GROUND - WATER HYDROLOGY

NEAR THE L - BAR

TAILINGS RESERVOIR -

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FOR

SOHIO WESTERN MINING COMPANY
AND
RESERVE OIL AND MINERALS CORPORATION
ALBUQUERQUE, NEW MEXICO



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1.0 INTRODUCTION AND SUMMARY

SOHIO WESTERN Mining Company submitted a Ground-Water Discharge Plan for their L-Bar Uranium Project to New Mexico Environmental Improvement Division (EID) in October 1980. Several questions and concerns were expressed by EID personnel after review of the Plan. The purpose of this report is to address the questions and concerns of the EID relating to the ground-water hydrology near SOHIO's L-Bar tailings disposal reservoir.

The major geologic unit which outcrops in the area of the tailings pond is the Mancos shale. The first (upper) Tres Hermanos Sandstone in the Mancos shale and a thin mantle of alluvium are the two main aquifers for potentially transmitting seepage. The first Tres Hermanos sandstone generally dips to the north-northwest in this area while the alluvial system slopes with the local drainage to the west-southwest. An investigation of lineaments and joints in this area were presented in this report. The majority of the joints were oriented between the northwest to northeast directions.

Three new wells were constructed during this investigation and were used with the existing twenty-one wells to evaluate the ground-water systems near the tailings. One long term (69 days) pumping and recovery test was conducted with nine observation wells to obtain aquifer properties and define the continuity of the first Tres Hermanos aquifer. Five additional single well tests were also conducted to extend the coverage of transmissivity data.

Transmissivities varied from 0.4 to 1200 gal/day/ft for the first Tres Hermanos aquifer. A transmissivity in the range of 250 gal/day/ft is representative of a large area near wells 1A, 5, 6, 7, 8, 12 and 14. A much smaller

transmissivity in the range of 50 gal/day/ft is probably representative of the southwest portion of the tailings area near wells 3A, 4A and 15. The transmissivity of the first Tres Hermanos aquifer is very low east of the tailings pond, near well 17. A much higher zone of transmissivity exists near well 2A. The long term and 2A pump tests show that this zone does not extend to the west and that a much lower transmissivity zone probably exists between well 2A and the other wells in this area.

A permeability of 1.0 ft/day is representative of a large portion of the first Tres Hermanos aquifer in the area between wells 9 and 14. An average permeability of 0.5 ft/day is probably representative of the area near wells 3A, 4A and 15.

A storage coefficient of 3×10^{-5} is considered representative of the first Tres Hermanos aquifer from well 5 to the north. The first Tres Hermanos sandstone is not fully saturated from well 3A to the south.

The alluvial aquifer is not very transmissive near the tailings site. The transmissivity and permeability of the alluvial aquifer are probably less than 2 gal/day/ft and 0.1 ft/day, respectively.

The primary permeability of first Tres Hermanos sandstone should be significantly less than one ft/day. The results of the pump tests indicates that the permeability of the aquifer at several of the wells is probably influenced by fractures. Conductivity and temperature profiles were also used as indicators of fracture permeability. Sharp changes in either of these parameters in the perforated interval of a well are good indicators of fracture permeability. The profiles indicated that wells 2A, 5, 6, 8, 10, 12 and 14 have fracture permeability. Some fracture permeability probably exists in wells 1A, 7 and 9. Profiles of well 3A, 3B, 4A, 15 and 17 did not

1'/1000' = .001 gradient T.H. ss
1/300' = .003 gradient Alluv.

show indications of fractures.

Ground water is moving mainly to the west and north of the tailings pond in the first Tres Hermanos aquifer. Movement of ground water in the alluvial aquifer is to the west of the tailings pond area. The water level rise of one foot in the first Tres Hermanos aquifer is less than one thousand feet from the tailings pile. An equal rise in the alluvial aquifer is approximately 300 feet downstream of the tailings dam.

Ground water moves at an average rate of 0.5 ft/day (180 ft/yr) in the first Tres Hermanos aquifer in the area of wells 5 and 10. A rate of 0.1 ft/day (36 ft/yr) is generally representative of the area between wells 3A, 4A and 15. Ground water in the alluvial aquifer on the west side of the tailings pond moves in the range of 0.03 ft/day (11 ft/yr). A rate of ground-water flow of 17 gpm was estimated for the first Tres Hermanos aquifer between wells 5 and 10. If the piezometric head of well 2A is not used, the flow rate estimate is approximately one-half this value. Flow in this area prior to the tailings is roughly estimated to be 3 gpm. Flows of 1.0 and 0.4 gpm were computed for the present and prior flow rates in the first Tres Hermanos aquifer near wells 3A, 4A and 15 respectively. Very little ground water (an estimate of 0.04 gpm) is flowing in the alluvial aquifer. These estimates indicate that 14 and 0.6 gpm of seepage from the tailings reservoir is flowing in the areas between wells 5 and 10 and wells 3A and 4A respectively. The amount of seepage flowing between wells 5 and 10 could be approximately one-half of 14 gpm. If seepage to the north and east are assumed equal to above estimates, total seepage to the Tres Hermanos aquifer could likely be twice this amount or approxmiately 30 gpm. An estimate without the use of the peizometric elevation of well 2A indicates roughly one-half this amount.

1.76×10⁻⁴ cm/s
3.5×10⁻⁵ cm/s
1.05×10⁻⁵ cm/s
.04 cfs
.007 cfs

QW

The ground-water quality of the aquifers near the tailings disposal area has varied considerably areally and with time. Generally, the water quality in these units is naturally poor due to the types of rocks (Mancos) which make up the aquifers. A sodium-chloride rock salt was added to the clay in the bottom of the tailings pond during construction. (state insisted) A major constituent pulse of higher concentration water has been observed in several of the observation wells from the rock salt. This pulse has lasted from one to two years in the wells where it has passed. A gradual increase in the major constituents is expected after the decline of the pulse

Chloride concentrations have been increased to the northwest of the tailings dam for approximately 1000 feet. Increases of chloride concentrations extend approximately 500 ft west of the tailings dam. Sulfate concentrations extend in a similar area of the first Tres Hermanos aquifer.

Field pH values varied from 6.69 to 7.83 for the first Tres Hermanos aquifer. Only well 2A has a pH value of less than 7. The lower pH in well 2A is not significant because the high permeability area near well 2A does not extend down-gradient. None of the observed concentrations of radionuclides or heavy metals are considered above background levels. Elevated levels of heavy metals and radionuclides are likely not to be observed because the local geologic units have sufficient buffering capacity.

The average concentrations of chloride and sulfate in the tailings reservoir is approximately 640 and 60,000 mg/l respectively. Chloride concentrations in the close observation wells should eventually approach a concentration of 640 mg/l. The maximum concentration of sulfate which is likely to be observed in the aquifers is in the range of 40,000 mg/l. Geochemical alterations of the tailings water should limit the sulfate concentrations to this value.

A one dimensional model was used to simulate the movement of constituents with time. The tailings input was assumed to last for 20 years. The chloride concentrations for wells 1A, 3A, 5, 6 and 7 were simulated and indicate that chloride should peak at 640 mg/l at each of these sites and stay at this elevated value for slightly less than 20 years. A simulation one mile down-gradient of the tailings pond indicates that chloride will reach the peak of 640 mg/l and last at that level for approximately ten years. Estimates of movement of radium and uranium were made by using conservative adsorption coefficients. Peak concentrations of 6, 9, 8, 7 and 7 pCi/l were predicted for radium $_{226}$ for wells 1A, 3A, 5, 6 and 7 respectively. These predicted concentrations of radium are not expected and should be conservative (high) because very low adsorption coefficients were used. Conservative (high) values were also simulated for uranium movement. Maximum concentrations of 9 pCi/l and 5 mg/l for radium$_{226}$ and uranium were simulated at the tailings property boundary. These values should be the worst possible case and are still within the ground-water standards.

A ground-water monitoring program which is based on the results of this investigation is proposed. This monitoring will define whether the contingency plan needs to be implemented. A contingency plan of pumping wells to stabilize the first Tres Hermanos aquifer is outlined. A horizontal drain is discussed as a contingency plan to intercept the ground water in the alluvial system. The implementation of these contingency plans is not considered necessary for the present conditions of the ground-water systems.

2.0 GROUND-WATER USE

The State Engineer and USGS files were searched for ground-water users within five miles of the tailings area. Ground-water use for this area is tabulated in Table 1. Only four of the wells are defined as being completed in the Tres Hermanos sandstones. Well 11N.5W.08.110 is a second Tres Hermanos well and is located approximately 3 miles northwest of the tailings area. Well 11N.5W.20.223 is located approximately 3 miles west of the tailings and also is completed in the second Tres Hermanos sandstone. The nearest second Tres Hermanos well is located approximately one mile northeast of the tailings area. The only well which is thought to be completed in the first Tres Hermanos sandstone is approximately 3 miles west of the tailings area and approximately one-half of a mile west of the town of Bibo. All of the wells without an aquifer designation are located up-gradient of the tailings area. Only the four Tres Hermanos wells which are listed in Table 1 are pertinent to the tailings ground water. Seepage from the tailings to the second Tres Hermanos sandstone is very unlikely. The first Tres Hermanos sandstone dips to the northwest in the tailings area. Therefore, seepage to the first Tres Hermanos aquifer should mainly flow toward the northwest instead of west toward well 11N.5W.17.3.

3.0 GEOLOGIC SETTING

The geologic map of the Moquino quadrangle (Schlee and Moench, 1963) presents the surface geology in the area of the L-Bar site. The Mancos shale is the major geologic unit which outcrops in the area of the tailings disposal site. A thin mantle of alluvial deposits covers the Mancos shale in the area of the tailings dam. The portion of the Mancos shale which is the most important with respect to the ground water in the tailings disposal area is the first Tres Hermanos sandstone. This unit is labeled Kms3 on Schlee and Moench's (1963) geologic map. It outcrops to the south, southwest and east of the tailings disposal area.

3.1 Geologic Structure

Structure maps of the top and bottom of the first Tres Hermanos sandstone in the tailings area were presented in the ground-water discharge report (SOHIO 1980). These contours generally show a dip to the north-northwest. Structure contours on the base of the Dakota sandstone are given in Schlee and Moench's (1963) map. These contours show a regional dip to the northwest in this area of about 2%. The dip of the first Tres Hermanos sandstone is close to the Dakota dip on the north side of the tailings. The regional dip of the first Tres Hermanos sandstone in this area ia similar to the Dakota dip also. Additional discussion of the geologic setting is given in SOHIO (1980) ground water discharge report.

3.2 Lineaments and Joints

The contours on the base of the Dakota sandstone indicate that no major faulting has occurred in the tailings area. Several faults are shown approximately three miles north of the tailings disposal site.

These faults have resulted in only a few feet of displacement in the Dakota sandstone. The structure contours indicate that these faults are not continuous to the south toward the tailings disposal area. It is doubtful that faulting only above the Dakota has occurred in this area. Faulting is therefore considered not significant to the ground-water systems in the tailings disposal area.

Fractures and joints could be significant to the ground-water flow system in the Mancos sandstones without major faulting. The geologic staff of SOHIO has investigated the Moquino quadrangle for lineaments and joints from aerial photography. Drawing 1 (LBGLG-C-0481-01) shows the lineaments and joints which were interpreted from aerial photography and field work. This drawing shows that one weak lineament and a couple of very weak lineaments were interpreted from the aerial photography in the tailings disposal area. Numerous joints were measured in the first or Kms3 Tres Hermanos sandstone and other geologic units during SOHIO's geologic investigation. The majority of the joints had a northeast (32% N 10°-30°E) or northwest (30% N 10°-30°W) orientation. The joint patterns, if they influence the sandstone permeability, would tend to increase the permeability to the northeast and northwest. If joints affect the permeability of the sandstone, the same amount to the northeast, then preferential flow would be to the northwest because the dip of the sandstone would aid flow down dip. A section on fracture permeabilities is given in the Aquifer Properties section of the report.

WELL CONSTRUCTION

Fifteen, two and four wells were completed in the first Tres Hermanos and second Tres Hermanos sandstones and the alluvium, respectively, prior to the start of this investigation. Three additional alluvial wells have been

completed to extend the coverage in this system. Table 3 presents the basic well data for all of the wells near the tailings disposal site. This table presents the well depth, perforated interval, lithologic unit, depth to the first sandstone and water-level information. All of the wells are constructed out of 4 inch diameter PVC casing except for wells 1A - 4A and 1B - 4B which are 6 inch PVC. Wells 18, 19 and 20 are the three new alluvial wells which were installed during the course of this study. These wells were constructed by installing the well casing in a backhoe pit and backfilling after the placement of a gravel pack around the perforations. The backhoe pits were approximately 3 ft. by 8 ft. in area prior to the casing installation. Drawing 2 shows the location of the three new alluvial wells in the southwest portion of the tailings disposal area.

5.0 AQUIFER PROPERTIES

Appendix D presents a discussion of all of the pump test theories which were used to calculate aquifer properties. Theis' non-leaky confined aquifer equation and the straight line (Jacob) equation were used to analyze these pump tests. Modifications of these two equations to field conditions are also presented.

