363410	61610	51.8	1030	20.0
								51.5
	10:	40.0	1210.0	364440	62640	51.8	1090	21.0
								51.9
	11:	1.0	1231.0	365530	63730	51.8	980	19.0
								51.6
	11:	20.0	1250.0	366510	64710	51.8	1040	20.0
								52.0
	11:	40.0	1270.0	367550	65750	51.8	1080	21.0
								51.4
	12:	1.0	1291.0	368630	66830	51.8	990	19.0
								52.1
	12:	20.0	1310.0	369620	67820	51.8	1030	20.0
								51.5
	12:	40.0	1330.0	370650	68850	51.8	1140	22.0
								51.8
	13:	2.0	1352.0	371790	69990	51.8	930	18.0
								51.7
	13:	20.0	1370.0	372720	70920	51.8	1190	23.0
								51.7
	13:	43.0	1393.0	373910	72110	51.8	1020	20.0
								51.0
	14:	3.0	1413.0	374930	73130	51.8	890	17.0
								52.4
	14:	20.0	1430.0	375820	74020	51.8	1020	20.0
								51.0
	14:	40.0	1450.0	376840	75040	51.8	1030	20.0
								51.5
	15:	0.0	1470.0	377870	76070	51.7	1040	20.0
								52.0
	15:	20.0	1490.0	378910	77110	51.8	1040	20.0
								52.0
	15:	40.0	1510.0	379950	78150	51.8	1030	20.0
								51.5
	16:	0.0	1530.0	380980	79180	51.8	1040	20.0
								52.0
	16:	20.0	1550.0	382020	80220	51.8	1030	20.0
								51.5
	16:	40.0	1570.0	383050	81250	51.8	1040	20.0
								52.0
	17:	0.0	1590.0	384090	82290	51.8	1020	20.0
								51.0
	17:	20.0	1610.0	385110	83310	51.7	1050	20.0
								52.5
	17:	40.0	1630.0	386160	84360	51.8		

TABLE D-1. (continued)

Campbell et al. #2 pump test -- metered discharge

DATE		ELAPSED	METER	TOTAL	RUNNING	INCREMENTAL		
OCT	HOUR	TIME	READING	DISCHARGE	AVERAGE	V	V/T	
1981	(MDT)	(T1, MIN)		(V, GAL)	(V/T1, GPM)	(GAL)	(MIN)	(GPM)
	8 18: 0.0	1650.0	387200	85400	51.8	1040	20.0	52.0
	18:20.0	1670.0	388240	86440	51.8	1040	20.0	52.0
	18:40.0	1690.0	389280	87480	51.8	1040	20.0	52.0
	19: 0.0	1710.0	390830	89030	52.1	1550	20.0	77.5
	19:24.0	1734.0	391550	89750	51.8	720	24.0	30.0
	19:40.0	1750.0	392380	90580	51.8	830	16.0	51.9
	20: 0.0	1770.0	393420	91620	51.8	1040	20.0	52.0
	20:20.0	1790.0	394450	92650	51.8	1030	20.0	51.5
	20:40.0	1810.0	395490	93690	51.8	1040	20.0	52.0
	21: 0.0	1830.0	396540	94740	51.8	1050	20.0	52.5
	21:20.0	1850.0	397550	95750	51.8	1010	20.0	50.5
	21:40.0	1870.0	398570	96770	51.7	1020	20.0	51.0
	22: 1.0	1891.0	399670	97870	51.8	1100	21.0	52.4
	22:30.0	1920.0	401160	99360	51.8	1490	29.0	51.4
	23: 0.0	1950.0	402720	100920	51.8	1560	30.0	52.0
	23:30.0	1980.0	404270	102470	51.8	1550	30.0	51.7
	9 0: 0.0	2010.0	405820	104020	51.8	1550	30.0	51.7
	0:37.0	2047.0	407750	105950	51.8	1930	37.0	52.2
	1: 0.0	2070.0	408940	107140	51.8	1190	23.0	51.7
	1:30.0	2100.0	410480	108680	51.8	1540	30.0	51.3
	2: 0.0	2130.0	412020	110220	51.7	1540	30.0	51.3
	2:30.0	2160.0	413570	111770	51.7	1550	30.0	51.7
	3: 0.0	2190.0	415110	113310	51.7	1540	30.0	51.3
	3:30.0	2220.0	416650	114850	51.7	1540	30.0	51.3
	4: 0.0	2250.0	418190	116390	51.7	1540	30.0	51.3

TABLE D-1. (continued)

Campbell et al. #2 pump test -- metered discharge

DATE		ELAPSED	METER	TOTAL	RUNNING	INCREMENTAL		
OCT 1981	HOUR (MDT)	TIME (T1, MIN)	READING	DISCHARGE (V, GAL)	AVERAGE (V/T1, GPM)	V (GAL)	(MIN)	V/T (GPM)
	4:30.0	2280.0	419730	117930	51.7	1540	30.0	51.3
	5: 0.0	2310.0	421270	119470	51.7	1540	30.0	51.3
	5:30.0	2340.0	422810	121010	51.7	1540	30.0	51.3
	6: 0.0	2370.0	424360	122560	51.7	1550	30.0	51.7
	6:30.0	2400.0	425890	124090	51.7	1530	30.0	51.0
	7: 0.0	2430.0	427430	125630	51.7	1540	30.0	51.3
	7:30.0	2460.0	429000	127200	51.7	1570	30.0	52.3
	8: 0.0	2490.0	430520	128720	51.7	1520	30.0	50.7
	8:30.0	2520.0	432050	130250	51.7	1530	30.0	51.0
	8:40.0	2530.0	432560	130760	51.7	510	10.0	51.0
	9: 0.0	2550.0	433620	131820	51.7	1060	20.0	53.0
	9:30.0	2580.0	435110	133310	51.7	1490	30.0	49.7
	10: 0.0	2610.0	436620	134820	51.7	1510	30.0	50.3
	10: 5.0	2615.0	436870	135070	51.7	250	5.0	50.0
	10:30.0	2640.0	438150	136350	51.6	1280	25.0	51.2
	11: 0.0	2670.0	439700	137900	51.6	1550	30.0	51.7
	11:30.0	2700.0	441200	139400	51.6	1500	30.0	50.0
	12: 0.0	2730.0	442730	140930	51.6	1530	30.0	51.0
	12:30.0	2760.0	444250	142450	51.6	1520	30.0	50.7
	13: 0.0	2790.0	445770	143970	51.6	1520	30.0	50.7
	13:45.0	2835.0	448050	146250	51.6	2280	45.0	50.7
	14: 0.0	2850.0	448800	147000	51.6	750	15.0	50.0
	14: 6.0	2856.0	449110	147310	51.6	310	6.0	51.7
	14: 7.0	2857.0	449160	147360	51.6	50	1.0	50.0
	14: 8.0	2858.0	449210	147410	51.6	50	1.0	50.0

TABLE D-1. (continued)

Campbell et al. #2 pump test -- metered discharge

---DATE---		ELAPSED	METER	TOTAL	RUNNING	---INCREMENTAL---		
OCT	HOUR	TIME	READING	DISCHARGE	AVERAGE	V	V/T	
1981	(MDT)	(T1, MIN)		(V, GAL)	(V/T1, GPM)	(GAL)	(MIN)	(GPM)
						340	7.0	48.6
9	14:15.0	2865.0	449550	147750	51.6	370	7.0	52.9
	14:22.0	2872.0	449920	148120	51.6	160	3.0	53.3
	14:25.0	2875.0	450080	148280	51.6	230	5.3	43.4
	14:30.3	2880.3	450310	148510	51.6			
HE AVERAGE DISCHARGE IS			51.6 GPM					

APPENDIX D

TABLE D-2. Campbell et al. #2 pump test -- water level data

DATE	ELAPSED TIME	WATER LEVEL	TYPE OF*	
OCT 81	HOUR	(MINUTES)	READING	READING
				REMARKS
7	12: 2.0	-148.0	89.90	TRANS
	12: 5.0	-145.0	78.10	STEEL
	12: 5.0	-145.0	89.00	TRANS
	12:17.0	-133.0	79.92	STEEL
	12:17.0	-133.0	88.00	TRANS
	12:21.0	-129.0	78.13	STEEL
	12:21.0	-129.0	88.00	TRANS
	14: 3.0	-27.0	77.97	STEEL
	14: 3.0	-27.0	88.10	TRANS
	14:13.0	-17.0	77.96	STEEL
	14:13.0	-17.0	88.10	TRANS
	14:26.0	-4.0	77.95	STEEL
	14:26.0	-4.0	88.10	TRANS
	14:28.0	-2.0	77.97	STEEL
	14:28.0	-2.0	88.10	TRANS
	14:30.0	0.0	88.10	TRANS
	14:30.3	0.3	79.30	TRANS
	14:30.5	0.5	74.50	TRANS
	14:30.8	0.8	72.00	TRANS
	14:31.0	1.0	70.50	TRANS
	14:31.3	1.3	69.60	TRANS
	14:31.5	1.5	69.10	TRANS
	14:31.8	1.8	68.80	TRANS
	14:32.0	2.0	68.60	TRANS
	14:32.3	2.3	68.50	TRANS
	14:32.5	2.5	68.50	TRANS
	14:32.8	2.8	68.40	TRANS
	14:33.0	3.0	68.40	TRANS
	14:33.5	3.5	68.40	TRANS
	14:34.0	4.0	68.30	TRANS
	14:34.5	4.5	68.30	TRANS
	14:35.0	5.0	68.30	TRANS
	14:35.5	5.5	68.30	TRANS
	14:36.0	6.0	68.20	TRANS
	14:36.5	6.5	68.20	TRANS
	14:37.0	7.0	68.20	TRANS
	14:37.5	7.5	68.10	TRANS
	14:38.0	8.0	68.10	TRANS
	14:38.5	8.5	69.00	TRANS
	14:39.0	9.0	68.00	TRANS
	14:39.5	9.5	68.00	TRANS
	14:40.0	10.0	68.00	TRANS
	14:41.0	11.0	69.40	TRANS
	14:42.0	12.0	68.20	TRANS
	14:43.0	13.0	67.80	TRANS
	14:44.0	14.0	67.70	TRANS
	14:45.0	15.0	67.70	TRANS
	14:46.0	16.0	67.70	TRANS
	14:47.0	17.0	67.60	TRANS
	14:48.0	18.0	67.60	TRANS
	14:49.0	19.0	67.50	TRANS

SLIGHTLY SMEARED

PUMP TURNED ON

DRAIN COCK OPEN-CLOSE

TEMP 141.5 F

TABLE D-2. (continued)

Campbell et al. #2 pump test -- water level data

OCT 81	DATE	ELAPSED TIME	WATER LEVEL	TYPE OF*	REMARKS
	HOUR	(MINUTES)	READING#	READING	
7	14:50.0	20.0	67.50	TRANS	
	14:52.0	22.0	67.50	TRANS	TEMP 142 F
	14:53.0	23.0	67.40	TRANS	
	14:54.0	24.0	67.40	TRANS	
	14:55.0	25.0	67.40	TRANS	
	14:56.0	26.0	67.40	TRANS	
	14:57.0	27.0	67.40	TRANS	
	14:58.0	28.0	67.30	TRANS	
	14:59.0	29.0	67.30	TRANS	
	15: 0.0	30.0	67.30	TRANS	TEMP 143 F
	15: 2.0	32.0	67.30	TRANS	
	15: 4.0	34.0	67.30	TRANS	
	15: 6.0	36.0	99.28	STEEL	
	15: 6.0	36.0	67.30	TRANS	
	15: 8.0	38.0	67.20	TRANS	
	15:10.0	40.0	67.20	TRANS	
	15:12.5	42.5	67.20	TRANS	
	15:16.0	46.0	67.20	TRANS	
	15:20.0	50.0	67.20	TRANS	
	15:24.0	54.0	67.20	TRANS	
	15:28.0	58.0	67.10	TRANS	
	15:32.0	62.0	67.10	TRANS	
	15:36.0	66.0	67.00	TRANS	
	15:40.0	70.0	67.20	TRANS	TEMP 143.5 F
	15:45.0	75.0	67.10	TRANS	
	15:55.0	85.0	67.10	TRANS	
	16: 0.0	90.0	67.20	TRANS	
	16: 5.0	95.0	98.48	STEEL	
	16: 5.0	95.0	67.10	TRANS	
	16:10.0	100.0	67.20	TRANS	
	16:15.0	105.0	67.10	TRANS	
	16:20.0	110.0	66.90	TRANS	
	16:25.0	115.0	66.80	TRANS	
	16:30.0	120.0	66.80	TRANS	
	16:40.0	130.0	66.80	TRANS	
	16:30.0	140.0	66.80	TRANS	
	17: 0.0	150.0	98.77	STEEL	
	17: 0.0	150.0	66.70	TRANS	
	17:10.0	160.0	66.70	TRANS	
	17:20.0	170.0	66.60	TRANS	
	17:30.0	180.0	66.60	TRANS	
	17:40.0	190.0	66.60	TRANS	
	17:50.0	200.0	66.60	TRANS	
	18: 0.0	210.0	98.85	STEEL	
	18: 0.0	210.0	66.60	TRANS	
	18:10.0	220.0	66.50	TRANS	
	18:20.0	230.0	66.50	TRANS	
	18:30.0	240.0	66.50	TRANS	
	18:40.0	250.0	66.50	TRANS	
	18:50.0	260.0	66.40	TRANS	
	19: 0.0	270.0	66.40	TRANS	

TABLE D-2. (continued)

Campbell et al. #2 pump test -- water level data

DATE	ELAPSED TIME	WATER LEVEL	TYPE OF*	REMARKS
OCT 81	HOURS(MINUTES)	READING#	READING	
7	19:20:00	290.0	66.40	TRANS
	19:40.0	310.0	66.40	TRANS
	20:00:00	330.0	66.30	TRANS
	20:06.0	336.0	100.85	STEEL
	20:20.0	350.0	66.30	TRANS
	20:40.0	370.0	66.30	TRANS
	21:00.0	390.0	98.94	STEEL
	21:00.0	390.0	66.30	TRANS
	21:20.0	410.0	66.20	TRANS
	21:40.0	430.0	66.20	TRANS
	22:00:00	450.0	66.10	TRANS
	22:05.0	455.0	101.45	STEEL
	22:15.0	465.0	98.69	STEEL
	22:20.0	470.0	66.10	TRANS
	22:40.0	490.0	66.00	TRANS
	23:00.0	510.0	66.00	TRANS
	23:03.0	513.0	101.14	STEEL
	23:13.0	523.0	99.20	STEEL
	23:20.0	530.0	66.00	TRANS
	23:30.0	540.0	65.90	TRANS
	23:40.0	550.0	65.90	TRANS
8	00:00:00	570.0	65.90	TRANS
	00:02.0	572.0	101.17	STEEL
	00:12.0	582.0	101.06	STEEL
	00:22.0	592.0	65.80	TRANS
	00:40.0	610.0	65.80	TRANS
	01:00.0	630.0	65.80	TRANS
	01:02.0	632.0	99.70	STEEL
	01:13.0	643.0	98.63	STEEL
	01:20.0	650.0	65.70	TRANS
	01:40.0	670.0	65.70	TRANS
	02:00.0	690.0	65.70	TRANS
	02:02.0	692.0	100.31	STEEL
	02:06.0	696.0	98.50	STEEL
	02:30.0	720.0	65.60	TRANS
	03:00.0	750.0	65.60	TRANS
	03:02.0	752.0	100.93	STEEL
	03:30.0	780.0	65.50	TRANS
	04:00.0	810.0	65.50	TRANS
	04:02.0	812.0	101.33	STEEL
	04:06.0	816.0	99.39	STEEL
	04:30.0	840.0	65.40	TRANS
	05:00.0	870.0	65.30	TRANS
	05:30.0	900.0	65.30	TRANS
	05:32.0	902.0	101.55	STEEL
	05:43.0	913.0	101.17	STEEL
	05:48.0	918.0	99.94	STEEL
	05:56.0	926.0	100.84	STEEL
	06:00.0	930.0	65.20	TRANS
	06:30.0	960.0	101.19	STEEL
	06:30.0	960.0	65.20	TRANS

TABLE D-2. (continued)

Campbell et al. #2 pump test -- water level data

=====					
DATE	ELAPSED TIME	WATER LEVEL	TYPE OF*		
OCT 81	HOUR	(MINUTES)	READING#	READING	REMARKS

8	7: 0.0	990.0	99.04	STEEL	BADLY SMEARED
	7: 0.0	990.0	65.10	TRANS	
	7:10.0	1000.0	99.42	STEEL	SMEARED; SAMPLE @0711
	7:30.0	1020.0	65.00	TRANS	
	8: 0.0	1050.0	99.45	STEEL	SLIGHTLY SMEARED
	8: 0.0	1050.0	65.10	TRANS	
	8:30.0	1080.0	65.00	TRANS	
	9: 0.0	1110.0	100.41	STEEL	HUNG - BADLY SMEARED
	9: 0.0	1110.0	64.90	TRANS	
	9:30.0	1140.0	64.90	TRANS	
	9:58.0	1168.0	100.85	STEEL	SMEARED
	10: 0.0	1170.0	64.80	TRANS	
	10: 5.0	1175.0	101.35	STEEL	BADLY SMEARED; HUNG?
	10:30.0	1200.0	64.80	TRANS	
	10:59.0	1229.0	101.11	STEEL	BADLY SMEARED
	11: 0.0	1230.0	64.80	TRANS	
	11: 4.0	1234.0	100.13	STEEL	DECENT MARK
	11:30.0	1260.0	64.70	TRANS	
	11:59.0	1289.0	100.20	STEEL	BADLY SMEARED
	11:59.0	1289.0	64.70	TRANS	
	12:30.0	1320.0	64.70	TRANS	
	13: 0.0	1350.0	100.49	STEEL	BADLY SMEARED
	13: 0.0	1350.0	64.60	TRANS	
	14: 0.0	1410.0	64.60	TRANS	
	14:55.0	1465.0	99.35	STEEL	GOOD MARK
	15: 0.0	1470.0	64.50	TRANS	
	16: 0.0	1530.0	64.30	TRANS	
	16:56.0	1586.0	99.42	STEEL	SMEARED
	17: 0.0	1590.0	64.20	TRANS	
	18: 0.0	1650.0	64.00	TRANS	
	18:47.0	1697.0	100.12	STEEL	GOOD ON BACK
	19: 0.0	1710.0	63.80	TRANS	
	20: 0.0	1770.0	63.70	TRANS	
	21: 0.0	1830.0	99.55	STEEL	SMEARED
	21: 0.0	1830.0	63.60	TRANS	
	21: 7.0	1837.0	100.24	STEEL	GOOD MEASUREMENT
	22: 0.0	1890.0	63.40	TRANS	
	22:11.0	1901.0	100.61	STEEL	SMEARED
	23: 0.0	1950.0	63.20	TRANS	
	23:13.0	1963.0	98.37	STEEL	SMEARED
	23:19.0	1969.0	100.53	STEEL	SMEARED
	23:24.0	1974.0	100.55	STEEL	GOOD MEASUREMENT
9	0: 0.0	2010.0	63.00	TRANS	
	0:14.0	2024.0	101.00	STEEL	FRONT SMEARED GOOD ON
	1: 0.0	2070.0	62.00	TRANS	
	1: 8.0	2078.0	98.53	STEEL	GOOD MEASUREMENT
	1:12.0	2082.0	98.46	STEEL	GOOD MEASUREMENT
	2: 0.0	2130.0	61.60	TRANS	
	2: 8.0	2138.0	100.42	STEEL	FRONT SMEARED GOOD ON
	2:13.0	2143.0	100.57	STEEL	GOOD MEASUREMENT
	3: 0.0	2190.0	61.60	TRANS	