5.1 Pump-Test Results

One long-term test (pumping 69 and recovery 14 days) and several single-well tests were conducted to define the aquifer properties of the first Tres Hermanos and alluvial aquifers. Table 3 presents the type and length of each of the tests. An additional purpose of the long-term test was to define the continuity of the Tres Hermanos aquifer between wells. A much larger or much samller transmitting ability between wells can essentially separate a

geologic unit into separate systems. For example, a narrow band of an aquifer with a much higher transmissivity can prevent the drawdown from a pumping well on one side from extending into the other side. The high transmissivity zone acts as a constant head boundary. A much lower transmissivity zone could act as an impermeable boundary and also separate the aquifer into separate systems. Observed drawdowns in non-pumping wells were used to demonstrate aquifer continuity.

5.1.1 Long Term Test

Wells 1A, 8 and 10 were pumped (see Table 3 for length of pumping) while the remainder of the wells were monitored for drawdown. Wells 8 and 10 were pumped continuously at discharge rates of 0.95 and 1.05 gpm, respectively.

The pump in well 1A utilized liquid level probes and pumped cyclically. The average pumping rate over the test period was 0.2 gpm. Drawdown data are presented in Tables 4-8 for observation of wells 5, 6, 7, 9 and 12, respectively. These drawdowns were analyzed by the straight-line and Theis methods. As discussed in the Pump-Test Theory in Appendix D, the sum of the discharges is used in the normal form of the straight-line equation to compute transmissivity. A modified form of the equation for the storage coefficient must be used for the three pumping wells (see Appendix D for a discussion). Type curves had to be constructed for each observation well from the Theis equation for the log-log analyses.

Most of the wells in this area were experiencing a prior trend of water-level rises before the long-term test. This trend was not very well defined in some of the observation wells. The same trend might not be applicable for the three months of this test. Therefore, no adjustments in prior trends were made. This should yield transmissivity values slightly too high for the

pumping phase and slightly too low during the recovery phase.

Figure 1 presents the semi-log plot of drawdown data for observation well 5. The radius of the observation well from each pumping well is given in this figure. A transmissivity of 280 gal/day/ft and a storage coefficient of 4.0×10^{-5} were computed for this straight-line fit. A type-curve match was not completed for observation well 5 because of the limited data. The straight-line fit of observation well 6 yielded aquifer properties of 310 gal/day/ft and 4.0×10^{-5} for the transmissivity and storage coefficient, respectively (see Figure 2). Figure 3 presents the Theis type curve which was constructed for the three pumping wells and their respective radii. This type-curve match yields similar aquifer properties to the ones from straight-line analysis.

Figures 4 and 5 present drawdown data for observation well 7. The semi-log fit produced a transmissivity and storage coefficient of 330 gal/day/ft and 2.0×10^{-5} respectively, and the type-curve match yielded values of 320 gal/day/ft and 2.0×10^{-5}. The drawdown matches (see Figures 6 and 7) for observation well 9 indicate the Tres Hermanos aquifer is less transmissive in that area. Well 12 was also observed for drawdowns during the pumping of wells 1A, 8 and 10. Figures 8 and 9 give the semi-log and log-log plots of this data. The matches of the drawdown from well 12 produced similar aquifer properties to these from observation well 7, which is in the same area.

Water-level observations of other first Tres Hermanos wells are given in Table 9. Pumping in well 1A was discontinued on May 1, 1981, after 52 days of pumping, to determine whether this well had connection with the other two pumping wells. Water levels in well 1A recovered quickly to a depth of 100.7 ft but showed little additional change during the next two weeks. The lack of

continuous recovery shows that the aquifer near well 1A is connected to the aquifer in the area of the other pumping wells. Wells 1A and 8 were trial tested for several days beginning on January 7, 1981. These tests showed continuity in the first Tres Hermanos aquifer in the area of wells 1A, 8, and 10. The drawdowns in observation wells 5, 6, 7, 9 and 12 demonstrate that a very high or low transmitting zone (see Section 5.1 for a discussion) does not exist between these wells and the pumping wells. Continuity in the first Tres Hermanos aquifer in the area of these wells has been proven by this test.

Water levels during the long-term test for first Tres Hermanos well 2A are also given in Table 9. These water levels generally show a slight increase over the two months of the test. This increase is typical of the water-level rise in well 2A for several months prior to the pump test. Therefore, no drawdown was observed in well 2A as a result of pumping wells 1A, 8 and 10. Table 9 presents water levels for well 3A, 4A, 14 and 15 during the long-term pump test. Wells 3A, 4A and 15 were not influenced by the long-term pumping. The distance of these wells from the pumping wells and the low transmitting ability of the aquifer in the area of wells 3A, 4A and 15 prevented the drawdown cone from extending into this area. Also, the first Tres Hermanos aquifer is unconfined in this area which further dampens the extent of drawdown. Some drawdown (greater than one foot) was observed in well 14 during the test.

The water levels of the alluvial wells during the pumping of the three, first Tres Hermanos wells are given in Table 10. These water levels do not show any drawdown effects from pumping the first Tres Hermanos aquifer.

Water-level recovery data for the three pumping wells and several other first Tres Hermanos wells are presented in Table 11. The time ratio of $(t/t'_{8\&10})^{Q_8+Q_{10}}$ $(t/t'_{1A})^{Q_{1A}}$ (see Appendix D for a discussion) was used instead of the normal t/t' for the recovery plots, because the pump in well 1A was turned off prior to those in wells 8 and 10.

The water-level recovery data for pumping well 1A is given in Figure 10. The straight-line fit of these data yielded a transmissivity of 250 gal/day/ft. This transmissivity is close to other values computed for wells in this area of the first Tres Hermanos sandstone. Water-level recovery plots for observation wells 5, 6 and 7 are given in Figures 11, 12 and 13, respectively. Transmissivities from 200 to 260 gal/day/ft were computed from the recovery data for these three observation wells.

Analysis of recovery data (see Figure 14) for pumping well 8 produced a transmissivity of 250 gal/day/ft for the aquifer near this well. Figures 15, 17, 18 and 16 give plots of recovery data for observation wells 9, 12, and 14, and pumping well 10, respectively. The recovery data for these wells produced transmissivities in the range of 160 to 380 gal/day/ft.

Water-level data for wells 2A, 3A, 4A and 15 are also given in Table 11. The data from well 3A indicates that some recovery after cessation of pumping in wells 1A, 8 and 10 was observed in well 3A. Data from wells 2A, 4A and 15 show no indication of water-level response to either the pumping or recovery phases of the aquifer tests. Results from well 2A is the only data which conclusively shows non-continuity in an area of the first Tres Hermanos aquifer.

5.1.2 Single-Well Tests

Several single-well tests were conducted to define aquifer properties in areas where the long-term test did not yeild aquifer properties.

The length of the single well tests are also given in Table 3. Well 2A was pumped at 3, 5.5 and 3.4 gpm for 260, 39 and 26 minutes, respectively, for a total of 325 minutes of pumping. Table 12 presents the drawdown and recovery data for well 2A, and Figure 19 presents the drawdown plot for the period of pumping at 3 gpm. A transmissivity of 660 gal/day/ft was computed from this drawdown data. The recovery plot for well 2A takes into account the three different pumping rates for this well. A transmissivity of 1200 gal/day/ft was computed from the recovery data. This value is probably more representative of the first Tres Hermanos aquifer near well 2A, because the efficiency of the well is more likely to influence the drawdown data. The transmissivity near well 2A is significantly greater than the transmissivity for the rest of the aquifer in this area.

Water levels of several adjacent wells (see Table 13) were observed during the pumping of well 2A. The water level in the adjacent alluvial well, 2B, did not respond to the pumping of well 2A. First Tres Hermanos wells 3A, 5, 6, 7 and 8 were monitored during this test but did not respond to the pumping of well 2A. This test shows that the first Tres Hermanos aquifer near well 2A is not readily hydrologically connected to the rest of the aquifer in this area. A drawdown of greater than one foot would be expected in the aquifer near wells 6 and 7 at the end of pumping well 2A. The long-term test discussed previously should have caused several feet of drawdown in well 2A. This test also demonstrated the lack of continuity of the aquifer near well 2A with the remainder of the aquifer.

Well 3A was pumped for 24 minutes at an average rate of 0.84 gpm (see Talbe 14). Drawdown data from this test is presented in Figure 21. The straight-line method was used with the data fit to obtain an estimate of 62 gal/day/ft for the transmissivity near well 3A. This value may be slightly

high, because well storage was still producing a significant portion of the pumped water at the end of the test. Approximately forty percent of the water was produced from well storage during the 3A test. The recovery plot for well 3A is presented in Figure 22. A much lower transmissivity of 6.3 gal/day/ft was computed from these recovery data. This value is probably low, because transmissivities computed from recovery tests on wells with significant well-storage effects are typically low. A transmissivity between the values obtained from the recovery and drawdown analysis for well 3A is probably representative of the aquifer near well 3A.

The pumping and recovery data for a very short pump test (pumping 4 and recovery 43 minutes) on well 4A are given in Table 15. A transmissivity of 39 gal/day/ft was computed from the recovery plot (see Figure 23). Well-storage also significantly affected the results of this test. Therefore, the transmissivity of the first Tres Hermanos aquifer near well 4A is probably greater than 39 gal/day/ft.

Well 15 was pumped at 0.3 gpm for 18 minutes (see Table 16). Recovery data for this test, presented in Figure 24, indicate a transmissivity of 21 gal/day/ft for the aquifer near this well. Again, well-storage effects were significant for this short test; and, therefore, the transmissivity of the aquifer is probably higher than 21 gal/day/ft.

The recovery of the water level in well 17 was observed after bailing the well for 8 minutes at an average rate of 0.5 gpm. The water-level recovery in this well was so slow that the rate of filling of the casing was used to estimate the transmissivity of the aquifer in this area. Table 17 presents the tabulation of the water level, drawdown, rate at which casing was filled and the ratio of the drawdown to the rate of fill (s/Q). A plot of s/Q versus time which is given in Figure 25 for well 17, is used to estimate

the transmissivity of the aquifer. This method allows the drawdown and discharge both to be variable. A transmissivity of 0.4 gal/day/ft was computed for the first Tres Hermanos sandstone near well 17.

5.2 Summary of Aquifer Properties

Table 18 presents a summary of the aquifer properties computed from the aquifer tests. The average transmissivity values are listed by each well on Drawing 8. Transmissivities varied from 0.4 to 1200 gal/day/ft for the first Tres Hermanos aquifer. A transmissivity in the range of 250 gal/day/ft is indicative of a large area near wells 1A, 5, 6, 7, 8, 12 and 14 (see Drawing 8). The transmissivity is slightly less to the north of this area near wells 9 and 10. A much greater zone of transmissivity exists near well 2A. This zone does not extend to the west, because uniform drawdowns were observed in all of the observation wells between wells 9 and 14 during the long-term pump test. The extension of a zone of higher transmissivity between wells 7 and 6 would have caused a dampening of the drawdowns in well 6. A low transmissivity zone is thought to exist between the other wells and well 2A in the first Tres Hermanos aquifer. A low transmissivity zone as depicted on Drawing 8 would effectively cause the aquifer near well 2A to act as a separate system. No drawdowns were observed in well 2A during the long-term pump test.

A much smaller transmissivity in the range of 50 gal/day/ft is probably representative of the southwest portion of the tailings area near wells 3A, 4A and 15. The first Tres Hermanos aquifer also has a very low transmissivity east of the tailings pond, near well 17.

Permeabilities were computed from transmissivities and aquifer thicknesses. The aquifer thickness near each well is assumed to be equal to the saturated portion of the perforated interval. This should yield conservative

(high permeabilities) values if the aquifer extends below the bottom of the well. Permeabilities of 0.01 to 16 ft/day were computed for the Tres Hermanos aquifer. A permeability of 1.0 ft/day is representative of a large portion of the first Tres Hermanos in the area between wells 9 and 14. An average permeability of 0.5 ft/day is probably representative of the area near wells 3A, 4A and 15.

Storage coefficients of 1.1×10^{-5} to 4.1×10^{-5} were computed for the first Tres Hermanos from the long-term aquifer test data. A storage coefficient of 3×10^{-5} is considered representative of the first Tres Hermanos aquifer from well 5 to the north. The first Tres Hermanos sandstone is not fully saturated from well 3A to the south. A specific yield (unconfined storage value) of 0.1 is probably representative of first Tres Hermanos in this area.

The alluvial aquifer is not very transmissive near the tailings site. Well 3B is the only alluvial well with sufficient water to bail. A twelve minute bail test on this well produced only seven gallons of water. The water level in the well still had 3.35 feet of drawdown after twelve minutes of recovery and recovered only 0.04 ft in 21 more minutes. These data show that the alluvial aquifer near well 3B is not very transmissive. The transmissivity and permeability of the alluvial aquifer are probably less than 2 gal/day/ft and 0.1 ft/day, respectively. The specific yield of the alluvial aquifer is probably in the range of 0.1.

5.3 Fracture Permeability

Numerous permeabilities have been determined for the first Tres Hermanos sandstone. A permeability in the range of one ft/day is the maximum primary permeability expected for a sandstone (see Table 2.2 of Freeze and Cherry 1979). The primary permeability for the fine Tres Hermanos sandstones

would be expected to be significantly less than one ft/day. This indicates that fracture permeability is likely influencing the permeability of the sandstone near well 2A. Fracture permeability could be significant in the aquifer near the other wells with permeabilities in the range of one ft/day or greater.