TABLE D-2. (continued)

Campbell et al. #2 PUMP test -- water level data

DATE		ELAPSED TIME	WATER LEVEL	TYPE OF*	REMARKS
OCT 81	HOUR	(MINUTES)	READING#	READING	
9	3: 2.0	2192.0	100.22	STEEL	GOOD MEASUREMENT
	3: 5.0	2195.0	100.45	STEEL	GOOD FRONT AND BACK
	4: 0.0	2250.0	61.60	TRANS	
	4: 2.0	2252.0	100.09	STEEL	
	5: 0.0	2310.0	61.50	TRANS	
	5: 2.0	2312.0	99.62	STEEL	GOOD MARK ON BACK
	5: 7.0	2317.0	100.28	STEEL	GOOD MARK ON FRONT
	5:11.0	2321.0	99.87	STEEL	SMEARED
	6: 0.0	2370.0	61.70	TRANS	
	6: 2.0	2372.0	100.13	STEEL	SLIGHTLY SMEARED
	6: 6.0	2376.0	100.12	STEEL	
	6:46.0	2416.0	101.22	STEEL	BADLY SMEARED
	6:50.0	2420.0	101.37	STEEL	SMEARED MARK ON BACK
	7: 0.0	2430.0	100.47	STEEL	BADLY SMEARED; MARK O
	7: 0.0	2430.0	61.60	TRANS	
	7: 6.0	2436.0	101.00	STEEL	BADLY SMEARED; MARK O
	7:29.0	2459.0	101.70	STEEL	SMEARED
	7:34.0	2464.0	99.53	STEEL	SMEARED
	7:39.0	2469.0	99.98	STEEL	BADLY SMEARED
	7:59.0	2489.0	99.91	STEEL	SMEARED
	7:59.0	2489.0	61.70	TRANS	
	8:35.0	2525.0	101.42	STEEL	SMEARED
	8:45.0	2535.0	99.45	STEEL	SMEARED
	8:50.0	2540.0	99.43	STEEL	SMEARED
	8:59.0	2549.0	100.53	STEEL	SMEARED
	8:59.0	2549.0	61.90	TRANS	
	9:15.0	2565.0	100.36	STEEL	BADLY SMEARED
	9:29.0	2579.0	99.80	STEEL	SMEARED
	9:45.0	2595.0	99.21	STEEL	BADLY SMEARED
	10: 0.0	2610.0	99.13	STEEL	SMEARED
	10: 0.0	2610.0	62.30	TRANS	
	10:15.0	2625.0	102.25	STEEL	BADLY SMEARED
	10:18.0	2628.0	101.52	STEEL	BADLY SMEARED
	10:22.0	2632.0	101.98	STEEL	BADLY SMEARED; HUNG?
	10:29.0	2639.0	101.77	STEEL	SMEARED
	10:59.0	2669.0	101.11	STEEL	BADLY SMEARED
	10:59.0	2669.0	61.90	TRANS	
	11:28.0	2698.0	100.61	STEEL	BADLY SMEARED
	12: 0.0	2730.0	99.06	STEEL	BADLY SMEARED
	12: 0.0	2730.0	62.30	TRANS	
	12: 6.0	2736.0	100.01	STEEL	BADLY SMEARED
	12:30.0	2760.0	99.27	STEEL	BADLY SMEARED
	12:59.0	2789.0	101.09	STEEL	
	12:59.0	2789.0	62.20	TRANS	
	13:30.0	2820.0	100.29	STEEL	BADLY SMEARED
	14: 0.0	2850.0	62.50	TRANS	
	14:23.0	2873.0	99.58	STEEL	MARK ON BACK
	14:30.0	2880.0	62.50	TRANS	PUMP OFF
	14:30.3	2880.3	71.30	TRANS	OTHER PUMP OFF
	14:30.5	2880.5	79.20	TRANS	
	14:30.8	2880.8	80.50	TRANS	

TABLE D-2. (continued)

Campbell et al. #2 pump test -- water level data

DATE		ELAPSED TIME	WATER LEVEL	TYPE OF*	REMARKS
OCT 81	HOUR	(MINUTES)	READING#	READING	
9	14:31.0	2881.0	81.00	TRANS	
	14:31.3	2881.3	81.20	TRANS	
	14:31.5	2881.5	81.20	TRANS	
	14:32.0	2882.0	81.30	TRANS	
	14:33.0	2883.0	81.30	TRANS	
	14:34.0	2884.0	81.40	TRANS	
	14:35.0	2885.0	81.40	TRANS	
	14:37.0	2887.0	79.99	STEEL	
	14:37.0	2887.0	81.40	TRANS	
	14:39.0	2889.0	81.50	TRANS	
	14:42.0	2892.0	81.60	TRANS	
	14:45.0	2895.0	81.70	TRANS	
	14:50.0	2900.0	81.90	TRANS	
	14:54.0	2904.0	82.00	TRANS	
	14:58.0	2908.0	82.10	TRANS	
	15: 2.0	2912.0	81.00	STEEL	SMEARED
	15: 2.0	2912.0	82.20	TRANS	
	15: 6.0	2916.0	82.30	TRANS	
	15:10.0	2920.0	82.30	TRANS	
	15:15.0	2925.0	82.40	TRANS	
	15:20.0	2930.0	82.50	TRANS	
	15:25.0	2935.0	82.50	TRANS	
	15:30.0	2940.0	82.60	TRANS	
	15:40.0	2950.0	82.70	TRANS	
	15:50.0	2960.0	82.70	TRANS	
	16: 0.0	2970.0	82.80	TRANS	
	16:10.0	2980.0	82.80	TRANS	
	16:20.0	2990.0	82.90	TRANS	
	16:30.0	3000.0	82.90	TRANS	
	16:40.0	3010.0	82.90	TRANS	
	17: 0.0	3030.0	83.00	TRANS	
	17:20.0	3050.0	83.00	TRANS	
	17:40.0	3070.0	83.10	TRANS	
	18: 0.0	3090.0	79.37	STEEL	TAPE HUNG?
	18: 0.0	3090.0	83.10	TRANS	
	18: 4.0	3094.0	78.50	STEEL	GOOD MEASUREMENT
	18:20.0	3110.0	83.20	TRANS	
	18:40.0	3130.0	83.20	TRANS	
	18:55.0	3145.0	78.40	STEEL	
	19: 0.0	3150.0	83.20	TRANS	
	19:30.0	3180.0	83.10	TRANS	
	20: 0.0	3210.0	83.20	TRANS	
	20:30.0	3240.0	83.30	TRANS	
	21: 0.0	3270.0	83.20	TRANS	
	21:30.0	3300.0	83.20	TRANS	
	22: 0.0	3330.0	83.30	TRANS	
	22: 8.0	3338.0	78.47	STEEL	
	22:31.0	3361.0	83.30	TRANS	
	22:58.0	3388.0	83.30	TRANS	
	23:31.0	3421.0	83.30	TRANS	
	23:59.0	3449.0	83.30	TRANS	

TABLE D-2. (continued)

Campbell et al. #2 pump test -- water level data

DATE		ELAPSED TIME	WATER LEVEL	TYPE OF*	
OCT 81	HOUR	(MINUTES)	READING#	READING	REMARKS
10	0:59.0	3509.0	83.40	TRANS	
	1:57.0	3567.0	78.44	STEEL	
	1:57.0	3567.0	83.40	TRANS	
	3: 0.0	3630.0	83.40	TRANS	
	4: 0.0	3690.0	83.50	TRANS	
	5: 0.0	3750.0	83.60	TRANS	
	6: 0.0	3810.0	83.60	TRANS	
	8: 0.0	3930.0	83.60	TRANS	
	9:52.0	4042.0	79.62	STEEL	TAPE HUNG?
	9:56.0	4046.0	78.66	STEEL	GOOD ON BACK
	9:56.0	4046.0	83.70	TRANS	
	11:49.0	4159.0	78.47	STEEL	GOOD MEASUREMENT
	11:49.0	4159.0	83.80	TRANS	
	16: 0.0	4410.0	78.17	STEEL	GOOD MEASUREMENT
	16: 0.0	4410.0	84.00	TRANS	
	20: 6.0	4656.0	78.22	STEEL	SMEARED
	20: 6.0	4656.0	84.00	TRANS	
	11	0: 0.0	4890.0	78.30	STEEL
0: 0.0		4890.0	84.00	TRANS	
4: 7.0		5137.0	78.08	STEEL	
4: 7.0		5137.0	84.20	TRANS	
8: 3.0		5373.0	78.15	STEEL	SMEARED
8: 3.0		5373.0	84.00	TRANS	
12: 0.0		5610.0	78.22	STEEL	
12: 0.0		5610.0	83.60	TRANS	
16: 6.0		5856.0	78.03	STEEL	
16: 6.0		5856.0	83.70	TRANS	
20: 0.0		6090.0	78.10	STEEL	SMEARED
20: 0.0		6090.0	83.40	TRANS	
12	0: 6.0	6336.0	78.20	STEEL	GOOD MEASUREMENT
	0: 6.0	6336.0	82.10	TRANS	
	2:30.0	6480.0	78.17	STEEL	
	2:30.0	6480.0	81.40	TRANS	

*THE TYPE OF READING DENOTES THE TYPE OF DEPTH TO WATER MEASUREMENT MADE. THESE MAY BE ANY OF THE FOLLOWING:

TRANS= MEASUREMENT MADE BY A TRANSDUCER IN THE WELL.
THE MEASUREMENT IS THE HEIGHT OF THE WATER COLUMN ABOVE THE SENSOR.

STEEL= MEASUREMENT MADE BY A STEEL TAPE.

AIR= MEASUREMENT MADE BY AN AIRLINE.

AIRTRAN=MEASUREMENT MADE BY AN AIRLINE COUPLED WITH A TRANSDUCER.

ELECT= MEASUREMENT MADE BY AN ELECTRIC TAPE.

ABSOL= ALL MEASUREMENTS HAVE BEEN CHANGED TO ABSOLUTE DEPTH-TO-WATER MEASUREMENTS.

#THE WATER LEVEL READING IS THE INSTRUMENT READING

TABLE D-2. (continued)

(continued) L-150847

MADE TO FIND THE DEPTH TO WATER.

ELAPSED TIME IS TAKEN FROM TO AT 1430 ON 7 - OCT - 81

1000	00.00	00.00	00.00
1001	00.01	00.01	00.01
1002	00.02	00.02	00.02
1003	00.03	00.03	00.03
1004	00.04	00.04	00.04
1005	00.05	00.05	00.05
1006	00.06	00.06	00.06
1007	00.07	00.07	00.07
1008	00.08	00.08	00.08
1009	00.09	00.09	00.09
1010	00.10	00.10	00.10
1011	00.11	00.11	00.11
1012	00.12	00.12	00.12
1013	00.13	00.13	00.13
1014	00.14	00.14	00.14
1015	00.15	00.15	00.15
1016	00.16	00.16	00.16
1017	00.17	00.17	00.17
1018	00.18	00.18	00.18
1019	00.19	00.19	00.19
1020	00.20	00.20	00.20
1021	00.21	00.21	00.21
1022	00.22	00.22	00.22
1023	00.23	00.23	00.23
1024	00.24	00.24	00.24
1025	00.25	00.25	00.25
1026	00.26	00.26	00.26
1027	00.27	00.27	00.27
1028	00.28	00.28	00.28
1029	00.29	00.29	00.29
1030	00.30	00.30	00.30
1031	00.31	00.31	00.31
1032	00.32	00.32	00.32
1033	00.33	00.33	00.33
1034	00.34	00.34	00.34
1035	00.35	00.35	00.35
1036	00.36	00.36	00.36
1037	00.37	00.37	00.37
1038	00.38	00.38	00.38
1039	00.39	00.39	00.39
1040	00.40	00.40	00.40
1041	00.41	00.41	00.41
1042	00.42	00.42	00.42
1043	00.43	00.43	00.43
1044	00.44	00.44	00.44
1045	00.45	00.45	00.45
1046	00.46	00.46	00.46
1047	00.47	00.47	00.47
1048	00.48	00.48	00.48
1049	00.49	00.49	00.49
1050	00.50	00.50	00.50
1051	00.51	00.51	00.51
1052	00.52	00.52	00.52
1053	00.53	00.53	00.53
1054	00.54	00.54	00.54
1055	00.55	00.55	00.55
1056	00.56	00.56	00.56
1057	00.57	00.57	00.57
1058	00.58	00.58	00.58
1059	00.59	00.59	00.59
1060	00.60	00.60	00.60
1061	00.61	00.61	00.61
1062	00.62	00.62	00.62
1063	00.63	00.63	00.63
1064	00.64	00.64	00.64
1065	00.65	00.65	00.65
1066	00.66	00.66	00.66
1067	00.67	00.67	00.67
1068	00.68	00.68	00.68
1069	00.69	00.69	00.69
1070	00.70	00.70	00.70
1071	00.71	00.71	00.71
1072	00.72	00.72	00.72
1073	00.73	00.73	00.73
1074	00.74	00.74	00.74
1075	00.75	00.75	00.75
1076	00.76	00.76	00.76
1077	00.77	00.77	00.77
1078	00.78	00.78	00.78
1079	00.79	00.79	00.79
1080	00.80	00.80	00.80
1081	00.81	00.81	00.81
1082	00.82	00.82	00.82
1083	00.83	00.83	00.83
1084	00.84	00.84	00.84
1085	00.85	00.85	00.85
1086	00.86	00.86	00.86
1087	00.87	00.87	00.87
1088	00.88	00.88	00.88
1089	00.89	00.89	00.89
1090	00.90	00.90	00.90
1091	00.91	00.91	00.91
1092	00.92	00.92	00.92
1093	00.93	00.93	00.93
1094	00.94	00.94	00.94
1095	00.95	00.95	00.95
1096	00.96	00.96	00.96
1097	00.97	00.97	00.97
1098	00.98	00.98	00.98
1099	00.99	00.99	00.99
1100	01.00	01.00	01.00

APPENDIX D

TABLE D-3.

Campbell et al. #2 pump test -- depth to water

DATE		ELAPSED TIME	DEPTH TO	TYPE OF*	REMARKS
OCT 81	HOUR	(MINUTES)	WATER (FT)	READING	
7	12: 2.0	-148.0	75.83	TRANS	
	12: 5.0	-145.0	78.10	STEEL	
	12: 5.0	-145.0	76.73	TRANS	
	12:17.0	-133.0	79.92	STEEL	
	12:17.0	-133.0	77.72	TRANS	
	12:21.0	-129.0	78.13	STEEL	SLIGHTLY SMEARED
	12:21.0	-129.0	77.72	TRANS	
	14: 3.0	-27.0	77.97	STEEL	
	14: 3.0	-27.0	77.54	TRANS	
	14:13.0	-17.0	77.96	STEEL	
	14:13.0	-17.0	77.53	TRANS	
	14:26.0	-4.0	77.95	STEEL	
	14:26.0	-4.0	77.52	TRANS	
	14:28.0	-2.0	77.97	STEEL	
	14:28.0	-2.0	77.52	TRANS	
	14:30.0	0.0	77.52	TRANS	PUMP TURNED ON
	14:30.3	0.3	86.32	TRANS	
	14:30.5	0.5	91.12	TRANS	
	14:30.8	0.8	93.61	TRANS	
	14:31.0	1.0	95.11	TRANS	
	14:31.3	1.3	96.01	TRANS	
	14:31.5	1.5	96.51	TRANS	
	14:31.8	1.8	96.81	TRANS	
	14:32.0	2.0	97.01	TRANS	
	14:32.3	2.3	97.11	TRANS	
	14:32.5	2.5	97.11	TRANS	
	14:32.8	2.8	97.21	TRANS	
	14:33.0	3.0	97.21	TRANS	
	14:33.5	3.5	97.21	TRANS	
	14:34.0	4.0	97.31	TRANS	
	14:34.5	4.5	97.31	TRANS	
	14:35.0	5.0	97.31	TRANS	
	14:35.5	5.5	97.31	TRANS	
	14:36.0	6.0	97.41	TRANS	
	14:36.5	6.5	97.41	TRANS	
	14:37.0	7.0	97.41	TRANS	
	14:37.5	7.5	97.51	TRANS	
	14:38.0	8.0	97.51	TRANS	
	14:38.5	8.5	96.61	TRANS	
	14:39.0	9.0	97.61	TRANS	
	14:39.5	9.5	97.61	TRANS	
	14:40.0	10.0	97.61	TRANS	
	14:41.0	11.0	96.21	TRANS	DRAIN COCK OPEN-CLOSE
	14:42.0	12.0	97.41	TRANS	
	14:43.0	13.0	97.81	TRANS	
	14:44.0	14.0	97.90	TRANS	
	14:45.0	15.0	97.90	TRANS	
	14:46.0	16.0	97.90	TRANS	TEMP 141.5 F
	14:47.0	17.0	98.00	TRANS	
	14:48.0	18.0	98.00	TRANS	
	14:49.0	19.0	98.10	TRANS	

TABLE D-3. (continued)

Campbell et al. #2 pump test -- depth to water

=====					
OCT 81	DATE	ELAPSED TIME	DEPTH TO#	TYPE OF*	REMARKS
	HOUR	(MINUTES)	WATER(FT)	READING	
7	14:50.0	20.0	98.10	TRANS	
	14:52.0	22.0	98.10	TRANS	TEMP 142 F
	14:53.0	23.0	98.20	TRANS	
	14:54.0	24.0	98.20	TRANS	
	14:55.0	25.0	98.20	TRANS	
	14:56.0	26.0	98.19	TRANS	
	14:57.0	27.0	98.19	TRANS	
	14:58.0	28.0	98.29	TRANS	
	14:59.0	29.0	98.29	TRANS	
	15: 0.0	30.0	98.29	TRANS	TEMP 143 F
	15: 2.0	32.0	98.29	TRANS	
	15: 4.0	34.0	98.29	TRANS	
	15: 6.0	36.0	99.28	STEEL	
	15: 6.0	36.0	98.29	TRANS	
	15: 8.0	38.0	98.39	TRANS	
	15:10.0	40.0	98.38	TRANS	
	15:12.5	42.5	98.38	TRANS	
	15:16.0	46.0	98.38	TRANS	
	15:20.0	50.0	98.38	TRANS	
	15:24.0	54.0	98.37	TRANS	
	15:28.0	58.0	98.47	TRANS	
	15:32.0	62.0	98.47	TRANS	
	15:36.0	66.0	98.56	TRANS	
	15:40.0	70.0	98.36	TRANS	TEMP 143.5 F
	15:45.0	75.0	98.46	TRANS	
	15:55.0	85.0	98.45	TRANS	
	16: 0.0	90.0	98.34	TRANS	
	16: 5.0	95.0	98.48	STEEL	
	16: 5.0	95.0	98.44	TRANS	
	16:10.0	100.0	98.34	TRANS	
	16:15.0	105.0	98.43	TRANS	
	16:20.0	110.0	98.63	TRANS	
	16:25.0	115.0	98.72	TRANS	
	16:30.0	120.0	98.72	TRANS	
	16:40.0	130.0	98.71	TRANS	
	16:50.0	140.0	98.70	TRANS	
	17: 0.0	150.0	98.77	STEEL	
	17: 0.0	150.0	98.80	TRANS	
	17:10.0	160.0	98.79	TRANS	
	17:20.0	170.0	98.88	TRANS	
	17:30.0	180.0	98.87	TRANS	
	17:40.0	190.0	98.86	TRANS	
	17:50.0	200.0	98.86	TRANS	
	18: 0.0	210.0	98.85	STEEL	
	18: 0.0	210.0	98.85	TRANS	
	18:10.0	220.0	98.94	TRANS	
	18:20.0	230.0	98.93	TRANS	
	18:30.0	240.0	98.92	TRANS	
	18:40.0	250.0	98.92	TRANS	
	18:50.0	260.0	99.01	TRANS	
	19: 0.0	270.0	99.00	TRANS	

TABLE D-3. (continued)

Campbell et al. #2 pump test -- depth to water

DATE	ELAPSED TIME	DEPTH TO#	TYPE OF*	
OCT 81	HOUR (MINUTES)	WATER (FT)	READING	REMARKS
7	19:20.0	290.0	98.98	TRANS
	19:40.0	310.0	98.97	TRANS
	20: 0.0	330.0	99.05	TRANS
	20: 6.0	336.0	100.85	STEEL
	20:20.0	350.0	99.04	TRANS
	20:40.0	370.0	99.02	TRANS
	21: 0.0	390.0	98.94	STEEL
	21: 0.0	390.0	99.01	TRANS
	21:20.0	410.0	99.09	TRANS
	21:40.0	430.0	99.07	TRANS
	22: 0.0	450.0	99.16	TRANS
	22: 5.0	455.0	101.45	STEEL
	22:15.0	465.0	98.69	STEEL
	22:20.0	470.0	99.14	TRANS
	22:40.0	490.0	99.23	TRANS
	23: 0.0	510.0	99.21	TRANS
	23: 3.0	513.0	101.14	STEEL
	23:13.0	523.0	99.20	STEEL
	23:20.0	530.0	99.19	TRANS
	23:30.0	540.0	99.29	TRANS
	23:40.0	550.0	99.28	TRANS
8	0: 0.0	570.0	99.26	TRANS
	0: 2.0	572.0	101.17	STEEL
	0:12.0	582.0	101.06	STEEL
	0:22.0	592.0	99.34	TRANS
	0:40.0	610.0	99.33	TRANS
	1: 0.0	630.0	99.31	TRANS
	1: 2.0	632.0	99.70	STEEL
	1:13.0	643.0	98.63	STEEL
	1:20.0	650.0	99.40	TRANS
	1:40.0	670.0	99.38	TRANS
	2: 0.0	690.0	99.37	TRANS
	2: 2.0	692.0	100.31	STEEL
	2: 6.0	696.0	98.50	STEEL
	2:30.0	720.0	99.44	TRANS
	3: 0.0	750.0	99.42	TRANS
	3: 2.0	752.0	100.93	STEEL
	3:30.0	780.0	99.50	TRANS
	4: 0.0	810.0	99.47	TRANS
	4: 2.0	812.0	101.33	STEEL
	4: 6.0	816.0	99.39	STEEL
	4:30.0	840.0	99.55	TRANS
	5: 0.0	870.0	99.62	TRANS
	5:30.0	900.0	99.60	TRANS
	5:32.0	902.0	101.55	STEEL
	5:43.0	913.0	101.17	STEEL
	5:48.0	918.0	99.94	STEEL
	5:56.0	926.0	100.84	STEEL
	6: 0.0	930.0	99.68	TRANS
	6:30.0	960.0	101.19	STEEL
	6:30.0	960.0	99.65	TRANS

TAPE HANGS @292'

GOOD

SMEARED

POOR READING
GOOD MEASUREMENT

BETTER MEASUREMENT

GOOD MEASUREMENT

SMEARED
SMEARED
HUNG - BADLY SMEARED

SMEARED

TABLE D-3. (continued)

Campbell et al. #2 pump test -- depth to water

DATE	ELAPSED TIME	DEPTH TO#	TYPE OF*		
OCT 81	HOUR	(MINUTES)	WATER(FT)	READING	REMARKS
8	7: 0.0	990.0	99.04	STEEL	BADLY SMEARED
	7: 0.0	990.0	99.73	TRANS	
	7:10.0	1000.0	99.42	STEEL	SMEARED; SAMPLE #0711
	7:30.0	1020.0	99.80	TRANS	
	8: 0.0	1050.0	99.45	STEEL	SLIGHTLY SMEARED
	8: 0.0	1050.0	99.68	TRANS	
	8:30.0	1080.0	99.76	TRANS	
	9: 0.0	1110.0	100.41	STEEL	HUNG - BADLY SMEARED
	9: 0.0	1110.0	99.83	TRANS	
	9:30.0	1140.0	99.81	TRANS	
	9:58.0	1168.0	100.85	STEEL	SMEARED
	10: 0.0	1170.0	99.89	TRANS	
	10: 5.0	1175.0	101.35	STEEL	BADLY SMEARED; HUNG?
	10:30.0	1200.0	99.86	TRANS	
	10:59.0	1229.0	101.11	STEEL	BADLY SMEARED
	11: 0.0	1230.0	99.84	TRANS	
	11: 4.0	1234.0	100.13	STEEL	DECENT MARK
	11:30.0	1260.0	99.91	TRANS	
	11:59.0	1289.0	100.20	STEEL	BADLY SMEARED
	11:59.0	1289.0	99.89	TRANS	
	12:30.0	1320.0	99.87	TRANS	
	13: 0.0	1350.0	100.49	STEEL	BADLY SMEARED
	13: 0.0	1350.0	99.94	TRANS	
	14: 0.0	1410.0	99.89	TRANS	
	14:55.0	1465.0	99.35	STEEL	GOOD MARK
	15: 0.0	1470.0	99.95	TRANS	
	16: 0.0	1530.0	100.10	TRANS	
	16:56.0	1586.0	99.42	STEEL	SMEARED
	17: 0.0	1590.0	100.15	TRANS	
	18: 0.0	1650.0	100.30	TRANS	
	18:47.0	1697.0	100.12	STEEL	GOOD ON BACK
	19: 0.0	1710.0	100.46	TRANS	
	20: 0.0	1770.0	100.51	TRANS	
	21: 0.0	1830.0	99.55	STEEL	SMEARED
	21: 0.0	1830.0	100.56	TRANS	
	21: 7.0	1837.0	100.24	STEEL	GOOD MEASUREMENT
	22: 0.0	1890.0	100.71	TRANS	
	22:11.0	1901.0	100.61	STEEL	SMEARED
	23: 0.0	1950.0	100.87	TRANS	
	23:13.0	1963.0	98.37	STEEL	SMEARED
	23:19.0	1969.0	100.53	STEEL	SMEARED
	23:24.0	1974.0	100.55	STEEL	GOOD MEASUREMENT
9	0: 0.0	2010.0	101.02	TRANS	
	0:14.0	2024.0	101.00	STEEL	FRONT SMEARED GOOD ON
	1: 0.0	2070.0	101.97	TRANS	
	1: 8.0	2078.0	98.53	STEEL	GOOD MEASUREMENT
	1:12.0	2082.0	98.46	STEEL	GOOD MEASUREMENT
	2: 0.0	2130.0	102.32	TRANS	
	2: 8.0	2138.0	100.42	STEEL	FRONT SMEARED GOOD ON
	2:13.0	2143.0	100.57	STEEL	GOOD MEASUREMENT
	3: 0.0	2190.0	102.27	TRANS	

TABLE D-3. (continued)

Campbell et al. #2 pump test -- depth to water

DATE	ELAPSED TIME	DEPTH TO	TYPE OF*		
OCT 81	HOUR	(MINUTES)	WATER (FT)	READING	REMARKS
9	3: 2.0	2192.0	100.22	STEEL	GOOD MEASUREMENT
	3: 5.0	2195.0	100.45	STEEL	GOOD FRONT AND BACK
	4: 0.0	2250.0	102.23	TRANS	
	4: 2.0	2252.0	100.09	STEEL	
	5: 0.0	2310.0	102.28	TRANS	
	5: 2.0	2312.0	99.62	STEEL	GOOD MARK ON BACK
	5: 7.0	2317.0	100.28	STEEL	GOOD MARK ON FRONT
	5:11.0	2321.0	99.87	STEEL	SMEARED
	6: 0.0	2370.0	102.03	TRANS	
	6: 2.0	2372.0	100.13	STEEL	SLIGHTLY SMEARED
	6: 6.0	2376.0	100.12	STEEL	
	6:46.0	2416.0	101.22	STEEL	BADLY SMEARED
	6:50.0	2420.0	101.37	STEEL	SMEARED MARK ON BACK
	7: 0.0	2430.0	100.47	STEEL	BADLY SMEARED; MARK O
	7: 0.0	2430.0	102.08	TRANS	
	7: 6.0	2436.0	101.00	STEEL	BADLY SMEARED; MARK O
	7:29.0	2459.0	101.70	STEEL	SMEARED
	7:34.0	2464.0	99.53	STEEL	SMEARED
	7:39.0	2469.0	99.98	STEEL	BADLY SMEARED
	7:59.0	2489.0	99.91	STEEL	SMEARED
	7:59.0	2489.0	101.94	TRANS	
	8:35.0	2525.0	101.42	STEEL	SMEARED
	8:45.0	2535.0	99.45	STEEL	SMEARED
	8:50.0	2540.0	99.43	STEEL	SMEARED
	8:59.0	2549.0	100.53	STEEL	SMEARED
	8:59.0	2549.0	101.69	TRANS	
	9:15.0	2565.0	100.36	STEEL	BADLY SMEARED
	9:29.0	2579.0	99.80	STEEL	SMEARED
	9:45.0	2595.0	99.21	STEEL	BADLY SMEARED
	10: 0.0	2610.0	99.13	STEEL	SMEARED
	10: 0.0	2610.0	101.24	TRANS	
	10:15.0	2625.0	102.25	STEEL	BADLY SMEARED
	10:18.0	2628.0	101.52	STEEL	BADLY SMEARED
	10:22.0	2632.0	101.98	STEEL	BADLY SMEARED; HUNG?
	10:29.0	2639.0	101.77	STEEL	SMEARED
	10:59.0	2669.0	101.11	STEEL	BADLY SMEARED
	10:59.0	2669.0	101.59	TRANS	
	11:28.0	2698.0	100.61	STEEL	BADLY SMEARED
	12: 0.0	2730.0	99.06	STEEL	BADLY SMEARED
	12: 0.0	2730.0	101.15	TRANS	
	12: 6.0	2736.0	100.01	STEEL	BADLY SMEARED
	12:30.0	2760.0	99.27	STEEL	BADLY SMEARED
	12:59.0	2789.0	101.09	STEEL	
	12:59.0	2789.0	101.20	TRANS	
	13:30.0	2820.0	100.29	STEEL	BADLY SMEARED
	14: 0.0	2850.0	100.85	TRANS	
	14:23.0	2873.0	99.58	STEEL	MARK ON BACK
	14:30.0	2880.0	100.83	TRANS	PUMP OFF
	14:30.3	2880.3	92.03	TRANS	OTHER PUMP OFF
	14:30.5	2880.5	84.13	TRANS	
	14:30.8	2880.8	82.83	TRANS	

TABLE D-3. (continued)

Campbell et al. #2 pump test -- depth to water

DATE		ELAPSED TIME	DEPTH TO#	TYPE OF*	REMARKS
OCT 81	HOUR	(MINUTES)	WATER(FT)	READING	
9	14:31.0	2881.0	82.33	TRANS	
	14:31.3	2881.3	82.12	TRANS	
	14:31.5	2881.5	82.12	TRANS	
	14:32.0	2882.0	82.02	TRANS	
	14:33.0	2883.0	82.02	TRANS	
	14:34.0	2884.0	81.92	TRANS	
	14:35.0	2885.0	81.92	TRANS	
	14:37.0	2887.0	79.99	STEEL	
	14:37.0	2887.0	81.92	TRANS	
	14:39.0	2889.0	81.82	TRANS	
	14:42.0	2892.0	81.72	TRANS	
	14:45.0	2895.0	81.61	TRANS	
	14:50.0	2900.0	81.41	TRANS	
	14:54.0	2904.0	81.31	TRANS	
	14:58.0	2908.0	81.20	TRANS	
	15: 2.0	2912.0	81.00	STEEL	SMEARED
	15: 2.0	2912.0	81.10	TRANS	
	15: 6.0	2916.0	81.00	TRANS	
	15:10.0	2920.0	80.99	TRANS	
	15:15.0	2925.0	80.89	TRANS	
	15:20.0	2930.0	80.79	TRANS	
	15:25.0	2935.0	80.78	TRANS	
	15:30.0	2940.0	80.68	TRANS	
	15:40.0	2950.0	80.57	TRANS	
	15:50.0	2960.0	80.56	TRANS	
	16: 0.0	2970.0	80.45	TRANS	
	16:10.0	2980.0	80.45	TRANS	
	16:20.0	2990.0	80.34	TRANS	
	16:30.0	3000.0	80.33	TRANS	
	16:40.0	3010.0	80.32	TRANS	
	17: 0.0	3030.0	80.21	TRANS	
	17:20.0	3050.0	80.19	TRANS	
	17:40.0	3070.0	80.07	TRANS	
	18: 0.0	3090.0	79.37	STEEL	TAPE HUNG?
	18: 0.0	3090.0	80.06	TRANS	
	18: 4.0	3094.0	78.50	STEEL	GOOD MEASUREMENT
	18:20.0	3110.0	79.94	TRANS	
	18:40.0	3130.0	79.93	TRANS	
	18:55.0	3145.0	78.40	STEEL	
	19: 0.0	3150.0	79.91	TRANS	
	19:30.0	3180.0	79.99	TRANS	
	20: 0.0	3210.0	79.86	TRANS	
	20:30.0	3240.0	79.74	TRANS	
	21: 0.0	3270.0	79.82	TRANS	
	21:30.0	3300.0	79.79	TRANS	
	22: 0.0	3330.0	79.67	TRANS	
	22: 8.0	3338.0	78.47	STEEL	
	22:31.0	3361.0	79.64	TRANS	
	22:58.0	3388.0	79.62	TRANS	
	23:31.0	3421.0	79.60	TRANS	
	23:59.0	3449.0	79.57	TRANS	

TABLE D-3. (continued)

Campbell et al. #2 pump test -- depth to water

DATE	ELAPSED TIME	DEPTH TO#	TYPE OF*	
OCT 81	HOUR	(MINUTES)	WATER(FT)	READING
				REMARKS
10	0:59.0	3509.0	79.43	TRANS
	1:57.0	3567.0	78.44	STEEL
	1:57.0	3567.0	79.38	TRANS
	3: 0.0	3630.0	79.33	TRANS
	4: 0.0	3690.0	79.18	TRANS
	5: 0.0	3750.0	79.03	TRANS
	6: 0.0	3810.0	78.99	TRANS
	8: 0.0	3930.0	78.89	TRANS
	9:52.0	4042.0	79.62	STEEL
	9:56.0	4046.0	78.66	STEEL
	9:56.0	4046.0	78.70	TRANS
	11:49.0	4159.0	78.47	STEEL
	11:49.0	4159.0	78.51	TRANS
	16: 0.0	4410.0	78.17	STEEL
	16: 0.0	4410.0	78.11	TRANS
	20: 6.0	4656.0	78.22	STEEL
	20: 6.0	4656.0	77.91	TRANS
11	0: 0.0	4890.0	78.30	STEEL
	0: 0.0	4890.0	77.73	TRANS
	4: 7.0	5137.0	78.08	STEEL
	4: 7.0	5137.0	77.33	TRANS
	8: 3.0	5373.0	78.15	STEEL
	8: 3.0	5373.0	77.34	TRANS
	12: 0.0	5610.0	78.22	STEEL
	12: 0.0	5610.0	77.56	TRANS
	16: 6.0	5856.0	78.03	STEEL
	16: 6.0	5856.0	77.26	TRANS
	20: 0.0	6090.0	78.10	STEEL
	20: 0.0	6090.0	77.37	TRANS
12	0: 6.0	6336.0	78.20	STEEL
	0: 6.0	6336.0	78.48	TRANS
	2:30.0	6480.0	78.17	STEEL
	2:30.0	6480.0	79.06	TRANS

*THE TYPE OF READING DENOTES THE TYPE OF DEPTH TO WATER MEASUREMENT MADE. THESE MAY BE ANY OF THE FOLLOWING:

TRANS= MEASUREMENT MADE BY A TRANSDUCER IN THE WELL. THE MEASUREMENT IS THE HEIGHT OF THE WATER COLUMN ABOVE THE SENSOR.

STEEL= MEASUREMENT MADE BY A STEEL TAPE.

AIR= MEASUREMENT MADE BY AN AIRLINE.

AIRTRAN=MEASUREMENT MADE BY AN AIRLINE COUPLED WITH A TRANSDUCER.

ELECT= MEASUREMENT MADE BY AN ELECTRIC TAPE.

ABSOL= ALL MEASUREMENTS HAVE BEEN CHANGED TO ABSOLUTE DEPTH-TO-WATER MEASUREMENTS.

#THE DEPTH TO WATER IS THE CALCULATED DEPTH TO WATER

TABLE D-3. (continued)

FROM THE TOP OF THE WELL CASING, .43 FEET ABOVE THE
LAND SURFACE.

THE DEPTH TO WATER BELOW THE TOP OF THE CASING IS COMPUTED BY
THE FORMULA,

FOR TRANS, DEPTH TO WATER = 164.9 - WATER LEVEL READING
+0.000765 FT/MIN* (ELAPSED TIME-900)

FOR STEEL, DEPTH TO WATER = WATER LEVEL READING

THE AVERAGE DISCHARGE DURING PUMPAGE IS 51.6 GPM.