Conductivity and temperature profiles were made on each well to further define which wells are influenced by fracture. A sharp change in these two parameters is possible if a large change in permeability occurs in the perforated interval of the well. Appendix A presents the tabulated conductivity and temperature profiles for all of the first Tres Hermanos, and four alluvial wells. An increase in the conductivity near the top of the perforated interval (see Table 2) of well 1A is shown in Appendix A. This increase is probably not that significant because the water above the perforated interval is fairly stagnant. A decrease in conductivity near the bottom of several wells has been observed. The decrease near the bottom of the well is generally considered to be influenced by the well bottom. The peak water temperature of 19.6°C at 135.8 feet below the top of the casing is an indication of higher permeability in this area of sandstone. Alluvial well 1B had sufficient water for only one in-situ conductivity measurement.

A much larger variation in the water temperature occurs in well 2A. The higher temperatures near depths of 71.3, 72.3 and 74.3 ft. are thought to be indicative of greater inflows to the well at these intervals. These temperature measurements indicate a significant variation in the permeability within the perforated interval of well 2A. Conductivity variations in the perforated section of the well are not that significant, but decrease as the temperature increases except for the bottom measurement.

The conductivity and temperature profiles for well 3A (see Appendix A) show the highest temperature and the lowest conductivity near the top of the water level. This indicates a greater permeability in the upper interval of the aquifer near well 3A, but could be influenced from the atmosphere. Measurements at well 3B show no stratification in the temperature or conductivity of the alluvial system in this area.

The conductivity and temperature measurements for well 4A show only a significant variation at one foot below the top of the water level. This variation could be attributed to a higher permeability at this interval, but is more likely caused by the exposure of the water to the atmosphere.

The water-temperature profile for well 5 shows a warmer zone at the 98.5 and 99.5 foot measurements. The conductivity data shows a peak two feet lower than the temperature peak. The higher temperature and conductivity data indicate that this interval has different transmitting properties than the remainder of the perforated interval in well 5.

A significant increase in the temperature in the profile of well 6 resulted in some decrease in the conductivity. These zones are the most likely to be influenced by fractures in well 6.

One peak in the temperature with a slight decrease in the conductivity was observed in the profile of well 7. The profile from well 7 is not as indicative of highly variable permeability zones as were the profiles from wells 5 and 6.

The profile from well 8 shows a temperature peak of 20.2°C at a depth of 114.3 feet. The conductivity increases in both directions from this depth, which also is a good indicator that the transmitting of water to this interval is unique. The typical decrease in conductivity toward the bottom of the well occurs several feet above the bottom of the well

in this case. This probably is caused by a significant difference in transmitting ability of the aquifer in this interval.

A significant temperature variation was observed in the water of well 9 on April 27, 1981 while the conductivity variation was small. The probe would not drop below the 198.1 foot level in this well. A very significant increase in temperature was observed near the top (139.6 ft) of the perforated interval in well 10. A decrease in the conductivity also occurred at this interval. This data is strongly indicative of fracture permeability at this interval. Another temperature increase is observed near the bottom of well 10.

The temperature and conductivity at the 108.0 foot depth indicate a different transmitting ability at this interval in well 12. The increase in the temperature at the bottom of the well indicates a significant difference in this interval of the aquifer.

The most likely zone of higher transmitting ability in well 14 is near the bottom of the well. The increase in temperature in this interval is probably indicative of greater permeability. The conductivity and temperature profiles of wells 15 and 17 show no strong stratification; and, therefore, no significant variation in permeability in the perforated interval of these two wells.

The conductivity and temperature profiles indicate that fracture permeability exists in the perforated interval of wells 2A, 5, 6, 8, 10, 12 and 14. Some fracture permeability is likely to occur also in wells 1A, 7 and 9. The permeability of the perforated interval of the Tres Hermanos aquifer in each of wells 3A, 4A, 15 and 17 seems very uniform. The profile of alluvial well 3B indicates a uniform permeability of this aquifer in this area.

6.0 GROUND-WATER FLOW

6.1 Water-Level Elevation

Static water levels measured to June, 1981, are tabulated in Appendix B. The June, 1981, water-level measurements, which are presented in Table 2, were used to construct water-level elevation maps for the first Tres Hermanos and alluvial aquifers. The solid lines in Drawing 2 represent the piezometric surface of the first Tres Hermanos sandstone. The flow direction on the west side of the tailings is presently mainly toward the west; whereas, the flow direction north of the tailings is mainly northerly. Flow of water in the first Tres Hermanos aquifer is probably predominantly northwesterly further west of the tailings area, becasue the Mancos dips in this direction (refer to Section 3.1).

Well 16, which is perforated in the first Tres Hermanos sandstone does not contain water, because the structure elevation of the sandstone rises to the south. Therefore, ground-water flow to the south of the tailings area is controlled structurally.

The dash-dot lines on Drawing 1 represent the piezometric surface of the alluvial aquifer west of the tailings pond. A very thin alluvial aquifer (generally less than 2 feet thick) exists in this area. These piezometric contours show that flow converges toward the existing arroyo west of the tailings.

Two water-level elevations (wells 11 and 13) for the second Tres Hermanos aquifer are given in Drawing 2. These two data points indicate a difference of 137 and 173 feet between the piezometric surface of the first and second Tres Hermanos sandstone aquifers. The indication is that flow is toward the south in the second Tres Hermanos aquifer. A flow direction in the same direction as the structure dip, to the northwest, would

be expected.

6.2 Water-Level Changes

Water-level hydrographs have been developed from static-water level elevations which are tabulated in Appendix B. These hydrographs are presented in Appendix B also. The hydrograph for well 1A shows a large water-level rise between the first (12/75) and second water-level measurements. This rise may be attributed to the ponding of fresh water during construction of the tailings pond. The water level in well 1A might not have stabilized with the aquifer by the December, 1975 measurement. If this large water-level rise was caused by the ponding of the fresh water, some decline in the water level would be expected after the ponding. Water levels from the Fall of 1976 are considered the pre-tailings water-level elevation.

The hydrograph for well 2A (see Appendix B) shows a large water-level rise in April of 1976. Use of the tailings reservoir started in the Fall of 1976; and, therefore, the initial rise is considered not to be a result of tailings disposal. Fresh water was diverted by a contractor into the tailings pond prior to its completion. This could have caused the large rise (18 ft) in the water level in well 2A during May, 1976. A steady water-level rise in well 2A started between October, 1977 and May, 1978. Water-level change averaged 0.19 ft/month until the middle of 1980. An average rate of rise of 0.085 ft/month has occurred for the last year.

The hydrograph for first Tres Hermanos well 3A does not show much change in its water level until May, 1980. However, the water level in well 3A has risen at a rate of 0.55 feet/month for the last year. The water level in well 4A started to rise much earlier than the level in well 3A, but has risen at a slower rate of 0.21 feet/month. The water-level

rise in well 5 started in September, 1979, and has risen at a rate of 0.34 feet/month for about the last year. The drop in water level during 1981 was caused by the trial and long-term pumping tests of wells 1A, 8 and 10. Water levels in well 6 started to rise at about the same time as in well 5 but has risen at a slower rate. The rate of the water-level rise in well 6 averaged 0.26 ft/month during 1980. Water-level rise observed in well 7 has been similar to that described for well 6.

The water levels measured in well 8 have been much more erratic. The hydrograph for well 8 does not show a consistant trend as has been noted in the other wells. It is doubtful that the water level in the aquifer has varied as these water-level measurements indicate. Water-level elevations in the range of 6130 and 6134 feet above mean sea level are thought indicative of early 1979 and June, 1981, respectively. Water-level in well 9 is not showing a rising trend. However, the January and March, 1981 water-levels were influenced by the long-term pumping test.

The hydrograph of well 10 indicates that the water-level has risen a total of approximately one foot. Water-levels measured in well 12 also show only a small rise since the installation of the well. The water-level in well 14 has risen approximately one foot during the last six months and seems to be rising at an average rate of 0.2 feet/month. Water-level has been fairly constant in well 15 since the installation of this well. However, the water-level in the first Tres Hermanos aquifer near well 15 may have risen a few tenths of a foot over this period. The hydrograph for well 17 shows very little change in water-level over the last six months. It is doubtful if the water-level in the aquifer in this area is consistantly rising.

Very little (approximately 0.1 ft) water exists in alluvial well 1B. The hydrograph of the water level from this well could easily be attributed

to natural recharge of this system. Water-level in well 2B has also changed very little since the tailings disposal system has been in operation. The only alluvial well in which significant water-level rise has been observed is well 3B. A rise of approximately 3 feet has been measured in the alluvial aquifer in this area. The rise started in January, 1980. The water-level in 4B has not varied significantly since the start of the tailings disposal operation.

Water-level changes between the Fall of 1976 (pre-operation) and June, 1981 are listed on Drawing 3. Water-level rise contours are shown for the alluvial and first Tres Hermanos aquifers. The contours for the first Tres Hermanos (solid line) show an even pattern with a maximum contour near well 2A. The water-level rise contours drop quickly to one foot. Water levels beyond 1000 feet from the tailings pond have not been influenced.

Very little water-level rise has occurred in the alluvial aquifer. Only a contour of one foot is shown on Drawing 3. Large water-level rises in the alluvial aquifer are not expected.

6.3 Rates of Ground-Water Movement

The macroscopic rate of ground-water movement is governed by the following equation (see pages 70 and 71 of Freeze and Cherry, 1979 for a discussion):

$$v = Ki/n$$

where: v = macroscopic average water velocity, in ft/day

K = permeability, in ft/day

i = hydraulic gradient, in ft/ft

n = effective porosity

The rate of ground-water movement in a westerly direction (down gradient) in the first Tres Hermanos aquifer in the area between wells 5 and 10 is

estimated to be 0.5 ft/day or 180 ft/yr. A permeability, hydraulic gradient and effective porosity of 1 ft/day, 0.05 ft/ft and 0.1, respectively, are representative of the aquifer in this area and were used to make the above estimate. The change in the moisture content in most of the neutron access hole logs in the first Tres Hermanos sandstone after saturation of the sandstone has been in the range of ten percent. This indicates the effective porosity of this sandstone is 0.1. The distance from the tailings divided by the time before the water quality change yields values close to this average water velocity.

The gradient north of the tailing disposal site prior to disposal can be approximated by utilizing the initial water-level measurements at wells 9 and 10 and the distance separating these wells. The gradient, thusly calculated, is approximately 0.008 ft/ft ($\frac{6}{760}$). The use of this gradient and the previous other properties indicated that the ground-water movement rate in this area prior to tailings was 0.08 ft/day (29 ft/yr).

The permeability and gradient in the area between wells 3A and 4A are smaller than those to the north. Using a permeability, hydraulic gradient and effective porosity of 0.5 ft/day, 0.02 ft/ft and 0.1, respectively, the velocity of the ground water in this area is presently 0.1 ft/day or 36 ft/yr. The velocity is probably lower than 0.1 ft/day near well 4A and may be slightly higher in the area of well 3A. The ground water in the first Tres Hermanos sandstone in this area prior to tailings disposal was probably in the range of 0.04 ft/day or 15 ft/yr.

Ground water in the alluvial aquifer on the west side of the tailings pond moves in the range of 0.03 ft/day (11 ft/yr). The recovery of alluvial well 3B from bailing was extremely slow, indicating low permeability sands in this system. The permeability of the alluvial aquifer is approximately less than 0.1 ft/day. This permeability and a hydraulic gradient and effec-

tive porosity of 0.03 ft/ft and 0.1, respectively, were used to estimate the above velocity. The gradient in the alluvial aquifer prior to tailings disposal was close to 0.02 ft/ft, which indicates the alluvial pre-tailings ground-water velocity was 0.02 ft/day.

The quantity of water moving in the aquifers in the tailings area can be estimated from Darcy's law:

$$Q = TiL$$

where: Q = quantity of water flowing, in gal/day

i = hydraulic gradient in ft/ft

L = width of aquifer cross-section through which water is flowing, in ft

A rate of 17 gpm is estimated as the flow in the first Tres Hermanos aquifer between wells 5 and 10. A cross-sectional aquifer width of 2000 ft (approximate distance between wells 5 and 10) and an average transmissivity and hydraulic gradient of 250 gal/day/ft and 0.05 ft/ft, respectively, were used to compute this flow rate. If the piezometric surface of well 2A is not used, a gradient and flow rate of approximately one-half of these values is obtained. Therefore, the 17 gpm flow rate is probably high. A transmissivity of 250 gal/day/ft is thought to be representative of this area. The transmissivities from the pumping phase of the long term test are thought to be too high because the prior trend was not corrected (see section 5.1.1). Also, the use of the transmissivity from well 2A is not warranted because this transmissivity zone does not extend into the area between wells 5, 6, 7, 8, 1A and 10. Using the estimated gradient of 0.008 ft/ft, a rough estimate of flow through this width is approximately 3 gpm prior to tailings disposal. The gradient prior to the operation of the tailings was not well defined. Therefore, estimates of flow prior to the tailings could contain significant errors.