ELAPSED TIME IS TAKEN FROM TO AT 1430 ON 7 - OCT - 81

APPENDIX D

TABLE D-4. --Campbell et al. #2 Pump test --
calculated adjusted time, Harrill's argument, drawdown, specific draw-
down (s/q) and specific drawdown adjusted for Jacob's correction (s'/q)

DATE	ELAPSED	t**	S/Q	DRAW-	S'/Q#
OCT 81 HOUR	t(MIN)	t(MIN)	(FT/GPM)	DOWN(FT)	
12: 5.0	0.0	0.0	0.58		
12: 5.0	0.0	0.0	-0.79		
12:17.0	0.0	0.0	2.40		
12:17.0	0.0	0.0	0.20		
12:21.0	0.0	0.0	0.61		
12:21.0	0.0	0.0	0.20		
14: 3.0	0.0	0.0	0.45		
14: 3.0	0.0	0.0	0.02		
14:13.0	0.0	0.0	0.44		
14:13.0	0.0	0.0	0.01		
14:26.0	0.0	0.0	0.43		
14:26.0	0.0	0.0	0.00		
14:28.0	0.0	0.0	0.45		
14:28.0	0.0	0.0	0.00		
14:30.0	0.0	0.0	0.00		
14:30.3	0.3	0.3	0.17	8.800	0.166
14:30.5	0.5	0.5	0.26	13.600	0.253
14:30.8	0.8	0.8	0.31	16.090	0.297
14:31.0	1.0	1.0	0.34	17.590	0.323
14:31.3	1.3	1.3	0.36	18.490	0.339
14:31.5	1.5	1.5	0.37	18.990	0.347
14:31.8	1.8	1.8	0.37	19.290	0.353
14:32.0	2.0	2.0	0.38	19.490	0.356
14:32.3	2.3	2.3	0.38	19.590	0.358
14:32.5	2.5	2.5	0.38	19.590	0.358
14:32.8	2.8	2.8	0.38	19.690	0.359
14:33.0	3.0	3.0	0.38	19.690	0.359
14:33.5	3.5	3.5	0.38	19.690	0.359
14:34.0	4.0	4.0	0.38	19.790	0.361
14:34.5	4.5	4.5	0.38	19.790	0.361
14:35.0	5.0	5.0	0.38	19.790	0.361
14:35.5	5.5	5.5	0.38	19.790	0.361
14:36.0	6.0	6.0	0.39	19.890	0.363
14:36.5	6.5	6.5	0.39	19.890	0.363
14:37.0	7.0	7.0	0.39	19.890	0.363
14:37.5	7.5	7.5	0.39	19.990	0.365
14:38.0	8.0	8.0	0.39	19.990	0.365
14:38.5	8.5	8.5	0.37	19.090	0.349
14:39.0	9.0	9.0	0.39	20.090	0.366
14:39.5	9.5	9.5	0.39	20.090	0.366
14:40.0	10.0	10.0	0.39	20.090	0.366
14:41.0	11.0	11.0	0.36	18.690	0.342
14:42.0	12.0	12.0	0.39	19.890	0.363
14:43.0	13.0	13.0	0.39	20.290	0.370
14:44.0	14.0	14.0	0.39	20.380	0.371
14:45.0	15.0	15.0	0.39	20.380	0.371
14:46.0	16.0	16.0	0.39	20.380	0.371
14:47.0	17.0	17.0	0.40	20.480	0.373
14:48.0	18.0	18.0	0.40	20.480	0.373
14:49.0	19.0	19.0	0.40	20.580	0.375
14:50.0	20.0	20.0	0.40	20.580	0.375

TABLE D-4. (continued)

Campbell et al. #2 PUMP test --

calculated adjusted time, Harrill's argument, drawdown, specific drawdown (s/g) and specific drawdown adjusted for Jacob's correction (s'/g)

OCT 81	DATE	ELAPSED	t'**	t/t'	S/Q	DRAW-	S'/Q#
	HOUR	t (MIN)	(MIN)		(FT/GPM)	DOWN(FT)	
7	14:52.0	22.0			0.40	20.580	0.375
	14:53.0	23.0			0.40	20.680	0.376
	14:54.0	24.0			0.40	20.680	0.376
	14:55.0	25.0			0.40	20.680	0.376
	14:56.0	26.0			0.40	20.670	0.376
	14:57.0	27.0			0.40	20.670	0.376
	14:58.0	28.0			0.40	20.770	0.378
	14:59.0	29.0			0.40	20.770	0.378
	15: 0.0	30.0			0.40	20.770	0.378
	15: 2.0	32.0			0.40	20.770	0.378
	15: 4.0	34.0			0.40	20.770	0.378
	15: 6.0	36.0			0.42	21.760	0.395
	15: 6.0	36.0			0.40	20.770	0.378
	15: 8.0	38.0			0.40	20.870	0.380
	15:10.0	40.0			0.40	20.860	0.379
	15:12.5	42.5			0.40	20.860	0.379
	15:16.0	46.0			0.40	20.860	0.379
	15:20.0	50.0			0.40	20.860	0.379
	15:24.0	54.0			0.40	20.850	0.379
	15:28.0	58.0			0.41	20.950	0.381
	15:32.0	62.0			0.41	20.950	0.381
	15:36.0	66.0			0.41	21.040	0.383
	15:40.0	70.0			0.40	20.840	0.379
	15:45.0	75.0			0.41	20.940	0.381
	15:55.0	85.0			0.41	20.930	0.381
	16: 0.0	90.0			0.40	20.820	0.379
	16: 5.0	95.0			0.41	20.960	0.381
	16: 5.0	95.0			0.41	20.920	0.380
	16:10.0	100.0			0.40	20.820	0.379
	16:15.0	105.0			0.41	20.910	0.380
	16:20.0	110.0			0.41	21.110	0.384
	16:25.0	115.0			0.41	21.200	0.385
	16:30.0	120.0			0.41	21.200	0.385
	16:40.0	130.0			0.41	21.190	0.385
	16:50.0	140.0			0.41	21.180	0.385
	17: 0.0	150.0			0.41	21.250	0.386
	17: 0.0	150.0			0.41	21.280	0.387
	17:10.0	160.0			0.41	21.270	0.386
	17:20.0	170.0			0.41	21.360	0.388
	17:30.0	180.0			0.41	21.350	0.388
	17:40.0	190.0			0.41	21.340	0.388
	17:50.0	200.0			0.41	21.340	0.388
	18: 0.0	210.0			0.41	21.330	0.387
	18: 0.0	210.0			0.41	21.330	0.387
	18:10.0	220.0			0.42	21.420	0.389
	18:20.0	230.0			0.41	21.410	0.389
	18:30.0	240.0			0.41	21.400	0.389
	18:40.0	250.0			0.41	21.400	0.389
	18:50.0	260.0			0.42	21.490	0.390
	19: 0.0	270.0			0.42	21.480	0.390
	19:20.0	290.0			0.42	21.460	0.390

TABLE D-4. (continued)

Campbell et al. #2 pump test --
 calculated adjusted time, Harrill's argument, drawdown, specific draw-
 down (s/q) and specific drawdown adjusted for Jacob's correction (s'/q)

DATE	ELAPSED	t**	S/Q	DRAW-	S'/Q#
OCT 81 HOUR	t (MIN)	(MIN)	(FT/GPM)	DOWN(FT)	
19:40.0	310.0		0.42	21.450	0.389
20: 0.0	330.0		0.42	21.530	0.391
20: 6.0	336.0		0.45	23.330	0.421
20:20.0	350.0		0.42	21.520	0.391
20:40.0	370.0		0.42	21.500	0.390
21: 0.0	390.0		0.42	21.420	0.389
21: 0.0	390.0		0.42	21.490	0.390
21:20.0	410.0		0.42	21.570	0.392
21:40.0	430.0		0.42	21.550	0.391
22: 0.0	450.0		0.42	21.640	0.393
22: 5.0	455.0		0.46	23.930	0.431
22:15.0	465.0		0.41	21.170	0.385
22:20.0	470.0		0.42	21.620	0.392
22:40.0	490.0		0.42	21.710	0.394
23: 0.0	510.0		0.42	21.690	0.394
23: 3.0	513.0		0.46	23.620	0.426
23:13.0	523.0		0.42	21.680	0.393
23:20.0	530.0		0.42	21.670	0.393
23:30.0	540.0		0.42	21.770	0.395
23:40.0	550.0		0.42	21.760	0.395
0: 0.0	570.0		0.42	21.740	0.394
0: 2.0	572.0		0.46	23.650	0.426
0:12.0	582.0		0.46	23.540	0.425
0:22.0	592.0		0.42	21.820	0.396
0:40.0	610.0		0.42	21.810	0.396
1: 0.0	630.0		0.42	21.790	0.395
1: 2.0	632.0		0.43	22.180	0.402
1:13.0	643.0		0.41	21.110	0.384
1:20.0	650.0		0.42	21.880	0.397
1:40.0	670.0		0.42	21.860	0.396
2: 0.0	690.0		0.42	21.850	0.396
2: 2.0	692.0		0.44	22.790	0.412
2: 6.0	696.0		0.41	20.980	0.382
2:30.0	720.0		0.42	21.920	0.397
3: 0.0	750.0		0.42	21.900	0.397
3: 2.0	752.0		0.45	23.410	0.422
3:30.0	780.0		0.43	21.980	0.398
4: 0.0	810.0		0.43	21.950	0.398
4: 2.0	812.0		0.46	23.810	0.429
4: 6.0	816.0		0.42	21.870	0.397
4:30.0	840.0		0.43	22.030	0.399
5: 0.0	870.0		0.43	22.100	0.400
5:30.0	900.0		0.43	22.080	0.400
5:32.0	902.0		0.47	24.030	0.433
5:43.0	913.0		0.46	23.650	0.426
5:48.0	918.0		0.43	22.420	0.406
5:56.0	926.0		0.45	23.320	0.421
6: 0.0	930.0		0.43	22.160	0.401
6:30.0	960.0		0.46	23.670	0.427
6:30.0	960.0		0.43	22.130	0.401
7: 0.0	990.0		0.42	21.520	0.391

TABLE D-4. (continued)

Campbell et al. #2 pump test --
 calculated adjusted time, Harrill's argument, drawdown, specific draw-
 down (s/g) and specific drawdown adjusted for Jacob's correction (s'/g)
 =====

	DATE	ELAPSED	t' **		S/Q	DRAW-	S'/Q#
OCT 81	HOUR	t (MIN)	(MIN)	t/t'	(FT/GPM)	DOWN(FT)	

8	7: 0.0	990.0			0.43	22.210	0.402
	7:10.0	1000.0			0.42	21.900	0.397
	7:30.0	1020.0			0.43	22.280	0.403
	8: 0.0	1050.0			0.43	21.930	0.398
	8: 0.0	1050.0			0.43	22.160	0.401
	8:30.0	1080.0			0.43	22.240	0.403
	9: 0.0	1110.0			0.44	22.890	0.414
	9: 0.0	1110.0			0.43	22.310	0.404
	9:30.0	1140.0			0.43	22.290	0.404
	9:58.0	1168.0			0.45	23.330	0.421
	10: 0.0	1170.0			0.43	22.370	0.405
	10: 5.0	1175.0			0.46	23.830	0.429
	10:30.0	1200.0			0.43	22.340	0.404
	10:59.0	1229.0			0.46	23.590	0.425
	11: 0.0	1230.0			0.43	22.320	0.404
	11: 4.0	1234.0			0.44	22.610	0.409
	11:30.0	1260.0			0.43	22.390	0.405
	11:59.0	1289.0			0.44	22.680	0.410
	11:59.0	1289.0			0.43	22.370	0.405
	12:30.0	1320.0			0.43	22.350	0.405
	13: 0.0	1350.0			0.45	22.970	0.415
	13: 0.0	1350.0			0.43	22.420	0.406
	14: 0.0	1410.0			0.43	22.370	0.405
	14:55.0	1465.0			0.42	21.830	0.396
	15: 0.0	1470.0			0.43	22.430	0.406
	16: 0.0	1530.0			0.44	22.580	0.409
	16:56.0	1586.0			0.42	21.900	0.397
	17: 0.0	1590.0			0.44	22.630	0.409
	18: 0.0	1650.0			0.44	22.780	0.412
	18:47.0	1697.0			0.44	22.600	0.409
	19: 0.0	1710.0			0.44	22.940	0.415
	20: 0.0	1770.0			0.45	22.990	0.415
	21: 0.0	1830.0			0.43	22.030	0.399
	21: 0.0	1830.0			0.45	23.040	0.416
	21: 7.0	1837.0			0.44	22.720	0.411
	22: 0.0	1890.0			0.45	23.190	0.419
	22:11.0	1901.0			0.45	23.090	0.417
	23: 0.0	1950.0			0.45	23.350	0.421
	23:13.0	1963.0			0.40	20.850	0.379
	23:19.0	1969.0			0.45	23.010	0.416
	23:24.0	1974.0			0.45	23.030	0.416
9	0: 0.0	2010.0			0.46	23.500	0.424
	0:14.0	2024.0			0.46	23.480	0.424
	1: 0.0	2070.0			0.47	24.450	0.440
	1: 8.0	2078.0			0.41	21.010	0.382
	1:12.0	2082.0			0.41	20.940	0.381
	2: 0.0	2130.0			0.48	24.800	0.446
	2: 8.0	2138.0			0.44	22.900	0.414
	2:13.0	2143.0			0.45	23.050	0.416
	3: 0.0	2190.0			0.48	24.750	0.445
	3: 2.0	2192.0			0.44	22.700	0.411

TABLE D-4. (continued)

Campbell et al. #2 pump test --
calculated adjusted time, Harrill's argument, drawdown, specific draw-
(down) (s/a) and specific drawdown adjusted for Jacob's correction (s'/a)

	DATE	ELAPSED	t**		S/Q	DRAW-	S'/Q#
	OCT 81	HOUR	t (MIN)	(MIN)	t/t'	(FT/GPM)	DOWN(FT)
9	3:	5.0	2195.0		0.44	22.930	0.414
10.0	4:	0.0	2250.0		0.48	24.710	0.444
11.0	4:	2.0	2252.0		0.44	22.570	0.408
12.0	5:	0.0	2310.0		0.48	24.760	0.445
13.0	5:	2.0	2312.0		0.43	22.100	0.400
14.0	5:	7.0	2317.0		0.44	22.760	0.412
15.0	5:	11.0	2321.0		0.43	22.350	0.405
16.0	6:	0.0	2370.0		0.48	24.510	0.441
17.0	6:	2.0	2372.0		0.44	22.610	0.409
18.0	6:	6.0	2376.0		0.44	22.600	0.409
19.0	6:	46.0	2416.0		0.46	23.700	0.427
20.0	6:	50.0	2420.0		0.46	23.850	0.430
21.0	7:	0.0	2430.0		0.44	22.950	0.415
22.0	7:	0.0	2430.0		0.48	24.560	0.442
23.0	7:	6.0	2436.0		0.46	23.480	0.424
24.0	7:	29.0	2459.0		0.47	24.180	0.435
25.0	7:	34.0	2464.0		0.43	22.010	0.399
26.0	7:	39.0	2469.0		0.44	22.460	0.407
27.0	7:	59.0	2489.0		0.43	22.390	0.405
28.0	7:	59.0	2489.0		0.47	24.420	0.439
29.0	8:	35.0	2525.0		0.46	23.900	0.431
30.0	8:	45.0	2535.0		0.43	21.930	0.398
31.0	8:	50.0	2540.0		0.42	21.910	0.397
32.0	8:	59.0	2549.0		0.45	23.010	0.416
33.0	8:	59.0	2549.0		0.47	24.170	0.435
34.0	9:	15.0	2565.0		0.44	22.840	0.413
35.0	9:	29.0	2579.0		0.43	22.280	0.403
36.0	9:	45.0	2595.0		0.42	21.690	0.394
37.0	10:	0.0	2610.0		0.42	21.610	0.392
38.0	10:	0.0	2610.0		0.46	23.720	0.428
39.0	10:	15.0	2625.0		0.48	24.730	0.444
40.0	10:	18.0	2628.0		0.47	24.000	0.432
41.0	10:	22.0	2632.0		0.47	24.460	0.440
42.0	10:	29.0	2639.0		0.47	24.250	0.436
43.0	10:	59.0	2669.0		0.46	23.590	0.425
44.0	10:	59.0	2669.0		0.47	24.070	0.433
45.0	11:	28.0	2698.0		0.45	23.090	0.417
46.0	12:	0.0	2730.0		0.42	21.540	0.391
47.0	12:	0.0	2730.0		0.46	23.630	0.426
48.0	12:	6.0	2736.0		0.44	22.490	0.407
49.0	12:	30.0	2760.0		0.42	21.750	0.395
50.0	12:	59.0	2789.0		0.46	23.570	0.425
51.0	12:	59.0	2789.0		0.46	23.680	0.427
52.0	13:	30.0	2820.0		0.44	22.770	0.412
53.0	14:	0.0	2850.0		0.45	23.330	0.421
54.0	14:	23.0	2873.0		0.43	22.060	0.400
55.0	14:	30.0	2880.0		0.45	23.310	0.421
56.0	14:	30.3	2880.3	0.0000E+00 0.0000E+00	0.28	14.510	0.26
57.0	14:	30.5	2880.5	2.0000E-01 1.4402E+04	0.13	6.610	0.12
58.0	14:	30.8	2880.8	5.0000E-01 5.7616E+03	0.10	5.310	0.10
59.0	14:	31.0	2881.0	7.0000E-01 4.1157E+03	0.09	4.810	0.09

TABLE D-4. (continued)

Campbell et al. #2 pump test --

calculated adjusted time, Harrill's argument, drawdown, specific draw-down (s/a) and specific drawdown adjusted for Jacob's correction (s'/a)

DATE		ELAPSED	t''*		S/Q	DRAW-	S'/Q*
OCT 81	HOUR	t (MIN)	(MIN)	t/t'	(FT/GPM)	DOWN(FT)	
9	14:31.3	2881.3	1.0000E+00	2.8813E+03	0.09	4.600	0.08
	14:31.5	2881.5	1.2000E+00	2.4012E+03	0.09	4.600	0.08
	14:32.0	2882.0	1.7000E+00	1.6953E+03	0.09	4.500	0.08
	14:33.0	2883.0	2.7000E+00	1.0678E+03	0.09	4.500	0.08
	14:34.0	2884.0	3.7000E+00	7.7946E+02	0.09	4.400	0.08
	14:35.0	2885.0	4.7000E+00	6.1383E+02	0.09	4.400	0.08
	14:37.0	2887.0	6.7000E+00	4.3090E+02	0.05	2.470	0.04
	14:37.0	2887.0	6.7000E+00	4.3090E+02	0.09	4.400	0.08
	14:39.0	2889.0	8.7000E+00	3.3207E+02	0.08	4.300	0.08
	14:42.0	2892.0	1.1700E+01	2.4718E+02	0.08	4.200	0.08
	14:45.0	2895.0	1.4700E+01	1.9694E+02	0.08	4.090	0.07
	14:50.0	2900.0	1.9700E+01	1.4721E+02	0.08	3.890	0.07
	14:54.0	2904.0	2.3700E+01	1.2253E+02	0.07	3.790	0.07
	14:58.0	2908.0	2.7700E+01	1.0498E+02	0.07	3.680	0.07
	15: 2.0	2912.0	3.1700E+01	9.1861E+01	0.07	3.480	0.06
	15: 2.0	2912.0	3.1700E+01	9.1861E+01	0.07	3.580	0.06
	15: 6.0	2916.0	3.5700E+01	8.1681E+01	0.07	3.480	0.06
	15:10.0	2920.0	3.9700E+01	7.3552E+01	0.07	3.470	0.06
	15:15.0	2925.0	4.4700E+01	6.5436E+01	0.07	3.370	0.06
	15:20.0	2930.0	4.9700E+01	5.8954E+01	0.06	3.270	0.06
	15:25.0	2935.0	5.4700E+01	5.3656E+01	0.06	3.260	0.06
	15:30.0	2940.0	5.9700E+01	4.9246E+01	0.06	3.160	0.06
	15:40.0	2950.0	6.9700E+01	4.2324E+01	0.06	3.050	0.05
	15:50.0	2960.0	7.9700E+01	3.7139E+01	0.06	3.040	0.05
	16: 0.0	2970.0	8.9700E+01	3.3110E+01	0.06	2.930	0.05
	16:10.0	2980.0	9.9700E+01	2.9890E+01	0.06	2.930	0.05
	16:20.0	2990.0	1.0970E+02	2.7256E+01	0.05	2.820	0.05
	16:30.0	3000.0	1.1970E+02	2.5063E+01	0.05	2.810	0.05
	16:40.0	3010.0	1.2970E+02	2.3207E+01	0.05	2.800	0.05
	17: 0.0	3030.0	1.4970E+02	2.0240E+01	0.05	2.690	0.05
	17:20.0	3050.0	1.6970E+02	1.7973E+01	0.05	2.670	0.05
	17:40.0	3070.0	1.8970E+02	1.6183E+01	0.05	2.550	0.04
	18: 0.0	3090.0	2.0970E+02	1.4735E+01	0.04	1.850	0.03
	18: 0.0	3090.0	2.0970E+02	1.4735E+01	0.05	2.540	0.04
	18: 4.0	3094.0	2.1370E+02	1.4478E+01	0.02	0.980	0.01
	18:20.0	3110.0	2.2970E+02	1.3539E+01	0.05	2.420	0.04
	18:40.0	3130.0	2.4970E+02	1.2535E+01	0.05	2.410	0.04
	18:55.0	3145.0	2.6470E+02	1.1881E+01	0.02	0.880	0.01
	19: 0.0	3150.0	2.6970E+02	1.1680E+01	0.05	2.390	0.04
	19:30.0	3180.0	2.9970E+02	1.0611E+01	0.05	2.470	0.04
	20: 0.0	3210.0	3.2970E+02	9.7361E+00	0.05	2.340	0.04
	20:30.0	3240.0	3.5970E+02	9.0075E+00	0.04	2.220	0.04
	21: 0.0	3270.0	3.8970E+02	8.3911E+00	0.04	2.300	0.04
	21:30.0	3300.0	4.1970E+02	7.8628E+00	0.04	2.270	0.04
	22: 0.0	3330.0	4.4970E+02	7.4049E+00	0.04	2.150	0.04
	22: 8.0	3338.0	4.5770E+02	7.2930E+00	0.02	0.950	0.01
	22:31.0	3361.0	4.8070E+02	6.9919E+00	0.04	2.120	0.04
	22:58.0	3388.0	5.0770E+02	6.6732E+00	0.04	2.100	0.04
	23:31.0	3421.0	5.4070E+02	6.3270E+00	0.04	2.080	0.04
	23:59.0	3449.0	5.6870E+02	6.0647E+00	0.04	2.050	0.03
10	0:59.0	3509.0	6.2870E+02	5.5814E+00	0.04	1.910	0.03

TABLE D-4. (continued)

Campbell et al. #2 pump test --
 calculated adjusted time, Harrill's argument, drawdown, specific draw-
 down (s/g) and specific drawdown adjusted for Jacob's correction (s'/g)
 =====

	DATE	ELAPSED	t' **		S/Q	DRAW-	S'/Q#
OCT 81	HOUR	t (MIN)	(MIN)	t/t'	(FT/GPM)	DOWN(FT)	
10	1:57.0	3567.0	6.8670E+02	5.1944E+00	0.02	0.920	0.01
	1:57.0	3567.0	6.8670E+02	5.1944E+00	0.04	1.860	0.03
	3: 0.0	3630.0	7.4970E+02	4.8419E+00	0.04	1.810	0.03
	4: 0.0	3690.0	8.0970E+02	4.5572E+00	0.03	1.660	0.03
	5: 0.0	3750.0	8.6970E+02	4.3118E+00	0.03	1.510	0.02
	6: 0.0	3810.0	9.2970E+02	4.0981E+00	0.03	1.470	0.02
	8: 0.0	3930.0	1.0497E+03	3.7439E+00	0.03	1.370	0.02
	9:52.0	4042.0	1.1617E+03	3.4794E+00	0.04	2.100	0.04
	9:56.0	4046.0	1.1657E+03	3.4709E+00	0.02	1.140	0.02
	9:56.0	4046.0	1.1657E+03	3.4709E+00	0.02	1.180	0.02
	11:49.0	4159.0	1.2787E+03	3.2525E+00	0.02	0.950	0.01
	11:49.0	4159.0	1.2787E+03	3.2525E+00	0.02	0.990	0.01
	16: 0.0	4410.0	1.5297E+03	2.8829E+00	0.01	0.650	0.01
	16: 0.0	4410.0	1.5297E+03	2.8829E+00	0.01	0.590	0.01
	20: 6.0	4656.0	1.7757E+03	2.6221E+00	0.01	0.700	0.01
	20: 6.0	4656.0	1.7757E+03	2.6221E+00	0.01	0.390	0.00
11	0: 0.0	4890.0	2.0097E+03	2.4332E+00	0.02	0.780	0.01
	0: 0.0	4890.0	2.0097E+03	2.4332E+00	0.00	0.210	0.00
	4: 7.0	5137.0	2.2567E+03	2.2763E+00	0.01	0.560	0.01
	4: 7.0	5137.0	2.2567E+03	2.2763E+00	-0.00	-0.190	
	8: 3.0	5373.0	2.4927E+03	2.1555E+00	0.01	0.630	0.01
	8: 3.0	5373.0	2.4927E+03	2.1555E+00	-0.00	-0.180	
	12: 0.0	5610.0	2.7297E+03	2.0552E+00	0.01	0.700	0.01
	12: 0.0	5610.0	2.7297E+03	2.0552E+00	0.00	0.040	0.00
	16: 6.0	5856.0	2.9757E+03	1.9679E+00	0.01	0.510	0.01
	16: 6.0	5856.0	2.9757E+03	1.9679E+00	-0.01	-0.260	
12	20: 0.0	6090.0	3.2097E+03	1.8974E+00	0.01	0.580	0.01
	20: 0.0	6090.0	3.2097E+03	1.8974E+00	-0.00	-0.150	
	0: 6.0	6336.0	3.4557E+03	1.8335E+00	0.01	0.680	0.01
	0: 6.0	6336.0	3.4557E+03	1.8335E+00	0.02	0.960	0.01
	2:30.0	6480.0	3.5997E+03	1.8002E+00	0.01	0.650	0.01
	2:30.0	6480.0	3.5997E+03	1.8002E+00	0.03	1.540	0.03

TABLE D-4. (continued)

#S' IS THE JACOB CORRECTION, $S' = S - S^{**2}/2D$.

THE DRAWDOWN S AT ELAPSED TIME T IS CALCULATED FROM THE EQUATION:

$S =$ OBSERVED DEPTH TO WATER AT TIME T-TREND

WHERE TREND= 0 * ELAPSED TIME + INITIAL DEPTH-TO-WATER.

THE LENGTH OF THE CONTRIBUTING INTERVAL OF THE WELL IS 170 FEET.

THE DEPTH FROM THE TOP OF CASING TO THE SCREEN IS 77.52 FEET.

**t' IS THE TIME THAT HAS ELAPSED SINCE THE PUMP WAS TURNED OFF.

t IS THE ELAPSED TIME FROM WHEN THE PUMP WAS TURNED ON.

APPENDIX D

TABLE D-5.

North Observation well pump test -- water level data

DATE	ELAPSED TIME	WATER LEVEL	TYPE OF*	REMARKS
OCT 81	HOUR (MINUTES)	READING	READING	
7	10:42.0	-228.0	5.23	STEEL
	11:44.0	-166.0	5.20	STEEL
	12:14.0	-136.0	5.41	STEEL
	14: 2.0	-28.0	5.28	STEEL
7	14:30.0	0.0		PUMP ON
	14:34.0	4.0	5.50	STEEL
	15: 3.0	33.0	5.70	STEEL
	15:16.0	46.0	5.39	STEEL
	15:33.0	63.0	5.43	STEEL
	15:59.0	89.0	5.50	STEEL
	16:32.0	122.0	5.55	STEEL
	16:58.0	148.0	5.49	STEEL
	17:35.0	185.0	5.49	STEEL
	18: 0.0	210.0	5.48	STEEL
	18:33.0	243.0	5.48	STEEL
	19: 7.0	277.0	5.46	STEEL
	19:30.0	300.0	5.48	STEEL
	20: 4.0	334.0	5.48	STEEL
	20:34.0	364.0	5.46	STEEL
	21: 4.0	394.0	5.48	STEEL
	21:35.0	425.0	5.57	STEEL
	22: 5.0	455.0	5.48	STEEL
	22:33.0	483.0	5.48	STEEL
	23: 3.0	513.0	5.49	STEEL
	23:36.0	546.0	5.49	STEEL
8	0: 6.0	576.0	5.50	STEEL
	0:34.0	604.0	5.49	STEEL
	1: 6.0	636.0	5.49	STEEL
	1:36.0	666.0	5.49	STEEL
	2: 7.0	697.0	5.49	STEEL
	2:39.0	729.0	5.51	STEEL
	3: 5.0	755.0	5.51	STEEL
	3:35.0	785.0	5.50	STEEL
	4: 5.0	815.0	5.51	STEEL
	4:35.0	845.0	5.50	STEEL
	5: 5.0	875.0	5.52	STEEL
	5:37.0	907.0	5.52	STEEL
	6: 7.0	937.0	5.52	STEEL
	6:37.0	967.0	5.52	STEEL
	7: 4.0	994.0	5.52	STEEL
	8: 4.0	1054.0	5.52	STEEL
	9: 5.0	1115.0	5.52	STEEL
	10: 4.0	1174.0	5.52	STEEL
	11: 5.0	1235.0	5.53	STEEL
	12: 5.0	1295.0	5.52	STEEL
	13: 4.0	1354.0	5.52	STEEL
	14: 3.0	1413.0	5.52	STEEL
	15: 2.0	1472.0	5.52	STEEL
	16: 0.0	1530.0	5.54	STEEL
	17: 2.0	1592.0	5.51	STEEL
	18: 0.0	1650.0	5.48	STEEL

PUMP ON
PUMP ON AT
CAMPBELL #2

Hard to read; steam
coming out of well

TABLE D-5. (continued)

North Observation well pump test -- water level data

=====						
DATE	ELAPSED TIME	WATER LEVEL	TYPE OF*			
OCT 81	HOUR	(MINUTES)	READING#	READING	REMARKS	

8	18: 2.0	1652.0	5.53	STEEL		
	19: 0.0	1710.0	5.49	STEEL		
	20: 2.0	1772.0	5.49	STEEL		
	21: 8.0	1838.0	5.52	STEEL		
	22: 9.0	1899.0	5.52	STEEL		
	23: 8.0	1958.0	5.53	STEEL		
9	0: 8.0	2018.0	5.52	STEEL		
	1: 8.0	2078.0	5.51	STEEL		
	2: 7.0	2137.0	5.52	STEEL		
	3: 7.0	2197.0	5.52	STEEL		
	4: 8.0	2258.0	5.53	STEEL		
	5: 8.0	2318.0	5.53	STEEL		
	6:10.0	2380.0	5.53	STEEL		
	7: 0.0	2430.0	5.53	STEEL		
	8: 0.0	2490.0	5.54	STEEL		
	9: 0.0	2550.0	5.53	STEEL		
	10: 0.0	2610.0	5.53	STEEL		
	11: 0.0	2670.0	5.54	STEEL		
	12: 0.0	2730.0	5.53	STEEL		
	13: 0.0	2790.0	5.53	STEEL		
	14: 3.0	2853.0	5.53	STEEL		
9	14:30.3	0.0			PUMP OFF	
	14:34.0	2884.0	5.55	STEEL	PUMP OFF AT	
	15: 0.0	2910.0	5.42	STEEL	CAMPBELL #2	
	16: 2.0	2972.0	5.37	STEEL		
	17: 0.0	3030.0	5.36	STEEL		
	18: 2.0	3092.0	5.34	STEEL		
	19:10.0	3160.0	5.35	STEEL		
	20:10.0	3220.0	5.33	STEEL		
	21: 8.0	3278.0	5.33	STEEL		
	21:58.0	3328.0	5.29	STEEL		
	23: 7.0	3397.0	5.35	STEEL		
10	0:18.0	3468.0	5.26	STEEL		
	1: 5.0	3515.0	5.29	STEEL		
	2: 6.0	3576.0	5.27	STEEL		
	4: 5.0	3695.0	5.26	STEEL		
	6: 5.0	3815.0	5.24	STEEL		
	8: 4.0	3934.0	5.27	STEEL		
	10: 6.0	4056.0	5.22	STEEL		
	11:54.0	4164.0	5.28	STEEL		
	16: 9.0	4419.0	5.28	STEEL		
	20:10.0	4660.0	5.28	STEEL		
11	0: 7.0	4897.0	5.28	STEEL		
	4:16.0	5146.0	5.25	STEEL		
	8: 9.0	5379.0	5.27	STEEL		
	12: 7.0	5617.0	5.24	STEEL		
	16: 5.0	5855.0	5.26	STEEL		
	20: 2.0	6092.0	5.21	STEEL		
12	0:14.0	6344.0	5.23	STEEL		
	2:45.0	6495.0	5.25	STEEL		

TABLE D-5. (continued)

*THE TYPE OF READING DENOTES THE TYPE OF DEPTH TO WATER MEASUREMENT MADE. THESE MAY BE ANY OF THE FOLLOWING:

TRANS= MEASUREMENT MADE BY A TRANSDUCER IN THE WELL.
THE MEASUREMENT IS THE HEIGHT OF THE WATER COLUMN ABOVE THE SENSOR.

STEEL= MEASUREMENT MADE BY A STEEL TAPE.

AIR= MEASUREMENT MADE BY AN AIRLINE.

AIRTRAN=MEASUREMENT MADE BY AN AIRLINE COUPLED WITH A TRANSDUCER.

ELECT= MEASUREMENT MADE BY AN ELECTRIC TAPE.

ABSOL= ALL MEASUREMENTS HAVE BEEN CHANGED TO ABSOLUTE DEPTH-TO-WATER MEASUREMENTS.

#THE WATER LEVEL READING IS THE INSTRUMENT READING MADE TO FIND THE DEPTH TO WATER.

ELAPSED TIME IS TAKEN FROM TO AT 1430 ON 7 - OCT - 81

0010	0010	0.000	0.000
0011	0011	0.000	0.000
0012	0012	0.000	0.000
0013	0013	0.000	0.000
0014	0014	0.000	0.000
0015	0015	0.000	0.000
0016	0016	0.000	0.000
0017	0017	0.000	0.000
0018	0018	0.000	0.000
0019	0019	0.000	0.000
0020	0020	0.000	0.000
0021	0021	0.000	0.000
0022	0022	0.000	0.000
0023	0023	0.000	0.000
0024	0024	0.000	0.000
0025	0025	0.000	0.000
0026	0026	0.000	0.000
0027	0027	0.000	0.000
0028	0028	0.000	0.000
0029	0029	0.000	0.000
0030	0030	0.000	0.000
0031	0031	0.000	0.000
0032	0032	0.000	0.000
0033	0033	0.000	0.000
0034	0034	0.000	0.000
0035	0035	0.000	0.000
0036	0036	0.000	0.000
0037	0037	0.000	0.000
0038	0038	0.000	0.000
0039	0039	0.000	0.000
0040	0040	0.000	0.000
0041	0041	0.000	0.000
0042	0042	0.000	0.000
0043	0043	0.000	0.000
0044	0044	0.000	0.000
0045	0045	0.000	0.000
0046	0046	0.000	0.000
0047	0047	0.000	0.000
0048	0048	0.000	0.000
0049	0049	0.000	0.000
0050	0050	0.000	0.000
0051	0051	0.000	0.000
0052	0052	0.000	0.000
0053	0053	0.000	0.000
0054	0054	0.000	0.000
0055	0055	0.000	0.000
0056	0056	0.000	0.000
0057	0057	0.000	0.000
0058	0058	0.000	0.000
0059	0059	0.000	0.000
0060	0060	0.000	0.000
0061	0061	0.000	0.000
0062	0062	0.000	0.000
0063	0063	0.000	0.000
0064	0064	0.000	0.000
0065	0065	0.000	0.000
0066	0066	0.000	0.000
0067	0067	0.000	0.000
0068	0068	0.000	0.000
0069	0069	0.000	0.000
0070	0070	0.000	0.000
0071	0071	0.000	0.000
0072	0072	0.000	0.000
0073	0073	0.000	0.000
0074	0074	0.000	0.000
0075	0075	0.000	0.000
0076	0076	0.000	0.000
0077	0077	0.000	0.000
0078	0078	0.000	0.000
0079	0079	0.000	0.000
0080	0080	0.000	0.000
0081	0081	0.000	0.000
0082	0082	0.000	0.000
0083	0083	0.000	0.000
0084	0084	0.000	0.000
0085	0085	0.000	0.000
0086	0086	0.000	0.000
0087	0087	0.000	0.000
0088	0088	0.000	0.000
0089	0089	0.000	0.000
0090	0090	0.000	0.000
0091	0091	0.000	0.000
0092	0092	0.000	0.000
0093	0093	0.000	0.000
0094	0094	0.000	0.000
0095	0095	0.000	0.000
0096	0096	0.000	0.000
0097	0097	0.000	0.000
0098	0098	0.000	0.000
0099	0099	0.000	0.000

APPENDIX D

TABLE D-6.

North Observation well pump test -- depth to water computations

DATE	ELAPSED TIME	DEPTH TO	TYPE OF*	
OCT 81	HOUR	(MINUTES)	WATER(FT)	READING
				REMARKS
7	10:42.0	-228.0	5.23	STEEL
	11:44.0	-166.0	5.20	STEEL
	12:14.0	-136.0	5.41	STEEL
	14: 2.0	-28.0	5.28	STEEL
7	14:30.0	0.0		PUMP ON
	14:34.0	4.0	5.50	STEEL
	15: 3.0	33.0	5.70	STEEL
	15:16.0	46.0	5.39	STEEL
	15:33.0	63.0	5.43	STEEL
	15:59.0	89.0	5.50	STEEL
	16:32.0	122.0	5.55	STEEL
	16:58.0	148.0	5.49	STEEL
	17:35.0	185.0	5.49	STEEL
	18: 0.0	210.0	5.48	STEEL
	18:33.0	243.0	5.48	STEEL
	19: 7.0	277.0	5.46	STEEL
	19:30.0	300.0	5.48	STEEL
	20: 4.0	334.0	5.48	STEEL
	20:34.0	364.0	5.46	STEEL
	21: 4.0	394.0	5.48	STEEL
	21:35.0	425.0	5.57	STEEL
	22: 5.0	455.0	5.48	STEEL
	22:33.0	483.0	5.48	STEEL
	23: 3.0	513.0	5.49	STEEL
	23:36.0	546.0	5.49	STEEL
8	0: 6.0	576.0	5.50	STEEL
	0:34.0	604.0	5.49	STEEL
	1: 6.0	636.0	5.49	STEEL
	1:36.0	666.0	5.49	STEEL
	2: 7.0	697.0	5.49	STEEL
	2:39.0	729.0	5.51	STEEL
	3: 5.0	755.0	5.51	STEEL
	3:35.0	785.0	5.50	STEEL
	4: 5.0	815.0	5.51	STEEL
	4:35.0	845.0	5.50	STEEL
	5: 5.0	875.0	5.52	STEEL
	5:37.0	907.0	5.52	STEEL
	6: 7.0	937.0	5.52	STEEL
	6:37.0	967.0	5.52	STEEL
	7: 4.0	994.0	5.52	STEEL
	8: 4.0	1054.0	5.52	STEEL
	9: 5.0	1115.0	5.52	STEEL
	10: 4.0	1174.0	5.52	STEEL
	11: 5.0	1235.0	5.53	STEEL
	12: 5.0	1295.0	5.52	STEEL
	13: 4.0	1354.0	5.52	STEEL
	14: 3.0	1413.0	5.52	STEEL
	15: 2.0	1472.0	5.52	STEEL
	16: 0.0	1530.0	5.54	STEEL
	17: 2.0	1592.0	5.51	STEEL
	18: 0.0	1650.0	5.48	STEEL

Hard to read steam
coming out of well

TABLE D-6. (continued)

North Observation well pump test -- depth to water computations

DATE	HOUR	ELAPSED TIME (MINUTES)	DEPTH TO WATER (FT)	TYPE OF*	REMARKS
OCT 81					
8	18: 2.0	1652.0	5.53	STEEL	
	19: 0.0	1710.0	5.49	STEEL	
	20: 2.0	1772.0	5.49	STEEL	
	21: 8.0	1838.0	5.52	STEEL	
	22: 9.0	1899.0	5.52	STEEL	
	23: 8.0	1958.0	5.53	STEEL	
9	0: 8.0	2018.0	5.52	STEEL	
	1: 8.0	2078.0	5.51	STEEL	
	2: 7.0	2137.0	5.52	STEEL	
	3: 7.0	2197.0	5.52	STEEL	
	4: 8.0	2258.0	5.53	STEEL	
	5: 8.0	2318.0	5.53	STEEL	
	6: 10.0	2380.0	5.53	STEEL	
	7: 0.0	2430.0	5.53	STEEL	
	8: 0.0	2490.0	5.54	STEEL	
	9: 0.0	2550.0	5.53	STEEL	
	10: 0.0	2610.0	5.53	STEEL	
	11: 0.0	2670.0	5.54	STEEL	
	12: 0.0	2730.0	5.53	STEEL	
	13: 0.0	2790.0	5.53	STEEL	
	14: 3.0	2853.0	5.53	STEEL	
9	14:30.3	2880.3		PUMP OFF	
	14:34.0	2884.0	5.55	STEEL	PUMP OFF AT
	15: 0.0	2910.0	5.42	STEEL	CAMPBELL #2
	16: 2.0	2972.0	5.37	STEEL	
	17: 0.0	3030.0	5.36	STEEL	
	18: 2.0	3092.0	5.34	STEEL	
	19: 10.0	3160.0	5.35	STEEL	
	20: 10.0	3220.0	5.33	STEEL	
	21: 8.0	3278.0	5.33	STEEL	
	21:58.0	3328.0	5.29	STEEL	
	23: 7.0	3397.0	5.35	STEEL	
10	0: 18.0	3468.0	5.26	STEEL	
	1: 5.0	3515.0	5.29	STEEL	
	2: 6.0	3576.0	5.27	STEEL	
	4: 5.0	3695.0	5.26	STEEL	
	6: 5.0	3815.0	5.24	STEEL	
	8: 4.0	3934.0	5.27	STEEL	
	10: 6.0	4056.0	5.22	STEEL	
	11:54.0	4164.0	5.28	STEEL	
	16: 9.0	4419.0	5.28	STEEL	
	20: 10.0	4660.0	5.28	STEEL	
11	0: 7.0	4897.0	5.28	STEEL	
	4: 16.0	5146.0	5.25	STEEL	
	8: 9.0	5379.0	5.27	STEEL	
	12: 7.0	5617.0	5.24	STEEL	
	16: 5.0	5855.0	5.26	STEEL	
	20: 2.0	6092.0	5.21	STEEL	
12	0: 14.0	6344.0	5.23	STEEL	
	2: 45.0	6495.0	5.25	STEEL	

TABLE D-6. (continued)

*THE TYPE OF READING DENOTES THE TYPE OF DEPTH TO WATER MEASUREMENT MADE. THESE MAY BE ANY OF THE FOLLOWING:

TRANS= MEASUREMENT MADE BY A TRANSDUCER IN THE WELL.
THE MEASUREMENT IS THE HEIGHT OF THE WATER COLUMN ABOVE THE SENSOR.
STEEL= MEASUREMENT MADE BY A STEEL TAPE.
AIR= MEASUREMENT MADE BY AN AIRLINE.
AIRTRAN=MEASUREMENT MADE BY AN AIRLINE COUPLED WITH A TRANSDUCER.
ELECT= MEASUREMENT MADE BY AN ELECTRIC TAPE.
ABSOL= ALL MEASUREMENTS HAVE BEEN CHANGED TO ABSOLUTE DEPTH-TO-WATER MEASUREMENTS.