A transmissivity, width of aquifer and gradient of 50 gal/day/ft, 1500 feet and 0.02 ft/ft, respectively, are representative of the aquifer in the area of wells 3A and 4A. These parameters were used to compute an estimate of 1.0 gpm for the flow of ground water in the sandstone in this area. If the gradient of the aquifer was 0.008 ft/ft prior to the start of tailings disposal, ground-water flow was roughly 0.4 gpm in this area at this time.

An estimate of the quantity of ground water flowing in the thin alluvial aquifer was made using Darcy's law also. The average transmissivity of the alluvial aquifer is probably less than 2 gal/day/ft. This transmissivity, an aquifer width of 1000 ft, and a gradient of 0.03 ft/ft indicate that 0.04 gpm of water is flowing in the alluvial system. Flow prior to the installation of the tailings pond was probably slightly less than this rate.

These estimates indicate that 14 and 0.6 gpm of seepage from the tailings reservoir is flowing in the areas between wells 5 and 10 and wells 3A and 4A respectively. Total seepage to the Tres Hermanos could likely be twice this amount or approximately 30 gpm if seepage to the north and east are equal to these values. This estimate is dependent on the estimate of ground-water flow prior to the tailings and therefore could be erroneous. A value approximately one-half this amount is obtained if the piezometric head in well 2A is not used in the analysis. This estimate also could be significantly in error if a large amount of water is still going into storage in the sandstone or if transmissivities vary greater than the measured values. The sandstone is completely saturated over most of the area where these estimates were made; and, therefore, the storage potential error should not be significant for our calculations. Seepage to the alluvial system is estimated to be less than one gpm. These est-

imates of total seepage to the tailings aquifers are only rough estimates.

7.0 GROUND-WATER QUALITY

The ground-water quality of the aquifers near the tailings disposal area has varied considerably areally and with time. Generally, the water quality in these units is naturally poor due to the types of rocks which make up the aquifers. Field water-quality data will be discussed first followed by a presentation of the laboratory water-quality results. A discussion of concentration maps will conclude this section.

7.1 Sampling Techniques

Water samples have typically been bailed from the monitoring wells. A bailer with an open bottom and vented top was used until collection of the February, 1981 samples. This bailer allowed the sample to be collected from the interval to which the bailer was lowered. Starting with the June, 1980 samples, wells 5-17 were air-lifted one or two days prior to sample collection by bailing. The February, March and April, 1981 samples were bailed with an open top bailer, which collects water from only near the water surface. The May and June, 1981 samples were bailed with a ball-valve bailer. This bailer enables the sample to be collected from the interval to which the bailer is lowered. The March and April, 1981 samples from wells 1A, 8 and 10 are an exception to the above procedures, because these samples were collected during the long-term pump test. The June, 1981 samples from wells 2A, 3A, 4A and 8 were also pumped.

Dissolved, not total constituents have been measured for all of the analyses. The June, 1981 samples were filtered in the field with 0.45 micron filters and a peristaltic pump. The quantities of water removed before collecting the June, 1981 samples are given in Table 19 and/or the pump test tables.

Samples were preserved with HNO_3 acid for the heavy metals and radionuclides. The samples to be analyzed for nitrate were preserved with H_2SO_4 acid. No preservative was added to the samples for the major constituent analyses.

7.2 Field Water-Quality Data

Table 19 presents June, 1981 field water-quality data for the first Tres Hermanos aquifer. Appendix A presents conductivity and temperature profile data for each of these wells and should be consulted for additional field water-quality information. Field conductivity and field pH values compared well to the June, 1981 lab values except for a few wells. The field pH values for wells 9, 12 and 17 are several tenths lower than the lab values. The difference in only four of the lab and field conductivities was more than ten percent.

A sample from well 1A was bailed on 6/17/81 for water-quality analysis. Field parameters of 19.5°C, 5330 µmhos/cm @ 25°C, 7.52 and 93.64 ft. were measured for the water temperature, conductivity, pH and static-water level, respectively. The analytical results from this bailed water sample compared favorably with results obtained from the pumped samples from well 1A.

A single-well aquifer test was conducted on well 2A on 6/10/81. A water sample was collected after 267 minutes of pumping at 3 gpm. Table 19 presents the field-water quality parameters measured during the trial test and at the time the sample was taken. The pump-test data table (Table 12) presents field-water quality results at several times on June 10th. The pH of the water from well 2A is the lowest of all of the tailings monitoring wells. The conductivity of water from well 2A is the second highest of the first Tres Hermanos monitoring wells.

Well 3A was pumped for 24 minutes at 0.84 gpm before running dry.

A sample of water from this well was pumped the following day. The conductivity of water from this well is the largest measured from all of the tailings wells. The temperatures given in Table 19 were apparently influenced by the ambient air temperature, because down-hole measurements ranged from 14.2-15.1°C (see Appendix A).

Well 4A is also a poor producer as it went dry after pumping for four minutes. Following a brief recovery period, a pumped sample was collected from well 4A. The pH of this sample was 7.20. Water temperatures from well 4A were also influenced by outside air temperatures.

Eleven gallons of water were bailed from well 5 on 6/15/81. A sample for chemical analysis was taken and field filtered from the last two gallons bailed. Field conductivity, temperature and pH were 6930 µmhos/cm @ 25°C, 14.8°C and 7.51, respectively. Several water-level measurements were made in this well after cessation of bailing to document the rate of recovery. The conductivity of water in well 5 significantly decreased between the time the conductivity profile was measured (4/24/81) and the field measurements were measured on 6/15/81.

Several gallons of water were bailed from wells 6 and 7 before collecting a sample in June 1981. Field parameters for these two wells are also given in Table 19.

Well 8 was pumped for approximately one week prior to sample collection in June 1981. Table 19 gives the field parameters after 10 minutes of pumping.

Water samples were bailed from wells 9, 10, 12 and 14 in June, 1981 (see Table 19). A sample from well 15 was bailed seven days after it was pumped dry. The field conductivity and pH compared favorably for the pumped and bailed samples. Table 19 gives field parameters for water samples bailed from well 17 also.

Table 20 presents field water-quality results for the alluvial wells. The conductivity of the alluvial water ranged from 1160 to 34,100 μmhos/cm @ 25°C for samples collected in June 1981. All water samples were bailed from the alluvial wells due to the limited amount of water available. The field and lab pH and conductivity values compared well for well 3B.

7.3 Laboratory Chemical Analyses

Laboratory analyses for the monitoring wells are presented in Table 21. Data for each well is given on two pages, with the major constituents and a few minor elements on the first page and the rest of the minor elements and radionuclides on the second page. (Analytical methods and detection limits are summarized in Appendix C.)

The cation-anion ratio is given with the major constituents when the eight major parameters (Ca, Mg, Na, K, SO_4, Cl, HCO_3, CO_3) were measured. This ratio is a good indicator of the accuracy of measurement of the major constituents. The actual charge balance should yield a cation-anion ratio of one, and, therefore, deviation from this value is an indication of error. Analyses of major constituents with cation-anion ratios between 0.9 and 1.1 are considered good. The cation-anion ratio shows that some of the earlier major constituents analyses are questionable, but most of the more recent analyses are good.

Comparison of the calculated TDS to the measured TDS is also a good evaluation of accuracy of major-constituents analysis as well as TDS. The calculated TDS was computed by adding one-half of the bicarbonate to the other seven major constituents. Only one-half of the bicarbonate is added to the calculated TDS because approximately one-half of the measured HCO_3 is lost during evaporation at 180°C. Calculated TDS

values generally compare favorably with the measured values. Some of the early calculated or measured values were greatly in error.

Prior to impact from tailings-water seepage, water in the first Tres Hermanos aquifer was predominantly a sodium sulfate-bicarbonate type. Seepage from the tailings reservoir has added chloride, sulfate, bicarbonate, sodium, calcium, and magnesium. Although the tailings water contains higher sodium and chloride concentrations than originally present in the groundwater, much of the input of these constituents resulted from dissolution of rock salt placed on the tailings clay to decrease permeability and, thus, retard seepage. Sodium and chloride input from this source is significant, but will have a relatively short impact time. The sodium-chloride front has already passed some of the monitoring wells and lasted from one to two years.

Increased concentrations of sulfate are largely due to high concentrations of sulfate in the tailings water. Increased quantities of calcium, magnesium and bicarbonate are attributed to dissolution of calcium carbonate in the host rock by the acidic tailings solution.

In general, most minor and trace elements have not been detected in excessive concentrations in the monitoring wells. However, on one occasion nitrate was detected in a concentration in excess of 5000 mg/l. This sample may have been analyzed from a sample preserved with nitric acid, but other concentrations in excess of ground-water standards have also been observed. Also, cadmium and chromium were several times noted slightly in excess of ground-water standards. These concentrations are thought to be background levels for the first Tres Hermanos aquifer. Radionuclide concentrations are generally low, with radium-$_{226}$ rarely exceeding 5 pCi/l.

Figures 26 through 42 show water-quality hydrographs for first and second Tres Hermanos aquifer wells and one alluvial aquifer well. Solid lines on these figures represent sulfate concentration and dashed lines depict chloride concentrations.

Figure 26 shows chloride and sulfate hydrographs for well 1A. After an initial period of baseline conditions, chloride concentration began to increase in 1979. Sulfate concentration was erratic during the period that chloride was relatively stable and in low concentration. Then, in 1979, sulfate concentration began to increase similarly to chloride concentration. Toward the end of 1980, both sulfate and chloride concentrations declined, but to a level considered greater than original baseline. The increased concentrations in 1979 and 1980 are most likely due to the effects of the rock salt placed in the tailings dam in 1976 to reduce dam permeability. Although the rock salt consisted mainly of sodium chloride, the sulfate concentration could also increase because of the increased solubility of calcium sulfate. As solution ionic strength increases, calcium sulfate solubility also increases to a point. The source of the calcium sulfate is that which was precipitated in the rock formations as a result of calcium carbonate dissolution. (See Section 7.3 for a more complete discussion of this mechanism.) Both chloride and sulfate concentrations are expected to continue to increase. The Ion Migration Simulation section (Section 8) in this report discusses more thoroughly expected movement of ions.

Chloride and sulfate hydrographs for well 2A are shown on Figure 27. Late in 1977, concentrations rose from baseline conditions and have remained elevated henceforth. Sulfate concentrations were erratic in 1977-1978, possibly due to analytical problems, but the analyses were not complete enough to evaluate the charge balances. Well 2A responded more quickly to the input of rock salt to the tailings dam, but concentrations have not

subsequently declined as in well 1A. The water level rise in well 2A also started quicker and has been longer than other wells. As discussed previously, well 2A is in a relatively high permeability zone of the first Tres Hermanos aquifer, but is bounded on the north, south, and west by much lower permeability zones (see Drawing 8). Therefore, seepage water from the tailings reservoir can quickly enter the aquifer near well 2A but can leave only very slowly.

Figure 28 shows the water-quality hydrograph for well 3A. Both chloride and sulfate concentrations increased from baseline levels in 1978 to the relatively elevated levels shown presently. Data points from 1979 through mid-1980 are scarce and are difficult to interpret. However, later data appear good and suggest that the first Tres Hermanos aquifer near well 3A is still under the influence of the impact of rock salt placement in the tailings dam in 1976. The influences of the rock salt and the tailings solution took longer to reach the aquifer near well 3A and will take longer to diminish because of the relatively low permeability of the aquifer material. Predictions of ion migration at well 3A due to tailings solution seepage are discussed in Section 8 of this report.

Figure 29 presents a water-quality hydrograph showing chloride and sulfate concentrations from 1978 through mid-1981 for well 4A. Again both chloride and sulfate levels have risen since 1978. However, chloride concentration has only increased to approximately 150 mg/l.

Sulfate and chloride concentration hydrographs for wells 5, 6, and 7 (Figures 30, 31, and 32, respectively) show peaks beginning in mid-1980 but declining or remaining stable throughout 1981. These peaks are considered to be mainly a result of rock salt placement in the tailings dam. Although the tailings solution has also had an effect on the aquifer water in these areas, it has largely been masked. Simulation of tailings solution migration

near wells 5, 6, and 7 is presented in Section 8 of this report.

Figure 33 shows water-quality hydrographs (sulfate and chloride) for well 8. Concentrations of both constituents increased rapidly in mid-1980 and have been decreasing, although quite erratically, through mid-1981. The initial concentration elevation is most likely due to impacts of the rock salt placement in the tailings dam in 1976. However, later data, although analytically sound (good cation-anion ratios) has not completely followed the expected pattern of a decrease in concentration after the sodium-chloride pulse. A gradual increase in concentrations of major constituents is expected to follow now.

Water quality in the first Tres Hermanos aquifer near wells 9, 12, 14, and 17 does not yet appear to be impacted by seepage from the tailings reservoir. Water-quality hydrographs for sulfate and chloride concentrations for these wells are shown on Figures 34, 37, 39, and 41, respectively.

Figure 35 shows sulfate and chloride water-quality hydrographs for well 10. When sampling of this well began in late 1980, impact from tailings water seepage had already apparently reached the area. Since that time, concentrations have been increasing, although somewhat erratically.

Water in well 11 appears to have been affected by tailings seepage and the rock salt placement in the tailings dam. As shown on Figure 36, sulfate and chloride concentrations peaked in late 1980 and have been relatively steeply declining since then. The water level in this well is too high which indicates a well completion problem also.