#THE DEPTH TO WATER IS THE CALCULATED DEPTH TO WATER FROM THE TOP OF THE WELL CASING, .35 FEET ABOVE THE LAND SURFACE.

THE DEPTH TO WATER BELOW THE TOP OF THE CASING IS COMPUTED BY THE FORMULA,

FOR STEEL, DEPTH TO WATER = WATER LEVEL READING

THE AVERAGE DISCHARGE DURING PUMPAGE IS 51.6 GPM.

ELAPSED TIME IS TAKEN FROM TO AT 1430 ON 7 - OCT - 81

APPENDIX D

TABLE D-7.

North Observation well pump test --

calculated adjusted time, Harrill's argument, drawdown, specific draw-down (s/q) and specific drawdown adjusted for Jacob's correction (s'/q)

DATE	ELAPSED t (MIN)	t** (MIN)	t/t'	S/Q (FT/GPM)	DRAW-DOWN (FT)	S'/Q#
OCT 81	HOUR					
11:44.0	00.0	00.0		-0.30		
12:14.0	00.0	00.0		-0.09		
14:12.0	00.0	00.0		-0.22		
14:34.0	4.0			0.00	0.000	0.000
15:3.0	33.0			0.00	0.200	0.004
15:16.0	46.0			-0.00	-0.110	-0.002
15:33.0	63.0			-0.00	-0.070	-0.001
15:59.0	89.0			0.00	0.000	0.000
16:32.0	122.0			0.00	0.050	0.001
16:58.0	148.0			-0.00	-0.010	-0.000
17:35.0	185.0			-0.00	-0.010	-0.000
18:0.0	210.0			-0.00	-0.020	-0.000
18:33.0	243.0			-0.00	-0.020	-0.000
19:7.0	277.0			-0.00	-0.040	-0.001
19:30.0	300.0			-0.00	-0.020	-0.000
20:4.0	334.0			-0.00	-0.020	-0.000
20:34.0	364.0			-0.00	-0.040	-0.001
21:4.0	394.0			-0.00	-0.020	-0.000
21:35.0	425.0			0.00	0.070	0.001
22:5.0	455.0			-0.00	-0.020	-0.000
22:33.0	483.0			-0.00	-0.020	-0.000
23:3.0	513.0			-0.00	-0.010	-0.000
23:36.0	546.0			-0.00	-0.010	-0.000
01:6.0	576.0			0.00	0.000	0.000
01:34.0	604.0			-0.00	-0.010	-0.000
1:6.0	636.0			-0.00	-0.010	-0.000
1:36.0	666.0			-0.00	-0.010	-0.000
2:17.0	697.0			-0.00	-0.010	-0.000
2:39.0	729.0			0.00	0.010	0.000
3:5.0	755.0			0.00	0.010	0.000
3:35.0	785.0			0.00	0.000	0.000
4:5.0	815.0			0.00	0.010	0.000
4:35.0	845.0			0.00	0.000	0.000
5:25.0	875.0			0.00	0.020	0.000
5:37.0	907.0			0.00	0.020	0.000
6:7.0	937.0			0.00	0.020	0.000
6:37.0	967.0			0.00	0.020	0.000
7:4.0	994.0			0.00	0.020	0.000
8:4.0	1054.0			0.00	0.020	0.000
9:5.0	1115.0			0.00	0.020	0.000
10:4.0	1174.0			0.00	0.020	0.000
11:5.0	1235.0			0.00	0.030	0.001
12:5.0	1295.0			0.00	0.020	0.000
13:4.0	1354.0			0.00	0.020	0.000
14:3.0	1413.0			0.00	0.020	0.000
15:2.0	1472.0			0.00	0.020	0.000
16:0.0	1530.0			0.00	0.040	0.001
17:2.0	1592.0			0.00	0.010	0.000
18:0.0	1650.0			-0.00	-0.020	-0.000
18:2.0	1652.0			0.00	0.030	0.001
19:0.0	1710.0			-0.00	-0.010	-0.000

TABLE D-7. (continued)

W. K. SUMMERS

North Observation well pump test --
 calculated adjusted time, Harrill's argument, drawdown, specific draw-
 down (s/q) and specific drawdown adjusted for Jacob's correction (s'/q)

DATE		ELAPSED	t'	t'/t		S/Q	DRAW-	S'/Q
OCT 81	HOUR	t (MIN)	(MIN)			(FT/GPM)	DOWN(FT)	
8	20: 2.0	1772.0				-0.00	-0.010	-0.000
	21: 8.0	1838.0				0.00	0.020	0.000
	22: 9.0	1899.0				0.00	0.020	0.000
	23: 8.0	1958.0				0.00	0.030	0.001
9	0: 8.0	2018.0				0.00	0.020	0.000
	1: 8.0	2078.0				0.00	0.010	0.000
	2: 7.0	2137.0				0.00	0.020	0.000
	3: 7.0	2197.0				0.00	0.020	0.000
	4: 8.0	2258.0				0.00	0.030	0.001
	5: 8.0	2318.0				0.00	0.030	0.001
	6:10.0	2380.0				0.00	0.030	0.001
	7: 0.0	2430.0				0.00	0.030	0.001
	8: 0.0	2490.0				0.00	0.040	0.001
	9: 0.0	2550.0				0.00	0.030	0.001
	10: 0.0	2610.0				0.00	0.030	0.001
	11: 0.0	2670.0				0.00	0.040	0.001
	12: 0.0	2730.0				0.00	0.030	0.001
	13: 0.0	2790.0				0.00	0.030	0.001
	14: 3.0	2853.0				0.00	0.030	0.001
	14:34.0	2884.0	3.7000E+00	7.7946E+02		0.00	0.050	0.00
	15: 0.0	2910.0	2.9700E+01	9.7980E+01		-0.00	-0.080	-0.00
	16: 2.0	2972.0	9.1700E+01	3.2410E+01		-0.00	-0.130	-0.00
	17: 0.0	3030.0	1.4970E+02	2.0240E+01		-0.00	-0.140	-0.00
	18: 2.0	3092.0	2.1170E+02	1.4606E+01		-0.00	-0.160	-0.00
	19:10.0	3160.0	2.7970E+02	1.1298E+01		-0.00	-0.150	-0.00
	20:10.0	3220.0	3.3970E+02	9.4790E+00		-0.00	-0.170	-0.00
	21: 8.0	3278.0	3.9770E+02	8.2424E+00		-0.00	-0.170	-0.00
	21:58.0	3328.0	4.4770E+02	7.4335E+00		-0.00	-0.210	-0.00
	23: 7.0	3397.0	5.1670E+02	6.5744E+00		-0.00	-0.150	-0.00
10	0:18.0	3468.0	5.8770E+02	5.9010E+00		-0.00	-0.240	-0.00
	1: 5.0	3515.0	6.3470E+02	5.5380E+00		-0.00	-0.210	-0.00
	2: 6.0	3576.0	6.9570E+02	5.1401E+00		-0.00	-0.230	-0.00
	4: 5.0	3695.0	8.1470E+02	4.5354E+00		-0.00	-0.240	-0.00
	6: 5.0	3815.0	9.3470E+02	4.0815E+00		-0.01	-0.260	-0.00
	8: 4.0	3934.0	1.0537E+03	3.7335E+00		-0.00	-0.230	-0.00
	10: 6.0	4056.0	1.1757E+03	3.4499E+00		-0.01	-0.280	-0.00
	11:54.0	4164.0	1.2837E+03	3.2437E+00		-0.00	-0.220	-0.00
	16: 9.0	4419.0	1.5387E+03	2.8719E+00		-0.00	-0.220	-0.00
	20:10.0	4660.0	1.7797E+03	2.6184E+00		-0.00	-0.220	-0.00
11	0: 7.0	4897.0	2.0167E+03	2.4282E+00		-0.00	-0.220	-0.00
	4:16.0	5146.0	2.2657E+03	2.2713E+00		-0.00	-0.250	-0.00
	8: 9.0	5379.0	2.4987E+03	2.1527E+00		-0.00	-0.230	-0.00
	12: 7.0	5617.0	2.7367E+03	2.0525E+00		-0.01	-0.260	-0.00
	16: 5.0	5855.0	2.9747E+03	1.9683E+00		-0.00	-0.240	-0.00
	20: 2.0	6092.0	3.2117E+03	1.8968E+00		-0.01	-0.290	-0.00
12	0:14.0	6344.0	3.4637E+03	1.8316E+00		-0.01	-0.270	-0.00
	2:45.0	6495.0	3.6147E+03	1.7968E+00		-0.00	-0.250	-0.00

TABLE D-7. (continued)

#S' IS THE JACOB CORRECTION, $S' = S - S^{**}2/2D$.

THE DRAWDOWN S AT ELAPSED TIME T IS CALCULATED FROM THE EQUATION:

$$S = \text{OBSERVED DEPTH TO WATER AT TIME T-TREND}$$

WHERE TREND= 0 * ELAPSED TIME + INITIAL DEPTH-TO-WATER.

THE LENGTH OF THE CONTRIBUTING INTERVAL OF THE WELL IS 34 FEET.

THE DEPTH FROM THE TOP OF CASING TO THE SCREEN IS 4 FEET.

**t' IS THE TIME THAT HAS ELAPSED SINCE THE PUMP WAS TURNED OFF.

t IS THE ELAPSED TIME FROM WHEN THE PUMP WAS TURNED ON.

1000	0.00	0.00
1010	0.00	0.00
1020	0.00	0.00
1030	0.00	0.00
1040	0.00	0.00
1050	0.00	0.00
1060	0.00	0.00
1070	0.00	0.00
1080	0.00	0.00
1090	0.00	0.00
1100	0.00	0.00
1110	0.00	0.00
1120	0.00	0.00
1130	0.00	0.00
1140	0.00	0.00
1150	0.00	0.00
1160	0.00	0.00
1170	0.00	0.00
1180	0.00	0.00
1190	0.00	0.00
1200	0.00	0.00
1210	0.00	0.00
1220	0.00	0.00
1230	0.00	0.00
1240	0.00	0.00
1250	0.00	0.00
1260	0.00	0.00
1270	0.00	0.00
1280	0.00	0.00
1290	0.00	0.00
1300	0.00	0.00
1310	0.00	0.00
1320	0.00	0.00
1330	0.00	0.00
1340	0.00	0.00
1350	0.00	0.00
1360	0.00	0.00
1370	0.00	0.00
1380	0.00	0.00
1390	0.00	0.00
1400	0.00	0.00
1410	0.00	0.00
1420	0.00	0.00
1430	0.00	0.00
1440	0.00	0.00
1450	0.00	0.00
1460	0.00	0.00
1470	0.00	0.00
1480	0.00	0.00
1490	0.00	0.00
1500	0.00	0.00
1510	0.00	0.00
1520	0.00	0.00
1530	0.00	0.00
1540	0.00	0.00
1550	0.00	0.00
1560	0.00	0.00
1570	0.00	0.00
1580	0.00	0.00
1590	0.00	0.00
1600	0.00	0.00
1610	0.00	0.00
1620	0.00	0.00
1630	0.00	0.00
1640	0.00	0.00
1650	0.00	0.00
1660	0.00	0.00
1670	0.00	0.00
1680	0.00	0.00
1690	0.00	0.00
1700	0.00	0.00
1710	0.00	0.00
1720	0.00	0.00
1730	0.00	0.00
1740	0.00	0.00
1750	0.00	0.00
1760	0.00	0.00
1770	0.00	0.00
1780	0.00	0.00
1790	0.00	0.00
1800	0.00	0.00
1810	0.00	0.00
1820	0.00	0.00
1830	0.00	0.00
1840	0.00	0.00
1850	0.00	0.00
1860	0.00	0.00
1870	0.00	0.00
1880	0.00	0.00
1890	0.00	0.00
1900	0.00	0.00
1910	0.00	0.00
1920	0.00	0.00
1930	0.00	0.00
1940	0.00	0.00
1950	0.00	0.00
1960	0.00	0.00
1970	0.00	0.00
1980	0.00	0.00
1990	0.00	0.00
2000	0.00	0.00

APPENDIX D

TABLE D-8.

South Observation well pump test -- water level data

DATE		ELAPSED TIME	WATER LEVEL		TYPE OF*	REMARKS
OCT 81	HOUR	(MINUTES)	READING#	READING		
7	11:45.0	-165.0	6.44	STEEL		
	12:20.0	-130.0	6.57	STEEL		
	13:58.0	-32.0	6.96	STEEL		
	14:30.0	0.0	6.96	STEEL		Pump on at Campbell #2
	15: 0.0	30.0	6.49	STEEL		
	15:13.0	43.0	6.44	STEEL		
	15:30.0	60.0	6.53	STEEL		
	16: 2.0	92.0	6.58	STEEL		
	16:29.0	119.0	6.55	STEEL		
	17: 0.0	150.0	6.45	STEEL		
	17: 1.0	151.0	6.42	STEEL		
	17:30.0	180.0	6.47	STEEL		
	18: 5.0	215.0	6.48	STEEL		
	18:30.0	240.0	6.46	STEEL		
	19: 4.0	274.0	6.45	STEEL		
	19:33.0	303.0	6.45	STEEL		
	20: 0.0	330.0	6.43	STEEL		
	20:30.0	360.0	6.49	STEEL		
	21:31.0	421.0	6.49	STEEL		
	22: 0.0	450.0	6.47	STEEL		
	22:30.0	480.0	6.43	STEEL		
	23: 0.0	510.0	6.43	STEEL		
	23:25.0	535.0	6.41	STEEL		
8	0: 4.0	574.0	6.43	STEEL		
	0:22.0	592.0	6.43	STEEL		
	1: 4.0	634.0	6.41	STEEL		
	1:34.0	664.0	6.40	STEEL		
	2: 3.0	693.0	6.39	STEEL		
	2:37.0	727.0	6.42	STEEL		
	3: 7.0	757.0	6.42	STEEL		
	3:37.0	787.0	6.41	STEEL		
	4: 7.0	817.0	6.42	STEEL		
	4:37.0	847.0	6.43	STEEL		
	5: 7.0	877.0	6.42	STEEL		
	5:39.0	909.0	6.42	STEEL		
	6:10.0	940.0	6.42	STEEL		
	6:40.0	970.0	6.42	STEEL		
	7: 6.0	996.0	6.42	STEEL		
	8: 6.0	1056.0	6.42	STEEL		
	9: 6.0	1116.0	6.42	STEEL		
	10: 6.0	1176.0	6.42	STEEL		
	11: 7.0	1237.0	6.42	STEEL		
	12: 5.0	1295.0	6.42	STEEL		
	13: 6.0	1356.0	6.42	STEEL		
	14: 0.0	1410.0	6.42	STEEL		
	15: 0.0	1470.0	6.44	STEEL		
	16: 2.0	1532.0	6.43	STEEL		
	17: 0.0	1590.0	6.43	STEEL		
	18: 2.0	1652.0	6.42	STEEL		
	19: 0.0	1710.0	6.42	STEEL		
	20: 3.0	1773.0	6.43	STEEL		

TABLE D-8. (continued)

South Observation well PUMP test -- water level data

DATE		ELAPSED TIME	WATER LEVEL	TYPE OF*	REMARKS
OCT 81	HOUR:MIN	(MINUTES)	READING	READING	
8	21: 7.0	1837.0	6.42	STEEL	
	22: 5.0	1895.0	6.40	STEEL	
	23: 5.0	1955.0	6.42	STEEL	
9	0: 6.0	2016.0	6.38	STEEL	
	1: 6.0	2076.0	6.42	STEEL	
	2: 5.0	2135.0	6.41	STEEL	
	3: 5.0	2195.0	6.42	STEEL	
	4: 5.0	2255.0	6.42	STEEL	
	4: 6.0	2256.0	6.42	STEEL	
	5: 8.0	2318.0	6.42	STEEL	
	7: 0.0	2430.0	6.42	STEEL	
	8: 0.0	2490.0	6.43	STEEL	
	9: 0.0	2550.0	6.42	STEEL	
	10: 0.0	2610.0	6.42	STEEL	
	11: 0.0	2670.0	6.41	STEEL	
	12: 0.0	2730.0	6.41	STEEL	
	13: 0.0	2790.0	6.42	STEEL	
9	14: 0.0	2850.0	6.42	STEEL	
	14:30.3	0.0			PUMP OFF
	14:32.0	2882.0	6.42	STEEL	PUMP OFF AT
	15: 4.0	2914.0	6.43	STEEL	CAMPBELL #2
	16: 0.0	2970.0	6.43	STEEL	
	17: 2.0	3032.0	6.47	STEEL	
	18: 0.0	3090.0	6.53	STEEL	
	19:12.0	3162.0	6.42	STEEL	
	20: 5.0	3215.0	6.46	STEEL	
	21:15.0	3285.0	6.44	STEEL	
	21:55.0	3325.0	6.45	STEEL	
	23: 3.0	3393.0	6.45	STEEL	
10	0:15.0	3465.0	6.47	STEEL	
	1: 9.0	3519.0	6.44	STEEL	
	2: 5.0	3575.0	6.43	STEEL	
	4: 6.0	3696.0	6.43	STEEL	
	6: 0.0	3810.0	6.43	STEEL	
	8: 6.0	3936.0	6.41	STEEL	
	10: 3.0	4053.0	6.47	STEEL	
	11:57.0	4167.0	6.47	STEEL	
	16: 5.0	4415.0	6.43	STEEL	
	20:12.0	4662.0	6.41	STEEL	
11	0: 6.0	4896.0	6.43	STEEL	
	4:17.0	5147.0	6.47	STEEL	
	8:12.0	5382.0	6.43	STEEL	
	12: 5.0	5615.0	6.40	STEEL	
	16: 8.0	5858.0	6.41	STEEL	
12	20: 0.0	6090.0	6.43	STEEL	
	0:18.0	6348.0	6.42	STEEL	
	2:47.0	6497.0	6.44	STEEL	

*THE TYPE OF READING DENOTES THE TYPE OF

TABLE D-8. (continued)

DEPTH TO WATER MEASUREMENT MADE. THESE MAY
BE ANY OF THE FOLLOWING:

TRANS= MEASUREMENT MADE BY A TRANSDUCER IN THE WELL.
THE MEASUREMENT IS THE HEIGHT OF THE WATER COLUMN
ABOVE THE SENSOR.

STEEL= MEASUREMENT MADE BY A STEEL TAPE.

AIR= MEASUREMENT MADE BY AN AIRLINE.

AIRTRAN=MEASUREMENT MADE BY AN AIRLINE COUPLED WITH A
TRANSDUCER.

ELECT= MEASUREMENT MADE BY AN ELECTRIC TAPE.

ABSOL= ALL MEASUREMENTS HAVE BEEN CHANGED TO ABSOLUTE DEPTH-
TO-WATER MEASUREMENTS.

*THE WATER LEVEL READING IS THE INSTRUMENT READING
MADE TO FIND THE DEPTH TO WATER.

ELAPSED TIME IS TAKEN FROM TO AT 1430 ON 7 - OCT - 81

APPENDIX D

TABLE D-9.

South Observation well pump test -- depth to water

DATE	ELAPSED TIME	DEPTH TO	TYPE OF*	
OCT 81	HOUR (MINUTES)	WATER (FT)	READING	REMARKS
7	11:45.0	-165.0	6.44	STEEL
	12:20.0	-130.0	6.57	STEEL
	13:58.0	-32.0	6.96	STEEL
	14:30.0	0.0	6.96	STEEL Pump on at Campbell #2
	15: 0.0	30.0	6.49	STEEL
	15:13.0	43.0	6.44	STEEL
	15:30.0	60.0	6.53	STEEL
	16: 2.0	92.0	6.58	STEEL
	16:29.0	119.0	6.55	STEEL
	17: 0.0	150.0	6.45	STEEL
	17: 1.0	151.0	6.42	STEEL
	17:30.0	180.0	6.47	STEEL
	18: 5.0	215.0	6.48	STEEL
	18:30.0	240.0	6.46	STEEL
	19: 4.0	274.0	6.45	STEEL
	19:33.0	303.0	6.45	STEEL
	20: 0.0	330.0	6.43	STEEL
	20:30.0	360.0	6.49	STEEL
	21:31.0	421.0	6.49	STEEL
	22:10.0	450.0	6.47	STEEL
	22:30.0	480.0	6.43	STEEL
	23: 0.0	510.0	6.43	STEEL
	23:25.0	535.0	6.41	STEEL
8	0: 4.0	574.0	6.43	STEEL
	0:22.0	592.0	6.43	STEEL
	1: 4.0	634.0	6.41	STEEL
	1:34.0	664.0	6.40	STEEL
	2: 3.0	693.0	6.39	STEEL
	2:37.0	727.0	6.42	STEEL
	3: 7.0	757.0	6.42	STEEL
	3:37.0	787.0	6.41	STEEL
	4: 7.0	817.0	6.42	STEEL
	4:37.0	847.0	6.43	STEEL
	5: 7.0	877.0	6.42	STEEL
	5:39.0	909.0	6.42	STEEL
	6:10.0	940.0	6.42	STEEL
	6:40.0	970.0	6.42	STEEL
	7: 6.0	996.0	6.42	STEEL
	8: 6.0	1056.0	6.42	STEEL
	9: 6.0	1116.0	6.42	STEEL
	10: 6.0	1176.0	6.42	STEEL
	11: 7.0	1237.0	6.42	STEEL
	12: 5.0	1295.0	6.42	STEEL
	13: 6.0	1356.0	6.42	STEEL
	14: 0.0	1410.0	6.42	STEEL
	15: 0.0	1470.0	6.44	STEEL
	16: 2.0	1532.0	6.43	STEEL
	17: 0.0	1590.0	6.43	STEEL
	18: 2.0	1652.0	6.42	STEEL
	19: 0.0	1710.0	6.42	STEEL
	20: 3.0	1773.0	6.43	STEEL

TABLE D-9. (continued)

South Observation well pump test -- depth to water

OCT 81	DATE	ELAPSED TIME	DEPTH TO#	TYPE OF*	REMARKS
	HOUR	(MINUTES)	WATER (FT)	READING	
8	21: 7.0	1837.0	6.42	STEEL	
	22: 5.0	1895.0	6.40	STEEL	
	23: 5.0	1955.0	6.42	STEEL	
9	0: 6.0	2016.0	6.38	STEEL	
	1: 6.0	2076.0	6.42	STEEL	
	2: 5.0	2135.0	6.41	STEEL	
	3: 5.0	2195.0	6.42	STEEL	
	4: 5.0	2255.0	6.42	STEEL	
	4: 6.0	2256.0	6.42	STEEL	
	5: 8.0	2318.0	6.42	STEEL	
	7: 0.0	2430.0	6.42	STEEL	
	8: 0.0	2490.0	6.43	STEEL	
	9: 0.0	2550.0	6.42	STEEL	
	10: 0.0	2610.0	6.42	STEEL	
	11: 0.0	2670.0	6.41	STEEL	
	12: 0.0	2730.0	6.41	STEEL	
	13: 0.0	2790.0	6.42	STEEL	
	14: 0.0	2850.0	6.42	STEEL	
9	14:30.3	2880.3		PUMP OFF	
	14:32.0	2882.0	6.42	STEEL	PUMP OFF AT
	15: 4.0	2914.0	6.43	STEEL	CAMPBELL #2
	16: 0.0	2970.0	6.43	STEEL	
	17: 2.0	3032.0	6.47	STEEL	
	18: 0.0	3090.0	6.53	STEEL	
	19:12.0	3162.0	6.42	STEEL	
	20: 5.0	3215.0	6.46	STEEL	
	21:15.0	3285.0	6.44	STEEL	
	21:55.0	3325.0	6.45	STEEL	
	23: 3.0	3393.0	6.45	STEEL	
10	0:15.0	3465.0	6.47	STEEL	
	1: 9.0	3519.0	6.44	STEEL	
	2: 5.0	3575.0	6.43	STEEL	
	4: 6.0	3696.0	6.43	STEEL	
	6: 0.0	3810.0	6.43	STEEL	
	8: 6.0	3936.0	6.41	STEEL	
	10: 3.0	4053.0	6.47	STEEL	
	11:57.0	4167.0	6.47	STEEL	
	16: 5.0	4415.0	6.43	STEEL	
	20:12.0	4662.0	6.41	STEEL	
11	0: 6.0	4896.0	6.43	STEEL	
	4:17.0	5147.0	6.47	STEEL	
	8:12.0	5382.0	6.43	STEEL	
	12: 5.0	5615.0	6.40	STEEL	
	16: 8.0	5858.0	6.41	STEEL	
	20: 0.0	6090.0	6.43	STEEL	
12	0:18.0	6348.0	6.42	STEEL	
	2:47.0	6497.0	6.44	STEEL	

*THE TYPE OF READING DENOTES THE TYPE OF

APPENDIX D

TABLE D-10. South Observation well PUMP test -- calculated adjusted time, Harrill's argument, drawdown, specific draw-down (s/a) and specific drawdown adjusted for Jacob's correction (s'/a)

DATE	ELAPSED	t**	S/Q	DRAW-	S'/Q#
OCT 81 HOUR	t (MIN)	(MIN)	(FT/GPM)	DOWN(FT)	
7	12:20.0		-0.39		
	13:58.0		0.00		
	14:30.0		0.00		
	15: 0.0	30.0	-0.01	-0.470	-0.009
	15:13.0	43.0	-0.01	-0.520	-0.010
	15:30.0	60.0	-0.01	-0.430	-0.008
	16: 2.0	92.0	-0.01	-0.380	-0.007
	16:29.0	119.0	-0.01	-0.410	-0.008
	17: 0.0	150.0	-0.01	-0.510	-0.010
	17: 1.0	151.0	-0.01	-0.540	-0.011
	17:30.0	180.0	-0.01	-0.490	-0.010
	18: 5.0	215.0	-0.01	-0.480	-0.009
	18:30.0	240.0	-0.01	-0.500	-0.010
	19: 4.0	274.0	-0.01	-0.510	-0.010
	19:33.0	303.0	-0.01	-0.510	-0.010
	20: 0.0	330.0	-0.01	-0.530	-0.010
	20:30.0	360.0	-0.01	-0.470	-0.009
	21:31.0	421.0	-0.01	-0.470	-0.009
	22: 0.0	450.0	-0.01	-0.490	-0.010
	22:30.0	480.0	-0.01	-0.530	-0.010
	23: 0.0	510.0	-0.01	-0.530	-0.010
	23:25.0	535.0	-0.01	-0.550	-0.011
8	0: 4.0	574.0	-0.01	-0.530	-0.010
	0:22.0	592.0	-0.01	-0.530	-0.010
	1: 4.0	634.0	-0.01	-0.550	-0.011
	1:34.0	664.0	-0.01	-0.560	-0.011
	2: 3.0	693.0	-0.01	-0.570	-0.011
	2:37.0	727.0	-0.01	-0.540	-0.011
	3: 7.0	757.0	-0.01	-0.540	-0.011
	3:37.0	787.0	-0.01	-0.550	-0.011
	4: 7.0	817.0	-0.01	-0.540	-0.011
	4:37.0	847.0	-0.01	-0.530	-0.010
	5: 7.0	877.0	-0.01	-0.540	-0.011
	5:39.0	909.0	-0.01	-0.540	-0.011
	6:10.0	940.0	-0.01	-0.540	-0.011
	6:40.0	970.0	-0.01	-0.540	-0.011
	7: 6.0	996.0	-0.01	-0.540	-0.011
	8: 6.0	1056.0	-0.01	-0.540	-0.011
	9: 6.0	1116.0	-0.01	-0.540	-0.011
	10: 6.0	1176.0	-0.01	-0.540	-0.011
	11: 7.0	1237.0	-0.01	-0.540	-0.011
	12: 5.0	1295.0	-0.01	-0.540	-0.011
	13: 6.0	1356.0	-0.01	-0.540	-0.011
	14: 0.0	1410.0	-0.01	-0.540	-0.011
	15: 0.0	1470.0	-0.01	-0.520	-0.010
	16: 2.0	1532.0	-0.01	-0.530	-0.010
	17: 0.0	1590.0	-0.01	-0.530	-0.010
	18: 2.0	1652.0	-0.01	-0.540	-0.011
	19: 0.0	1710.0	-0.01	-0.540	-0.011
	20: 3.0	1773.0	-0.01	-0.530	-0.010
	21: 7.0	1837.0	-0.01	-0.540	-0.011

TABLE D-10. (continued)

South Observation well pump test --
 calculated adjusted time, Harrill's argument, drawdown, specific draw-
 down (s/q) and specific drawdown adjusted for Jacob's correction (s'/q)

DATE		ELAPSED	t'	t'/t'	S/Q	DRAW-	S'/Q#
OCT 81	HOUR	t (MIN)	(MIN)		(FT/GPM)	DOWN(FT)	
8	22: 5.0	1895.0			-0.01	-0.560	-0.011
	23: 5.0	1955.0			-0.01	-0.540	-0.011
9	0: 6.0	2016.0			-0.01	-0.580	-0.011
	1: 6.0	2076.0			-0.01	-0.540	-0.011
	2: 5.0	2135.0			-0.01	-0.550	-0.011
	3: 5.0	2195.0			-0.01	-0.540	-0.011
	4: 5.0	2255.0			-0.01	-0.540	-0.011
	4: 6.0	2256.0			-0.01	-0.540	-0.011
	5: 8.0	2318.0			-0.01	-0.540	-0.011
	7: 0.0	2430.0			-0.01	-0.540	-0.011
	8: 0.0	2490.0			-0.01	-0.530	-0.010
	9: 0.0	2550.0			-0.01	-0.540	-0.011
	10: 0.0	2610.0			-0.01	-0.540	-0.011
	11: 0.0	2670.0			-0.01	-0.550	-0.011
	12: 0.0	2730.0			-0.01	-0.550	-0.011
	13: 0.0	2790.0			-0.01	-0.540	-0.011
	14: 0.0	2850.0			-0.01	-0.540	-0.011
10	14:32.0	2882.0	1.7000E+00	1.6953E+03	-0.01	-0.540	-0.01
	15: 4.0	2914.0	3.3700E+01	8.6469E+01	-0.01	-0.530	-0.01
	16: 0.0	2970.0	8.9700E+01	3.3110E+01	-0.01	-0.530	-0.01
	17: 2.0	3032.0	1.5170E+02	1.9987E+01	-0.01	-0.490	-0.01
	18: 0.0	3090.0	2.0970E+02	1.4735E+01	-0.01	-0.430	-0.00
	19:12.0	3162.0	2.8170E+02	1.1225E+01	-0.01	-0.540	-0.01
	20: 5.0	3215.0	3.3470E+02	9.6056E+00	-0.01	-0.500	-0.01
	21:15.0	3285.0	4.0470E+02	8.1171E+00	-0.01	-0.520	-0.01
	21:55.0	3325.0	4.4470E+02	7.4770E+00	-0.01	-0.510	-0.01
	23: 3.0	3393.0	5.1270E+02	6.6179E+00	-0.01	-0.510	-0.01
	0:15.0	3465.0	5.8470E+02	5.9261E+00	-0.01	-0.490	-0.01
	1: 9.0	3519.0	6.3870E+02	5.5096E+00	-0.01	-0.520	-0.01
	2: 5.0	3575.0	6.9470E+02	5.1461E+00	-0.01	-0.530	-0.01
	4: 6.0	3696.0	8.1570E+02	4.5311E+00	-0.01	-0.530	-0.01
	6: 0.0	3810.0	9.2970E+02	4.0981E+00	-0.01	-0.530	-0.01
	8: 6.0	3936.0	1.0557E+03	3.7283E+00	-0.01	-0.550	-0.01
	10: 3.0	4053.0	1.1727E+03	3.4561E+00	-0.01	-0.490	-0.01
	11:57.0	4167.0	1.2867E+03	3.2385E+00	-0.01	-0.490	-0.01
	16: 5.0	4415.0	1.5347E+03	2.8768E+00	-0.01	-0.530	-0.01
	20:12.0	4662.0	1.7817E+03	2.6166E+00	-0.01	-0.550	-0.01
11	0: 6.0	4896.0	2.0157E+03	2.4289E+00	-0.01	-0.530	-0.01
	4:17.0	5147.0	2.2667E+03	2.2707E+00	-0.01	-0.490	-0.01
	8:12.0	5382.0	2.5017E+03	2.1513E+00	-0.01	-0.530	-0.01
	12: 5.0	5615.0	2.7347E+03	2.0532E+00	-0.01	-0.560	-0.01
	16: 8.0	5858.0	2.9777E+03	1.9673E+00	-0.01	-0.550	-0.01
	20: 0.0	6090.0	3.2097E+03	1.8974E+00	-0.01	-0.530	-0.01
12	0:18.0	6348.0	3.4677E+03	1.8306E+00	-0.01	-0.540	-0.01
	2:47.0	6497.0	3.6167E+03	1.7964E+00	-0.01	-0.520	-0.01

TABLE D-10. (continued)

#S' IS THE JACOB CORRECTION, $S' = S - S^{**}2/2D$.

THE DRAWDOWN S AT ELAPSED TIME T IS CALCULATED FROM THE EQUATION:

$S =$ OBSERVED DEPTH TO WATER AT TIME T-TREND

WHERE TREND= 0 * ELAPSED TIME + INITIAL DEPTH-TO-WATER.

THE LENGTH OF THE CONTRIBUTING INTERVAL OF THE WELL IS 71 FEET.
THE DEPTH FROM THE TOP OF CASING TO THE SCREEN IS 4 FEET.

**t' IS THE TIME THAT HAS ELAPSED SINCE THE PUMP WAS TURNED OFF.
t IS THE ELAPSED TIME FROM WHEN THE PUMP WAS TURNED ON.

WATER CHEMISTRIES

[illegible]

APPENDIX E

CHEMICAL ANALYSIS OF WATER

Date collected: 10-6-81 Hour: 09:25 Source: Gila Hot Springs #14

Date analysis complete: 1-21-82 Location: T. 13 S., R. 13 W.

Laboratory: New Mexico Bureau of Mines Sec. 5.213

Laboratory No.: 1467

Source of data: NMBMMR

File No.: GHS14

Remarks

Other: old bathhouse spring

Temperature when sampled = 66 C.

Copper < 10 ppb, Zinc < 0.05 ppm, Selenium 0.02 ppm

Lithium 0.25 ppm, Nickel < 0.1 ppm, Chromium 2 ppb

Uranium < 0.05 ppm

Constituent	Concentration mg/l	me/l	Percent
SiO2	73		
Fe+3/total	<0.5	0.00	0.0
Mn+2	<0.1	0.00	0.0
Ca+2	10.6	0.53	8.7
Mg+2	0.05	0.00	0.1
Na+	125	5.44	89.6
K+	3.8	0.10	1.6
Sum of cations:		6.07	100.0
HC03-	76	1.25	20.6
C03-2	0	0.00	0.0
S04-2	110	2.29	37.8
Cl-	84.8	2.39	39.5
F-	2.25	0.12	2.0
B-			
PO4-3		0.00	0.0
NO3-	0.31	0.00	0.1
Sum of anions:		6.05	100.0

Sum of dissolved solids: 447.

Cations-Anions

100 X $\frac{\text{Cations}-\text{Anions}}{\text{Cations}+\text{Anions}} = 0.1$

Residue:

Lab	Date	Field	Date
pH	7.9	7.75	10-6-81
Sp. Cond.	600	640	10-6-81

Discharge rate: about 5 gpm

APPENDIX E CHEMICAL ANALYSIS OF WATER

Date collected: 10-6-81 Hour: 09:35 Source: Gila Hot Springs #41
Date analysis complete: 1-21-82 Location: T. 13 S., R. 13 W.
Laboratory: New Mexico Bureau of Mines Sec. 5.211
Laboratory No.: 1469
Source of data: NMBMMR File No.: GHS41

Remarks: Other: one of the piped springs
Temperature when sampled = 58 C.
Copper < 10 ppb, Zinc < 0.05 ppm, Selenium 0.02 ppm
Lithium 0.25 ppm, Nickel < 0.1 ppm, Chromium 2 ppb
Uranium < 0.05 ppm

Constituent	Concentration mg/l	Concentration me/l	Percent
SiO2	67		
Fe+3/total	<0.5	0.00	0.0
Mn+2	<0.1	0.00	0.0
Ca+2	10.2	0.51	8.7
Mg+2	0.08	0.01	0.1
Na+	121	5.26	89.6
K+	3.6	0.09	1.6
		Sum of cations:	100.0
		5.87	
HCO3-	76	1.25	21.3
CO3-2	0	0.00	0.0
SO4-2	103	2.14	36.6
Cl-	83.1	2.34	40.0
F-	2.20	0.12	2.0
B-			
PO4-3	0.0	0.00	0.0
NO3-	0.28	0.00	0.1
		Sum of anions:	100.0
		5.86	
Sum of dissolved solids:	428.		
		Cations-Anions	
		100 X ----- = 0.1	
Residue:		Cations+Anions	

Lab	Date	Field	Date
pH	10-13-81	7.85	10-6-81
Sp. Cond.	10-14-81	560	10-6-81

Discharge rate: about 1 gpm

APPENDIX E
CHEMICAL ANALYSIS OF WATER

Date collected: 10-7-81 Hour: 14:45 Source: Well Campbell et al. 2

Date analysis complete: 1-21-82 Location: T. 13 S., R. 13 W.