As shown on Figure 38, second Tres Hermanos aquifer water near well 13 has apparently not been impacted by seepage water. Although chloride and sulfate concentrations have varied during the period of monitoring, levels have remained within baseline tolerances.

Sulfate and chloride water-quality hydrographs are shown for well 15

on Figure 40. At the time of first monitoring in late 1980, aquifer water in this area had apparently already been impacted by tailings water seepage and rock salt placement in the tailings dam embankment.

Water-quality hydrographs showing sulfate and chloride concentrations in alluvial aquifer well 3B are shown on Figure 42. A relatively steady increase has been observed since monitoring was initiated in 1978.

Concentration contour maps were developed for chloride and sulfate, because these two major constituents are important ground-water standards. Drawing 4 shows June, 1981 chloride concentration contours for the first Tres Hermanos aquifer. The average chloride concentration of the tailings solution is approximately 640 mg/l. These contours show that the chloride gradient is steep in some areas of the aquifer. Concentrations of chloride in the Tres Hermanos aquifer exceed the tailings solution concentration at three locations. These high concentrations are most likely influenced by the sodium-chloride rock salt which was placed in the tailings dam clay materials in 1976. Chloride concentrations in excess of 1000 mg/l, which are presently in the area of well 10, were in the area of well 1A until late last year. The contours in Drawing 4 depict the zone of high chloride concentration near wells 1A and 10. The chloride water quality graph (Figure 28) was used with the estimated rate of ground-water movement in this area to compute distances down-gradient of the well 1A of the leading and trailing edges of the chloride concentration of 1000 mg/l. These estimates were made to depict the chloride plume down-gradient of well 1A. An area of chloride concentrations in excess of 1000 mg/l is shown in the area of well 3A. The movement of this zone of elevated chloride concentration has been much slower, because the permeability of the aquifer is considerably less in this area than in most other areas. The third area of concentrations in excess of 1000 mg/l is near well 2A. The largest permeability

of the first Tres Hermanos aquifer was measured at well 2A. However, the pump tests (long-term and 2A test) also showed that the aquifer near well 2A is not readily connected to the aquifer in the area of wells 1A, 5, 6, 7, 8, 9, 10 and 14. A very low permeability zone must exist between well 2A and the others (see Drawing 8). This low permeability zone prevents the water near well 2A from moving at a relatively fast rate through the system. Therefore, the water quality in well 2A was able to quickly respond to the tailings influences but will not quickly transfer these water-quality changes down-gradient. In wells 6 and 7, which are the closest monitoring wells to well 2A, observed concentration increases are less than those observed in wells 5 and 8. It is questionable whether any of the wells with chloride concentrations near 100 mg/l have been influenced by the tailings water seepage.

Several chloride concentrations are shown on Drawing 4 for the alluvial aquifer. The maximum measured chloride concentration in the alluvial aquifer has been at well 3B. A decrease in concentration is observed down-gradient toward wells 18 and 20 as expected.

Drawing 5 presents sulfate contours for June, 1981 for the first Tres Hermanos aquifer. Sulfate concentrations have peaked and then declined in some wells. The concentration of sulfate in the tailings is in the range of 60,000 mg/l. Concentrations near this level have not been measured in any monitoring wells because of geochemical processes described in Section 8 of this report. Sulfate concentrations entering the ground-water systems are also likely to have varied with time as the sodium and chloride concentrations varied. The sulfate concentration contours show a more continuous pattern than do the chloride concentration contours. Sulfate concentrations should generally increase with time to a maximum level which will be governed by the tailings-pond concentration and geochemical pro-

cesses described in Section 8 of this report. Sulfate concentrations entering the ground-water systems are also likely to have varied with time as the sodium and chloride concentrations varied. The sulfate concentration contours show a more continuous pattern than do the chloride concentration contours. Sulfate concentrations should generally increase with time to a maximum level which will be governed by the tailings-pond concentration and geochemical processes occurring as the water moves through aquifer materials.

The concentration of sulfate in well 1A was slightly less than 2000 mg/l in June, 1981, whereas concentrations up-gradient and down-gradient are probably greater than 2000 mg/l.

Field pH, uranium and radium-$_{226}$ are plotted on Drawing 6 for first and second Tres Hermanos and alluvial aquifer wells. The field pH measurements are those measured in June, 1981, and the uranium and radium are from the February, 1981 samples. Field pH values varied from 6.69 to 7.83 for the first Tres Hermanos aquifer. Well 2A contains the only water with a pH value less than 7. Water in well 2A is the only first Tres Hermanos water which shows signs of being influenced by the tailings water relative to acidity. This is not significant, because the high permeability area near well 2A does not extend down-gradient. None of the alluvial waters show any tailings-solution influence on their pH.

The pH is an important parameter, because a considerable drop must occur before heavy metals and radionuclides become significantly soluble and thus mobile. The solution Eh actually controls solubility and mobility of ionic species. However, generally, changes in pH reflect changes in Eh. The tailings solution, as its being neutralized, goes from a reduced to an oxidized state. During this change iron changes from ferrous (Fe^{+2}) to ferric (Fe^{+3}) form. Ferric iron is very insoluble and precipitates as a

hydroxide or carbonate. Precipitate has strong potential to adsorb, or complex radionuclides and other metallic cations.

The pH value, 10.6, of well 13 (a second Tres Hermanos well) indicates cement contamination.

Uranium and radium-$_{226}$ levels are just as high in wells (such as well 9) that have apparently not been influenced by the tailings seepage as in those that obviously have been impacted by the seepage. Therefore, no indication of uranium or radium-$_{226}$ movement has been detected in any of the observation wells. The pH values indicate that this should be the case also.

8.0 TAILINGS CONDITIONS

8.1 Tailings Pond Wat/ -Level Elevation

The water-level elevation of the tailings reservoir in the last two years is shown in Figure 43. This figure shows an overall steady increase in the water-surface elevation for the past two years. A leveling off or gradual decline of the water surface occurred each summer due to increased evaporation. The straight dashed line of Figure 43 represents an average rise of 0.3 feet per month. The rise in the tailings-water surface can be considered a constant relative to influence on the ground-water systems.

The tailings-water surface will gradually drop during the shut-down period. This will gradually decrease the amount of seepage to the ground-water systems. The predictions of ion migration in Section 9 assumes that the ground-water velocity will be constant and therefore, these estimates should be high during the shut-down period and until the tailings-water surface reaches their present levels during resumption of operation.

8.2 Tailings Pond Water Quality

Table 22 presents water-quality results from several monthly composite samples of the tailings solution. The average concentration of chloride in the tailings reservoir is approximately 640 mg/l. Sulfate concentrations are significantly higher with an average greater than 60,000 mg/l. The one analysis of sodium indicates its concentration is in the range of 1500 mg/l. Calcium is present in very low concentrations in the tailings solution. The iron concentration of the tailings water is about 4300 mg/l. Total dissolved solids are roughly 10,000 mg/l higher than the sulfate concentration. The tailings water has uranium (U_3O_8) and molybdenum concentrations of 50 mg/l and 1.2 mg/l, respectively. The results of the vanadium (V_2O_5) analyses have varied significantly from less than one to 187 mg/l. The tailings water contains radium-$_{226}$ in the range of 153 ± 8 pCi/l. One measurement (not shown in Table 20) indicates that the tailings solution is quite acidic, with a pH of 1.

8.3 Geochemical Alterations of Tailings Water Quality

The tailings solution changes considerably in chemical composition between the tailings reservoir and where its seepage is first detected in a down-gradient monitoring well. For example, in well 3A, sulfate concentration is less than 40,000 mg/l, iron concentration is less than one mg/l, calcium and bicarbonate concentrations are approximately 400 mg/l and the pH is significantly greater than seven. One mechanism for effecting this change is through the dissolution of calcium carbonate ($CaCO_3$) by the highly acidic tailings solution. During this dissolution process, calcium and bicarbonate ions are brought into solution and hydrogen ions (H^+) are depleted. Thus, the pH tends to be neutralized. During the neutralization process from a pH of 1 to a pH of 7, the hydrogen ion concentration

decreases from 10^{-1} to 10^{-7} moles/l. The release of calcium and bicarbonate ions is approximately 4000 and 6100 mg/l, respectively. By releasing large concentrations of calcium ion into a solution highly laden with sulfate ion, the solubility of $CaSO_4$ is exceeded and precipitation results. Therefore, when the tailings solution is neutralized due to dissolution of $CaCO_3$, approximately 9600 mg/l of sulfate ion are potentially precipitated from solution. This quantity is less if some carbon dioxide gas is released during these chemical reactions.

This mechanism accounts for a decrease in sulfate concentration from greater than 60,000 to greater than 50,000 mg/l. Since the sulfate concentration at well 3A is less than 40,000 mg/l, other reactions must be occurring to further deplete the system. As the tailings solution is being neutralized from pH 1 to pH 7, ferrous iron (Fe^{+2}) can be oxidized to highly insoluble ferric iron (Fe^{+3}) and precipitated out as the hydroxide or carbonate. For each mole of Fe^{+3} precipitated, three moles of H^+ are released to the solution. These added hydrogen ions are free to further dissolve $CaCO_3$, which, by the mechanism described previously, can cause the precipitation of $CaSO_4$. Approximately 4300 mg/l (77 mmoles) of iron are initially present in the tailings solution. Essentially all of this content is depleted by the time tailings seepage reaches well 3A. Therefore, about 230 mmoles of H^+ are released to dissolve $CaCO_3$. The subsequent precipitation of $CaSO_4$ would cause the depletion of about 20,000 mg/l sulfate. The quantity of sulfate depletion is less than this value if some carbon dioxide gas is released during these chemical reactions. The total sulfate loss by the above described mechanisms easily accounts for a decrease in sulfate concentration from greater than 60,000 to less than 40,000 mg/l.

The above described processes depend on the availability of $CaCO_3$ in the porous media in order to neutralize the tailings solution. Samples from the first Tres Hermanos sandstone and the alluvial material were found analytically to contain 1.2 percent $CaCO_3$ and 3.2 percent $CaCO_3$, respectively. The first Tres Hermanos sandstone sample showed evidence of already being impacted from tailings seepage. Therefore, an average of 2 percent $CaCO_3$ is assumed for both rock materials. Therefore, assuming rock density of 2 gm/cm^3, the neutralizing capability is about 0.8 equivalents/l. The tailings solution contains 0.1 equivalents/l of H^+ making the potential H^+ to $CaCO_3$ ratio 1:8. However, if the effective porosity is 0.1, each ft^3 of soil can hold only 0.1 ft^3 of water. Therefore, the soil materials have much more than sufficient neutralizing ability to prove the occurrence of the hydrolysis of $CaCO_3$ and the oxidation of the ferrous iron.

One other mechanism considered as a possible input of calcium (subsequently causing precipitation of $CaSO_4$ and the depletion of sulfate) is cation exchange. However, laboratory analysis of the first Tres Hermanos sandstone and alluvial material showed little exchangeable calcium. Therefore, hydrolysis of $CaCO_3$ and oxidation of ferrous iron are considered primarily responsible for the neutralization and sulfate depletion of the tailings solution.

9.0 ION MIGRATION SIMULATION

9.1 Theory of Ion Migration Model

9.1.1 General Theory

Water seeping through subsoil can transport dissolved ions with it. In addition to transportation of ions through water movement, other mechanisms, such as molecular diffusion, hydrodynamic dispersion, and adsorption can affect ion movement relative to the host water movement.

Diffusion is the mixing process, at a molecular level, which accounts for the movement of dissolved ions from areas of higher to lower relative concentrations in a given solution. Hydrodynamic dispersion is caused by the complexities of the porous medium and is more mechanical in nature. For more detailed information on diffusion and dispersion, the reader should refer to Fried (1975), Scheidegger (1954), and Scheidegger (1961).

When a slug of tracer is injected into a porous medium, it is not detected as a slug at distance down gradient from the injection site. Rather, it is detected as a gradually increasing concentration to a maximum value and then as a gradually decreasing concentration. This phenomenon is due to the combined effects of molecular diffusion and hydrodynamic dispersion. Quantitatively, hydrodynamic dispersion has the greater effect on solute transport, but both are accounted for and lumped together in some computational forms as a single dispersion coefficient.

Adsorption is a chemical process where ions in solution attach themselves to unoccupied activation sites or replace other ions already sorbed to solid particles. In general, clay minerals have high exchange and adsorption capacities and high valence, high atomic weight cations have greater replacing power. Robinson (1962) has presented a literature review and summary of the principles of ion exchange processes with respect to the disposal of high level radioactive wastes. A more theoretical treatment of adsorption by clays is presented by Bolt (1955).

A quantitative parameter for defining ion adsorption on soils is the distribution coefficient (Kd), also called the adsorption coefficient. It

is normally considered that within trace concentration ranges, this coefficient is constant (Hajek and Ames, 1966). The adsorption coefficient can vary with constituent, pH and other factors but data is not available to predict a multiple parameter relationship. The pH has not varied sufficiently to warrant the variation of Kd for pH variations.