Laboratory: New Mexico Bureau of Mines Sec. 5.212

Laboratory No.: 1473

Source of data: NMBMMR

File No.: CMBL21

Remarks Other: First sample in test.

Temperature when sampled = 61 C.

Copper < 10 PPB, Zinc < 00.05 PPM, Selenium 0.02 PPM

Lithium 0.25 PPM, Nickel < 0.1 PPM, Chromium < 2 PPB

Uranium < 0.05 PPM

Constituent	Concentration mg/l	me/l	Percent
SiO2	60		
Fe+3/total	<0.5	0.00	0.0
Mn+2	<0.1	0.00	0.0
Ca+2	10.6	0.53	9.1
Mg+2	0.08	0.01	0.1
Na+	120	5.22	89.3
K+	3.4	0.09	1.5
Sum of cations:		5.84	100.0
HC03-	76	1.25	21.2
C03-2	0	0.00	0.0
S04-2	100	2.08	35.4
Cl-	86.3	2.43	41.4
F-	2.25	0.12	2.0
B-			
PO4-3		0.00	0.0
NO3-	<0.09	0.00	0.0
Sum of anions:		5.88	100.0

Sum of dissolved solids: 420.

Cations-Anions

100 X $\frac{\text{Cations}-\text{Anions}}{\text{Cations}+\text{Anions}}$ = 0.3

Residue:

Lab	Date	Field	Date
pH 8.1	10-14-81	7.97	10-7-81
Sp. Cond. 600	10-14-81	620	10-7-81

Discharge rate: 51.8 gpm

APPENDIX E

GEOSTRATIGRAPHIC ANALYSIS OF WATER

Date collected: 10-7-81 Hour: 16:10 Source: Well Campbell et al. 2

Date analysis complete: 1-21-82 Location: T. 13 S., R. 13 W.

Laboratory: New Mexico Bureau of Mines Sec. 5.212

Laboratory No.: 1471

Source of data: NMBMMR

File No.: CMBL22

Remarks: (See print record)

Other: Second sample in test.

Temperature when sampled = 62 C.

Copper < 10 ppb, Zinc < 0.05 ppm, Selenium 0.02 ppm

Lithium 0.25 ppm, Nickel < 0.1 ppm, Chromium 2 ppb

Uranium < 0.05 ppm

Constituent	Concentration mg/l	Concentration mg/l	Percent
SiO2	65	65	
Fe+3/total	<0.5	0.00	0.0
Mn+2	<0.1	0.00	0.0
Ca+2	10.2	0.51	8.9
Mg+2	0.08	0.01	0.1
Na+2	118	5.13	89.5
K+	0.34	0.09	1.5
		Sum of cations:	100.0
		5.74	
HCO3-	76	1.25	21.7
CO3-2	0.0	0.00	0.0
SO4-2	100	2.08	36.3
Cl-	81.4	2.30	40.0
F-	2.15	0.11	2.0
B-			
PO4-3	0.0	0.00	0.0
NO3-	<0.09	0.00	0.0
		Sum of anions:	100.0
		5.74	
Sum of dissolved solids:	418.		
		Cations-Anions	
		100 X ----- =	0.0
Residue:		Cations+Anions	

Lab	Date	Field	Date
pH	8.1	10-14-81	10-7-81
Sp. Cond.	600	10-14-81	10-7-81

Discharge rate: 50.0 gpm

APPENDIX E

CHEMICAL ANALYSIS OF WATER

Date collected: 10-7-81 Hour: 22:52 Source: Well Campbell et al. 2

Date analysis complete: 1-21-82 Location: T. 13 S., R. 13 W.

Laboratory: New Mexico Bureau of Mines Sec. 5.212

Laboratory No.: 1468

Source of data: NMBMMR

File No.: CMEL23

Remarks: Other: Third sample in test.

Temperature when sampled = 60 C.

Copper < 10 ppb, Zinc < 0.05 ppm, Selenium 0.02 ppm

Lithium 0.25 ppm, Nickel < 0.1 ppm, Chromium 2 ppb

Uranium < 0.05 ppm

Constituent	Concentration mg/l	me/l	Percent
SiO2	68		
Fe+3/total	<0.5	0.00	0.0
Mn+2	<0.1	0.00	0.0
Ca+2	11.0	0.55	9.3
Mg+2	0.09	0.01	0.1
Na+	120	5.22	88.8
K+	3.9	0.10	1.7
Sum of cations:		5.88	100.0
HCO3-	76	1.25	21.1
CO3-2	0	0.00	0.0
SO4-2	103	2.14	36.4
Cl-	84.8	2.39	40.6
F-	2.10	0.11	1.9
B-			
PO4-3		0.00	0.0
NO3-	0.27	0.00	0.1
Sum of anions:		5.90	100.0

Sum of dissolved solids: 431.

Cations-Anions

Residue:

$$100 \times \frac{\text{Cations} - \text{Anions}}{\text{Cations} + \text{Anions}} = 0.2$$

Lab	Date	Field	Date
PH 7.7	10-13-81		
Sp. Cond. 600	10-14-81		

Discharge rate: 52.0 gpm

APPENDIX E

CHEMICAL ANALYSIS OF WATER

Date collected: 10-8-81 Hour: 07:11 Source: Well Campbell et al. 2

Date analysis complete: 1-21-82 Location: T. 13 S., R. 13 W.

Laboratory: New Mexico Bureau of Mines Sec. 5.212

Laboratory No.: 1470

Source of data: NMBMMR

File No.: CMBL24

Remarks of sample: 10-17-81

Other: Fourth sample in test.

Temperature when sampled = 61 C.

Copper < 10 ppb, Zinc < 0.05 ppm, Selenium 0.02 ppm

Lithium 0.25 ppm, Nickel < 0.1 ppm, Chromium 2 ppb

Uranium < 0.05 ppm

Constituent	Concentration mg/l	Concentration me/l	Percent
SiO2	66		
Fe+3/total	<0.5	0.00	0.0
Mn+2	<0.1	0.00	0.0
Ca+2	10.2	0.51	8.8
Mg+2	0.09	0.01	0.1
Na+3	118	5.13	89.1
K+	4.5	0.12	2.0
	Sum of cations:	5.76	100.0
HCO3-	76	1.25	21.2
CO3-2	0.0	0.00	0.0
SO4-2	100	2.08	35.4
Cl-	86.5	2.44	41.5
F-	2.05	0.11	1.8
B-			
PO4-3	0.0	0.00	0.0
NO3-	0.1	0.00	0.0
	Sum of anions:	5.88	100.0

Sum of dissolved solids: 425.

Cations-Anions

100 X ----- = 1.0

Residue: 425 - 425 = 0

Cations+Anions

Lab	Date	Field	Date
pH 8.1	10-14-81		
Sp. Cond. 650	10-14-81		

Discharge rate: 51.8 gpm

APPENDIX E

CHEMICAL ANALYSIS OF WATER

Date collected: 10-9-81 Hour: 14:00 Source: Well Campbell et al. 2

Date analysis complete: 12-31-81 Location: T. 13 S., R. 13 W.

Laboratory: New Mexico Bureau of Mines Sec. 5.212

Laboratory No.: 1472

Source of data: NBRMMR

File No.: CMBL25

Remarks: Other: Fifth sample in test.

Temperature when sampled = 62 C.

Copper < 10 ppb, Zinc < 0.05 ppm, Selenium 0.02 ppm

Lithium 0.25 ppm, Nickel < 0.1 ppm, Chromium 2 ppb

Uranium < 0.05 ppm

Constituent	Concentration mg/l	me/l	Percent
SiO2	70		
Fe+3/total	<0.5	0.00	0.0
Mn+2	<0.1	0.00	0.0
Ca+2	10.6	0.53	10.1
Mg+2	0.09	0.01	0.1
Na+	106	4.61	88.1
K+	3.4	0.09	1.7
Sum of cations:		5.23	100.0
HCO3-	76	1.25	22.0
CO3-2	0	0.00	0.0
SO4-2	100	2.08	36.7
Cl-	83.1	2.34	41.3
F-		0.00	0.0
B-			
PO4-3		0.00	0.0
NO3-	<0.09	0.00	0.0
Sum of anions:		5.67	100.0

Sum of dissolved solids: 411. Cations-Anions
 100 X ----- = 4.0
 Residue: Cations+Anions

Lab	Date	Field	Date
pH	8.1	7.72	11-4-81
Sp. Cond.	600	550	11-4-81

Discharge rate: 50.0 gpm

as follows:

$$\bar{H}_v = \frac{1}{2} (H_1 + H_2)$$

$$\bar{H}_v = \frac{1}{2} (H_1 + H_2)$$

APPENDIX F

VERTICALLY-AVERAGED HEAD

The vertically-averaged head is defined as the average of the head at the top and bottom of the water column. It is denoted by $\bar{H}_v$. The head at the top of the water column is denoted by H_1 and the head at the bottom is denoted by H_2 . The vertically-averaged head is given by the equation:

$$\bar{H}_v = \frac{1}{2} (H_1 + H_2)$$

The vertically-averaged head is a useful parameter in the design of water distribution systems. It is used to determine the required pipe size and the power requirements for the pumps. The vertically-averaged head is also used to determine the head loss in the pipes. The head loss in the pipes is denoted by H_f and is given by the equation:

$$H_f = K \bar{H}_v$$

The head loss in the pipes is a function of the pipe diameter, the flow rate, and the friction coefficient. The friction coefficient is denoted by K and is a function of the pipe material and the flow rate. The head loss in the pipes is an important factor in the design of water distribution systems. It is used to determine the required pipe size and the power requirements for the pumps. The head loss in the pipes is also used to determine the head available at the outlets. The head available at the outlets is denoted by H_o and is given by the equation:

$$H_o = \bar{H}_v - H_f$$

The head available at the outlets is a function of the pipe diameter, the flow rate, and the friction coefficient. The head available at the outlets is an important factor in the design of water distribution systems. It is used to determine the required pipe size and the power requirements for the pumps. The head available at the outlets is also used to determine the head loss in the pipes. The head loss in the pipes is denoted by H_f and is given by the equation:

$$H_f = K \bar{H}_v$$

APPENDIX F

VERTICALLY AVERAGED HEAD

We define the vertically averaged head as follows:

$$\begin{aligned}\bar{h}(x,y) &= \int_{z_1}^{z_2} h(x,y,z) dz / \int_{z_1}^{z_2} dz \\ &= \frac{1}{\Delta z} \int_{z_1}^{z_2} h(x,y,z) dz\end{aligned}$$

where

$$\Delta z = z_2 - z_1,$$

$\bar{h}(x,y)$ is the vertically averaged head,

$h(x,y,z)$ is the three-dimensional head distribution,

z is the variable in the vertical, and

z_1, z_2 are the limits over which we find the average value of $h(x,y,z)$.

$\bar{h}(x,y)$ always lies between $h(x_1, y_1, z_1)$ and $h(x_1, y_1, z_2)$.

Most ground-water systems, because they are three-dimensional, exhibit substantial head variation along verticals (z). The most variation occurs in recharge and discharge areas.

For illustration purposes, figure 1 shows a possible head distribution in one cross section. It also shows a graph of the head at the water table and the averaged head in the vertical. [Any two-dimensional (z,y) model of this system of necessity would generate the average head ($\bar{h}$) -- not the head at the water table.]

Figure F-1. Head distribution, head at the water table, and vertically-averaged head in one cross-section.

APPENDIX G

ESTIMATING THE OPTIMUM AND "FIRST-YEAR" YIELDS OF A WATER WELL

APPENDIX G

ESTIMATING THE OPTIMUM AND "FIRST-YEAR"

YIELDS OF A WATER WELL

By W.K. Summers

DEFINITIONS

The optimum instantaneous yield of a water well is the discharge that occurs when the water enters the well at the maximum permissible velocity. The "first-year" yield of a well is the volume of water the well will produce if it were to pump continuously for 365 days. We use "screen" for the interval through which water enters the well; the interval may actually be open hole, perforated casing, casing with torch-cut slots, wire-wrapped screen, or any other structure. "Screen" lets us avoid repeated use of phrases such as "contributing interval of the well".

PURPOSE AND SCOPE

This paper (1) presents equations for (a) estimating the optimum instantaneous yield (and the associated drawdown) at any point in time after pumping begins, taking well losses into account, and (b) estimating the "first-year" yield, and (2) discusses briefly the concept of maximum permissible entrance velocity.

NOTATION

We use the following notation in our analysis:

- a is the area of openings per foot of screen through which water enters the well (ft^2/ft),
- d is the length of the screen (ft),
- H_0 is the initial (pre pumping) depth to the bottom of the screen from the water level in the well (ft),
- Q is the optimum discharge rate (gpm),
- Q' is the optimum discharge rate (ft^3/sec),
- $\bar{Q}$ is the arithmetic mean discharge during a pumping period (gpm),
- r_w is the well radius (ft),
- s is the drawdown (ft),
- S is the coefficient of storage,
- t is the time (days),
- T is the transmissivity (gpd/ft),
- v is the velocity through the screen openings (ft/sec), and
- V is the volume of water pumped during a given time interval (gallons).

THEORY

In our analysis we assume that Theissian conditions apply. (Of these, the most important is that T remains approximately constant during the pumping period.)

If the pumping water level is above the top of the screen of a pumping well ($H_0 - s \geq d$)

$$v = Q' / ad \text{ ft/sec} \quad (1)$$

or

expressing Q' in gpm gives

$$Q = 448.8vad \quad (2)$$

In many cases the pumping level at the optimum pumping rate will be below the top of the screen. The screen length of the well then becomes $H_0 - s$ rather than d . So we have the maximum discharge

$$Q = 448.8va(H_0 - s) \quad (3)$$

However, we also know that for many wells

$$s = BQ + CQ^2 \quad (4)$$

where

$$B = \frac{114.6}{T} \int_u^\infty \frac{e^{-u}}{u} du, \quad (5)$$

where

$$u = \frac{1.87r_w^2 S}{Tt}$$

or

if $u \leq 0.01$

$$B = \frac{264}{T} \log_{10} \left(\frac{0.3Tt}{r_w^2 S} \right) \quad (6)$$

If we know v , a , d , T , t , r_w , S , and C for the case where the pumping level is above the screen we solve equation (2) and then estimate s using equation (4). However, for the case where the pumping level is in the screen, equations (3) and (4) become two equations with two unknowns. Substituting (4) in (3) and rearranging terms we get

$$448.8vaCQ^2 + (448.8vaB + 1)Q - 448.8vaH_0 = 0 \quad (7)$$

So

$$Q = \frac{-(448.8vaB + 1) + \sqrt{(448.8vaB + 1)^2 - 4(448.8vaC)(-448.8vaH_0)}}{2(448.8vaC)} \quad (8)$$

In this case we solve equation (8) for Q , we then estimate s using equation (4).

These procedures give an estimate of the instantaneous optimum Q and resulting s at time t . The total discharge (V) for the time period t_1 to t_2 is then

$$V = \left(\int_{t_1}^{t_2} Q \, dt \right) \times 1440 \quad (9)$$

We obtain the first-year yield by setting $t_1 = 1$ and $t_2 = 365$ days.

The average discharge rate is:

$$\bar{Q} = V / (t_1 - t_2) 1440 \quad (10)$$

ENTRANCE VELOCITIES

Presumably the velocity at the exterior screen face is the fastest that the water achieves in moving through the rocks to the well. The ideal approach velocity is the one that is perceptibly less than is necessary to produce turbulent flow in the rocks near the well. That is, the Reynolds Number (N_R) for the water-rock system near the well should be less than 100.

For ground water, $N_R = 10^3 Dv$, where D is the conduit diameter in feet, and v is the velocity in feet per second. Because, at $N_R = 100$, $v = 10^{-3}/D$, the diameter of the conduit controls the estimate of the optimum entrance velocity. Faster velocities are permissible in small-diameter conduits than in large-diameter conduits. So for flow through fine-grained rocks with intergranular pore diameters of 0.1 mm (.0003ft), the maximum permissible velocity would be about 3 ft/sec: whereas for flow through coarse-grained rocks with intergranular pore diameters of 5 mm (.02ft), the maximum permissible velocity would be about .05 ft/sec. Fractures and solution features may give rise to larger conduit diameters and even slower maximum permissible velocities.

The maximum entrance velocity depends upon well-site conditions. Drilling the well can cause changes in the porosity characteristics of the rocks near the well bore and the bore may cross water-yielding rocks of diverse porosity characteristics. So in practice we may not be able--on the strength of the data in hand--to determine the maximum permissible velocity at the screen.

Johnson, Inc. (1975, p.193) suggest that the maximum screen-entrance velocity should be less than or equal to 0.1 ft/sec, because experimental evidence indicates that for wire-wrapped screens, this minimizes:

- (a) friction losses,
- (b) the rate of incrustation, and
- (c) the rate of corrosion.

Our experience in determining the optimum yields of wells of all sorts using 0.1 ft/sec as the optimum entrance velocity in-

icates that the 0.1 ft/sec is an acceptable value to use in day to day practice.

DISCUSSION

Application

The procedure outlined above requires the results of a step pumping test on the well for which the optimum and "first-year" yield is to be estimated. These tests generally provide T and C. With an observation well during the step test S may also be measured, but if no data on S are available, a reasonable estimate of S can be made by either

- (1) assuming that $S = d \times S_s = d \times 10^{-6}/\text{ft}$
(where S_s is the specific storage), or
- (2) assuming that $S = S_y = .05$ for rocks with intergranular porosity or $S_y = .005$ for rocks with fracture porosity (when $S_y =$ specific yield).

These assumptions are reasonable, because order-of-magnitude errors in the estimates of S produce less than 20 percent error in estimates of Q and s.

We can estimate a in three ways:

- (1) from the construction records (the specifications for some louvered casing, mill-slotted casing, and wire-wrapped or plastic screens give a),
- (2) from television surveys of the well, or
- (3) from the pumping-test data.

To use pumping-test data to determine a , solve equation (8) by trial and error. Use as constants for the equation the values determined from the test and the last t of the pumping period. Then, assume a value for a and solve for Q ; if the computed Q doesn't agree with the observed Q , change a appropriately and solve for Q again. Repeat until the chosen value of a produces a computed Q approximately equal to the observed Q . Then check the validity of all computed parameters by solving equation (4) for s ; if the s computed for the test approximately equals the observed s , predictions of the instantaneous optimum yield after one year of pumping and of the "first-year" yield can be accepted with confidence.

Reservations

The procedure for estimating optimum yields and "first-year" yield presume Theissian conditions. Thus, the impacts of nearby pumping wells and hydrologic boundaries are excluded from the predictions. To refine the predictions taking these factors into account may require geologic or hydrologic mapping, an inventory of nearby wells, or site-specific additional information. Moreover, because the major Theissian assumption is that all water came from storage, long-term estimates of V may be too small because they fail to adequately take recharge into account.

REFERENCE

Johnson, Inc. (1975) Ground Water and Wells: St. Paul, Minnesota, 440p.

APPENDIX H

Determination of Aquifer Parameters from Step Tests and Intermittent Pumping Data

by Yüksel K. Birsoy and W. K. Summers

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