9.1.2 Model Presentation

By assuming no effects due to dispersion, diffusion, and convection, Hajek (1969) developed the following formula to predict ion migration velocity:

$$V_i = \frac{V}{1 + \frac{Bd \cdot Kd}{n}}$$

where: V_i = ion velocity

V = seepage velocity

Kd = distribution coefficient

Bd = bulk density

and n = volumetric moisture content

Routson (1969) describes a special solution to a partial differential solute transport equation developed by Hougen and Marshall (1947). This solution takes the following form:

$$C/C_o = \tfrac{1}{2}\left(1-\text{erf}\left(\frac{X-Vx \cdot t/a}{2\ Dm \cdot t/a}\right)\right)$$

where: $a = 1 + \frac{Bd \cdot Kd}{n}$

C = effluent concentration of solute

C_o = influent concentration of solute

n = pore fraction of exchanger

Kd = equilibrium distribution coefficient

Dm = dispersion coefficient

Vx = average solution velocity

x = distance from influent site

t = elapsed time measured from initial disposal

and erf(x) = error function of $x = \frac{2}{\pi} \int_0^x e^{-t^2} dt$.

This model assumes that diffusion and hydrodynamic dispersion can be accounted for in a single dispersion coefficient. It also has limitations imposed by the assumption of constant porosity, distribution coefficient, permeability, and flow rate.

9.2 Chloride Simulation

Using the one dimensional model previously described, chloride concentrations were simulated at wells 1A, 3A, 5, 6, and 7. Chloride is considered to be a conservative element, that is, no geochemical alterations to its basic ionic form generally occur. It moves at the same relative velocity as the water solution in which it is dissolved, except for the processes of dispersion. Simulations of chloride were therefore made assuming a zero distribution coefficient. Solution velocities used in the model predictions were essentially those determined by field tests as previously described in Section 6.3 of this report. Small adjustments were made to average groundwater velocities to aid fitting of predicted to observed data. These adjustments are justifiable because velocities previously computed are considered to be average velocities. Site specific velocities are expected to vary slightly.

The other model parameter that was varied to enable fitting of predicted to observed chloride concentrations was the dispersion coefficient, Dm. Classical field dispersion measurement techniques were not feasible due to relatively low permeabilities of the aquifer materials.

Only later-time chloride values at monitoring wells were used in obtaining matches of predicted to observed data. The earlier-time concentrations were heavily influenced by the placement of rock salt in the clay embankment of the tailings dam. Although this salt added significantly to chloride levels in the first Tres Hermanos and alluvial aquifers, it is considered to be a relatively short-term effect. The longer-term offect of the tailings solution seepage was deemed more relevant for simulation and prediction purposes.

The input level of chloride from the tailings reservoir was assumed to be 640 mg/l in the modeling computations. This input was begun in late 1976 and is assumed to continue for 20 years. Although the actual project life is not expected to be that long, the input effects from a tailings pond can last several years past its actual use as a disposal site. Also, periods of mill down-time during the project life can extend the usable life of the pond, and, thus, its effect on the ground-water systems. Therefore, 20 years was chosen as a conservative or worst-case length of impact on the first Tres Hermanos and alluvial aquifers.

Figures 44 through 48 show predicted chloride concentrations with time for wells 1A, 3A, 5, 6 and 7, respectively. The simulations presented on these figures show that the effects of tailings-pond seepage on chloride concentrations near these wells is already taking place. Chloride concentrations due to seepage effects should increase to a peak between 600 and 700 mg/l within another couple of years and remain at that level until approximately the year 2000. Slight variations to this time frame can be noted at each well because of differences in ground-water velocity, dispersion coefficient, and distance from the tailings reservoir.

Figure 49 shows predicted chloride concentration with time at a point one mile distant from the tailings reservoir. Typical ground-water velocity and dispersion coefficient of 0.5 ft/day and 5 ft^2/day, respectively, were used for this simulation. Chloride concentrations should reach a peak greater than 600 mg/l at approximately the turn of the century (35 years after initiation of tailings disposal) and begin to subside about ten years thereafter.

Following the geochemical processes which tend to decrease sulfate concentrations from greater than 60,000 mg/l in the tailings solution to about 35,000 mg/l in the aquifers, sulfate should move with the ground-water similarly to chloride. Estimates of sulfate concentrations can be obtained by multiplying the chloride results by the ratio of 35,000 and 640. Therefore, the previous discussion of chloride movement could equally apply to sulfate (or other relatively conservative ions) remembering the differences in initial concentrations.

9.3 Radionuclide Migration

Model predictions of radium-$_{226}$ and uranium (as U_3O_8) migration have also been made. Predicted radium-$_{226}$ concentrations with time at wells 1A, 3A, 5, 6 and 7 are shown on Figures 50 through 54. For these analyses the same ground-water velocities and dispersion coefficients were used as in the chloride simulations. Tailings water radium-$_{226}$ concentration was assumed to be 150 pCi/l. A conservative distribution coefficient of 10 ml/gm was used. This value yields conservative (high) radium concentrations in the simulation. Since actual radium-$_{226}$ values observed at all monitoring wells are considered background, and not yet affected by tailings-water seepage, fitting predicted to observed data was not possible. All radium-$_{226}$ simulations (Figures 50 - 54) indicate that peak concentrations will stay

well below 10 pCi/l, and that these peaks will occur greater than 1000 years from initiation of tailings disposal. As shown on Figure 55 the radium-$_{226}$ concentration should remain less than 5 pCi/l at a distance of one mile from the tailings reservoir.

For the uranium simulations at wells 1A, 3A, 5, 6 and 7 (Figures 56-60), a relatively conservative distribution coefficient of 5 ml/gm and an initial tailings-pond concentration of 50 mg/l were used. Greater than 500 years will be required at the simulated well sites for maximum values of less than 5 mg/l (as U_3O_8) to be observed. Figure 61 shows predicted uranium concentration with time one mile from the tailings pong. Approximately 4000 years will be required to reach a peak concentration of 1.5 mg/l. These predicted uranium concentrations should be conservative (high) because this simulation used a conservative Kd of 5 ml/gm.

From the foregoing discussion of predicted radionuclide migration from the L-Bar tailings reservoir, it can be concluded that minimal impact will be made on the ground-water systems by radionuclide contamination.

10.0 GROUND-WATER MONITORING

The following proposed monitoting program takes into account the following major factors:

1. Ground-water moves slowly through the aquifers near the tailings pond. The highest rate is near 0.5 ft/day in the area between wells 5 and 10.
2. No decreased pH front has been detected or is expected in the ground-water systems. Therefore, major constituents are the only contaminants expected to be detected in the ground waters.
3. The major potential impact to the ground water is increases in the major constituents in the first Tres Hermanos aquifer. This

aquifer is a poor producer and naturally contains salts in concentrations too great for domestic use of the water. The aquifer is approximately 300 feet deep only one mile down-gradient from the tailings pond. It is doubtful whether any use will be made of this poor aquifer at this depth or greater.

Table 23 presents the proposed ground-water monitoring program with consideration of the above three items. Water levels are proposed to be measured prior to sampling on a monthly basis to insure good definition of the rate of water-level rises. Field conductivity of the water is also proposed to enable some monthly control on the water quality. The main major constituents of concern, chloride and sulfate, are proposed to be measured on a quarterly basis, because movement of water in these ground-water systems is only a few tens of feet in a quarter of a year. Bicarbonate, carbonate, and pH are included in the quarterly monitoring to give complete control on all anions. This should also indicate whether major cations are changing. The complete yearly list of parameters are to be measured if the pH decreases one unit below its value the previous quarter.

Typically, heavy metals and radionuclides will move much slower in the ground-water system than the water due to adsorption. Therefore, yearly monitoring of the ground-water systems for heavy metals and radionuclides is considered adequate. Radium-$_{226}$ and uranium are the two radionuclides proposed for yearly monitoring, and Table 23 lists the proposed heavy metals. All major constituents are proposed to be measured annually so the accuracy of these measurements can be assessed and to determine the changes in major cations.

Wells 1A, 2A, 3A, 5, 8, 9, 10, 12, 13, 14, 15, 17 and 20 are proposed to be sampled for the annual list of constituents. All of these wells should be useful in defining the movement of constituents in the three aquifers of concern (first and second Tres Hermanos and the alluvial aquifers). Well 4A was not proposed to be sampled annually, because well 15 monitors the movement in this area. Wells 3A and 14 are both needed to monitor the slow movement of major and minor constituents in this area. Wells 5 and 8 are proposed for annual monitoring in their area instead of wells 6 and 7. The remainder of the first Tres Hermanos wells are at strategic locations and are proposed for annual monitoring.

Only wells 3B and 20 presently have sufficient water to enable a complete chemical analysis and are therefore the two alluvial wells proposed for annual monitoring. Well 13 is a second Tres Hermanos well and is proposed to be monitored for the annual list of constituents also.

Wells 1A, 8 and 10 are wired for pumps and are proposed to be sampled by pumping at one gpm. These three wells should be pumped 30 minutes prior to taking the sample each time. The water levels of wells north of wells 3A and 14 should be measured prior to any pumping. The remainder of the wells are proposed to be bailed for water samples. The bailer should be lowered to within the perforated interval of the well each time. At least ten gallons should be bailed before collecting the annual sample. Wells which will not yield ten gallons should be bailed dry and then sampled after recovery.

11.0 CONTINGENCY PLAN

The following is a contingency plan to stabilize the movement of contaminated ground water. This plan is not presently proposed but is presented if future monitoring indicates ground-water seepage needs to be contained.

Pumping of a few wells at a low rate will stabilize the movement of high concentration seepage water in the first Tres Hermanos sandstone, because this aquifer is confined and has relatively low transmitting properties. Pumping of three wells, 5, 8 and 10, at one gpm each was investigated to determine if these three wells create sufficient drawdowns in this area of the Tres Hermanos aquifer. Drawing 7 presents the predicted drawdowns for the aquifer properties of 250 gal/day/ft. and 3×10^{-5} for the transmissivity and storage coefficient, respectively. The pumping of wells 5, 8 and 10 at one gpm each for one year easily develops drawdowns greater than the water-level rises which have been observed since the start of the operation of the tailings disposal site. A recharge boundary was not used in the drawdown analysis to simulate the tailings pond, because the pump-test data indicated that the pond does not influence the aquifer in this manner. Contours are not shown further to the south or east because the transmissivity is much lower in these areas. Drawdown contours would be closer (steeper) in the low transmissivity areas and reach out into these areas at a slower rate. The pumping of these three wells (5, 8, and 10) at one gpm each could adequately stabilize the movement of ground water in this area of the first Tres Hermanos aquifer. Monitoring of water levels in wells 9, 12, 14, and 15 would show whether the pumping of these three wells is sufficient. A few additional pumping wells could be needed north and east of the tailings pond to stabilize the ground water in this area of the first Tres Hermanos aquifer.

Pumping of the first Tres Hermanos aquifer will not significantly influence the thin alluvial aquifer. The transmitting ability of the alluvial aquifer is so low that pumping of alluvial wells would not be feasible. If the alluvial system started transmitting a significant amount of seepage, the installation of a horizontal drain at the base

of the alluvium is proposed as a contingency plan for the alluvial aquifer. A trench 200 to 300 feet long and approximately 15 feet deep in the area of wells 19 and 20 would be required for the drain. The drain would slope toward the north and be tied to a vertical well or sump at the north end for collection purposes. A liner or low permeability fill could be placed on the down-gradient side of the drain to insure the interception of all of the alluvial water in this area.

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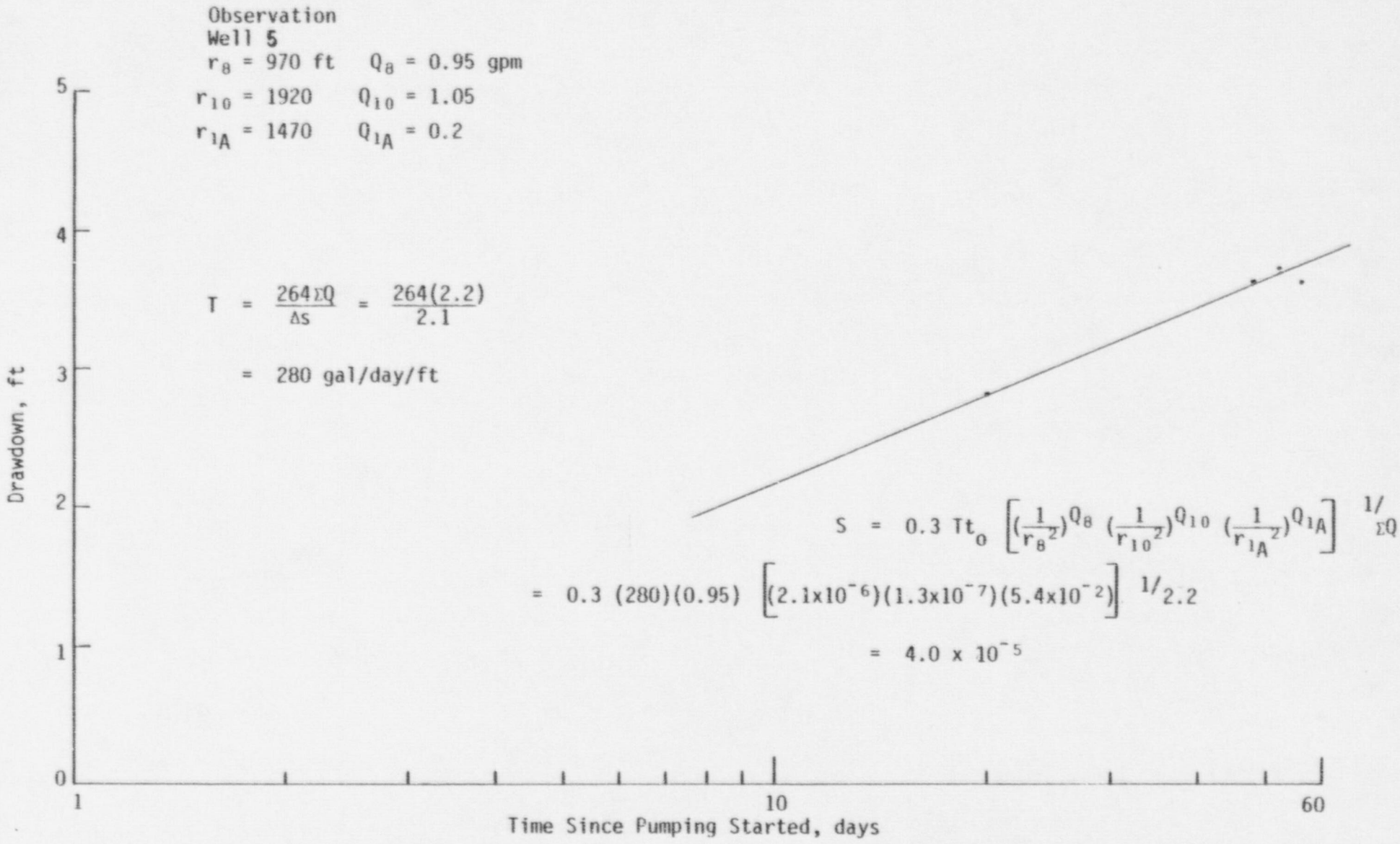


FIGURE 1. DRAWDOWN IN OBSERVATION WELL 5 (semi-log)

Observation Well 6

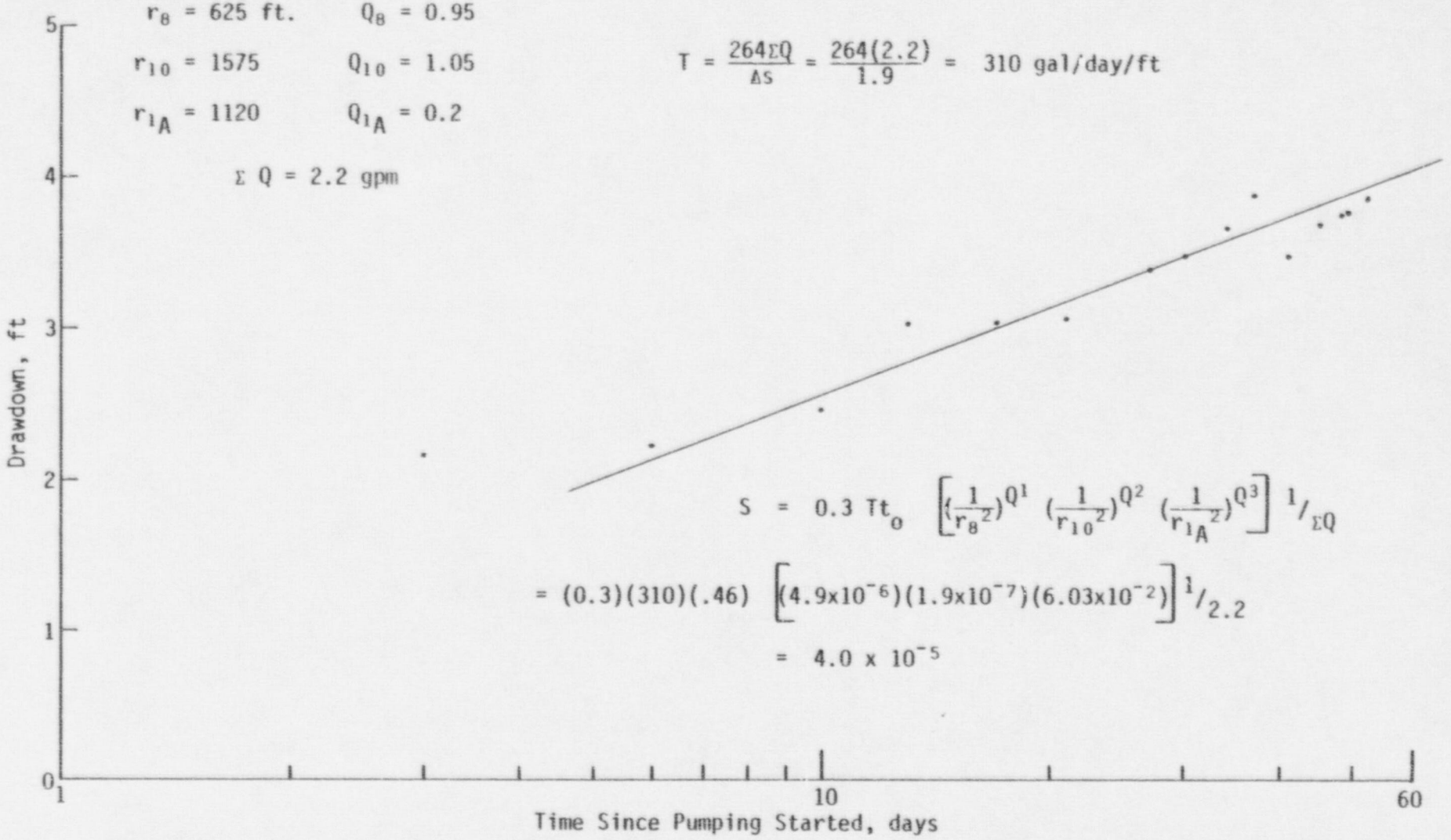
r_8 = 625 ft. Q_8 = 0.95

r_{10} = 1575 Q_{10} = 1.05

r_{1A} = 1120 Q_{1A} = 0.2

ΣQ = 2.2 gpm

$$T = \frac{264\Sigma Q}{\Delta s} = \frac{264(2.2)}{1.9} = 310 \text{ gal/day/ft}$$



$$S = 0.3\, Tt_o \left[\left(\frac{1}{r_8^2}\right)^{Q1} \left(\frac{1}{r_{10}^2}\right)^{Q2} \left(\frac{1}{r_{1A}^2}\right)^{Q3}\right]^{1/\Sigma Q}$$

$$= (0.3)(310)(.46) \left[(4.9\times10^{-6})(1.9\times10^{-7})(6.03\times10^{-2})\right]^{1/2.2}$$

$$= 4.0 \times 10^{-5}$$

FIGURE 2. DRAWDOWN IN OBSERVATION WELL 6 (semi-log)

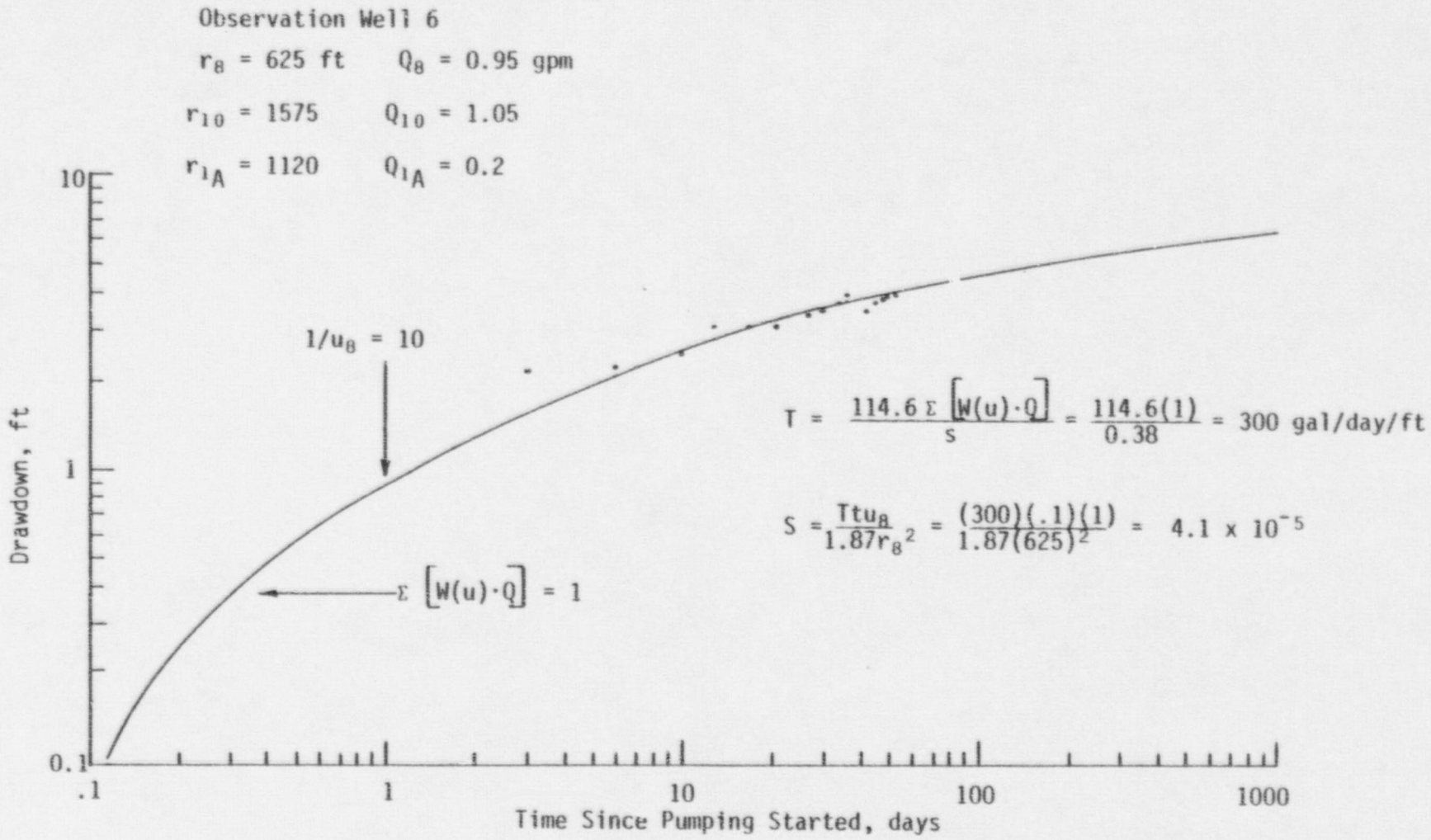


FIGURE 3. DRAWDOWN IN OBSERVATION WELL 6 AND TYPE CURVE FOR PUMPING WELLS 8, 10 AND 1A

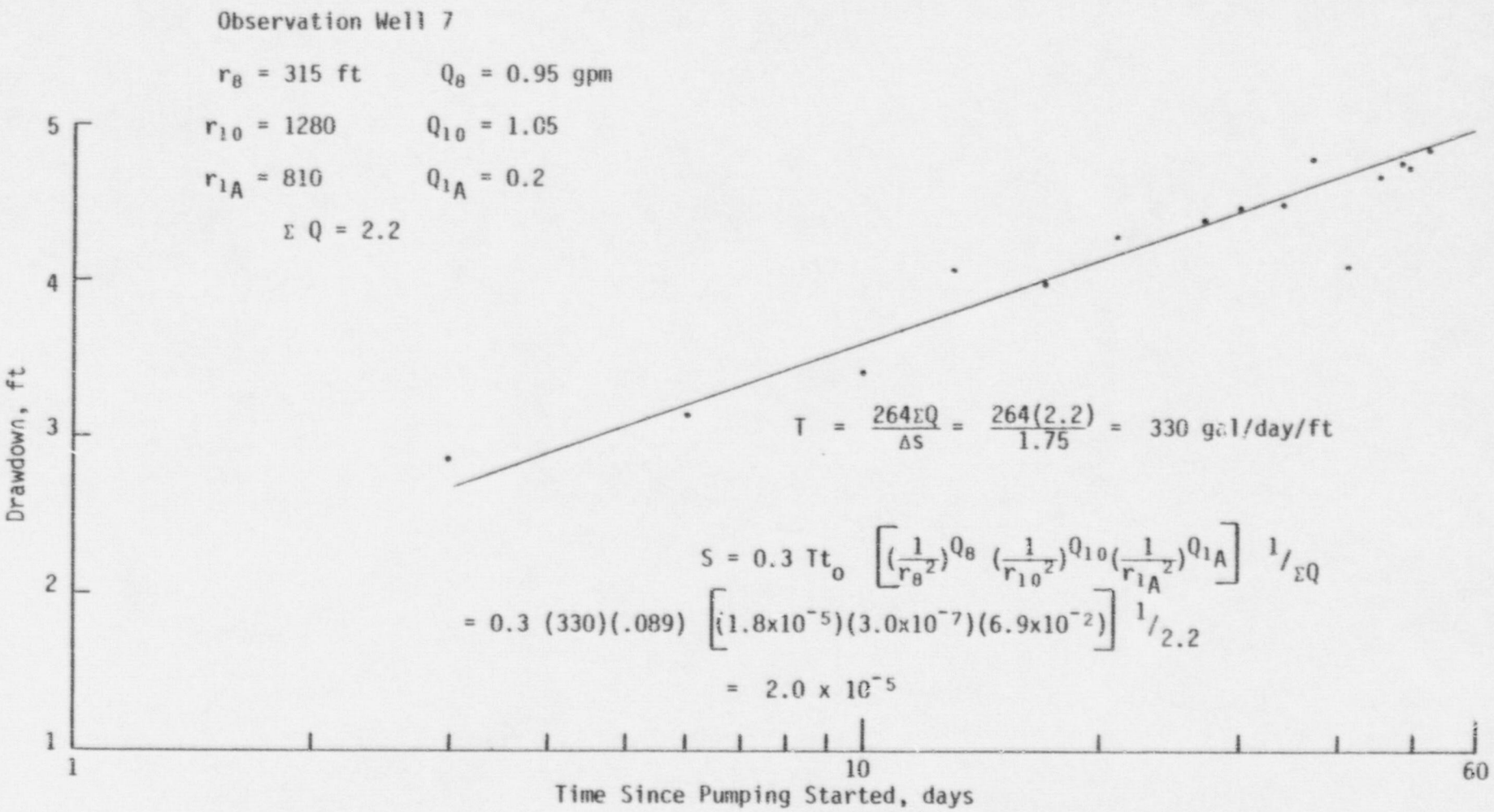


FIGURE 4. DRAWDOWN IN OBSERVATION WELL 7 (semi-log)

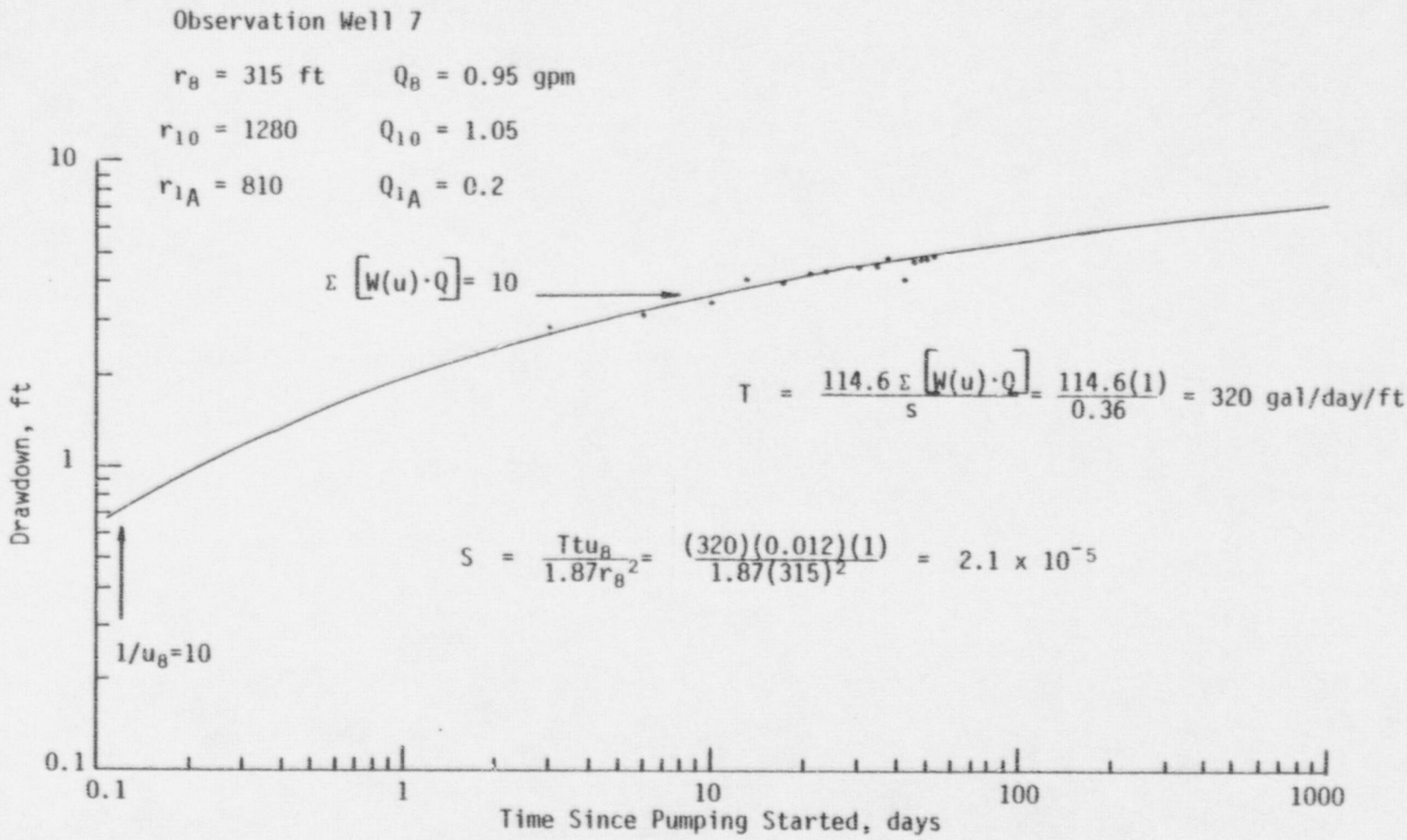


FIGURE 5. DRAWDOWN IN OBSERVATION WELL 7 AND TYPE CURVE FOR PUMPING WELLS 8, 10 AND 1A

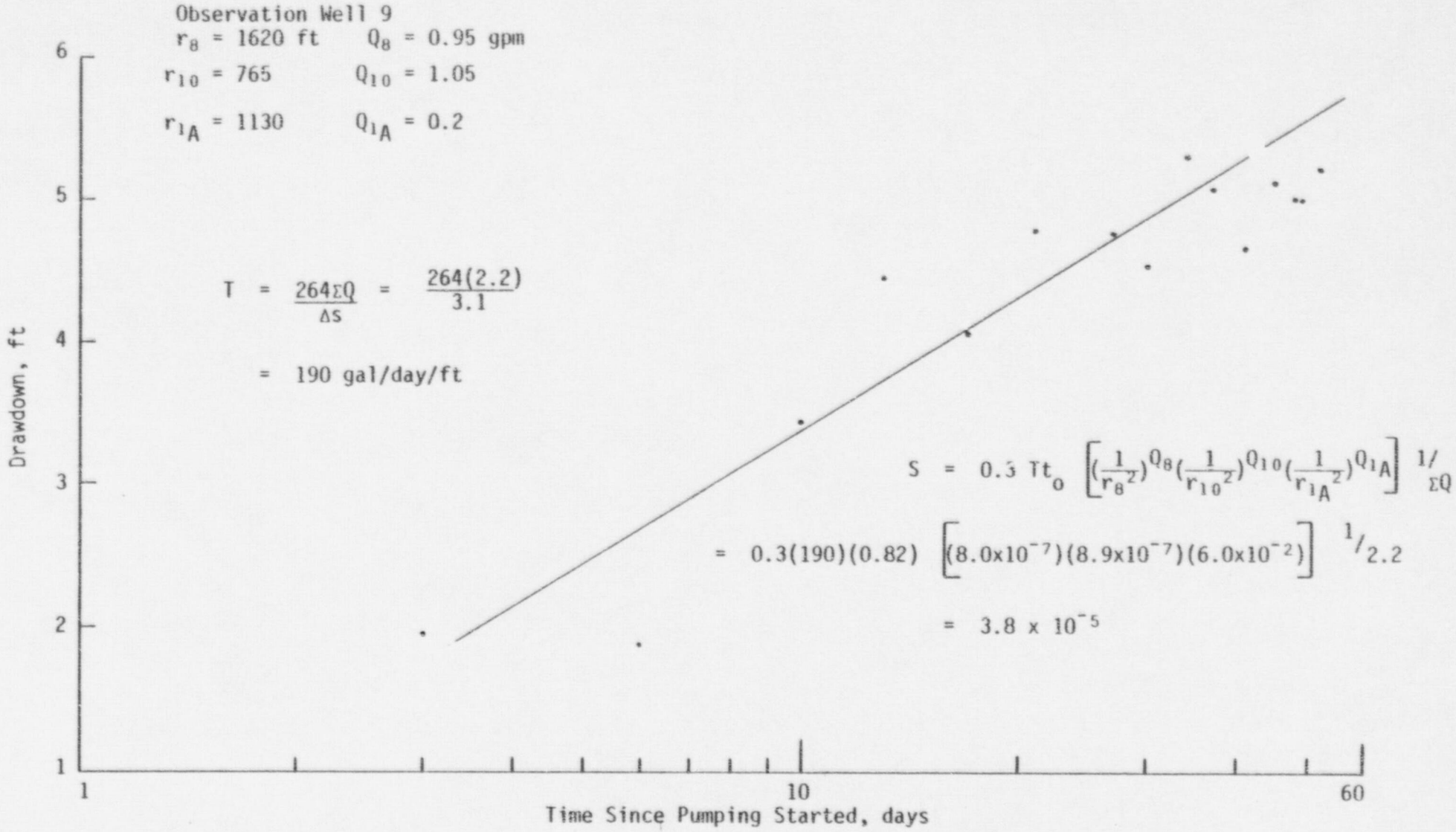


FIGURE 6. DRAWDOWN IN OBSERVATION WELL 9 (semi-log)

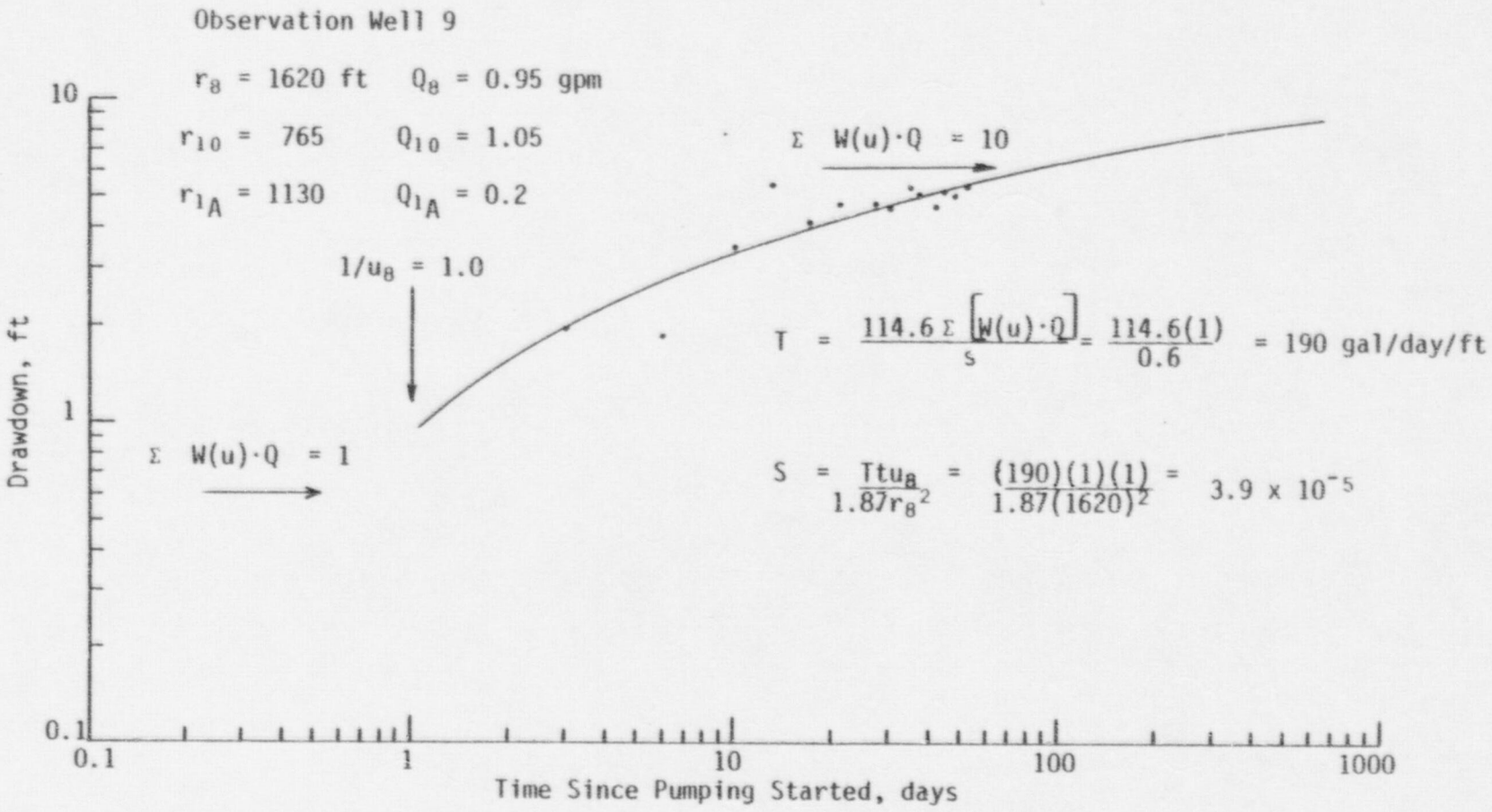


FIGURE 7. DRAWDOWN IN OBSERVATION WELL 9 AND TYPE CURVE FOR PUMPING WELLS 8, 10 AND 1A.

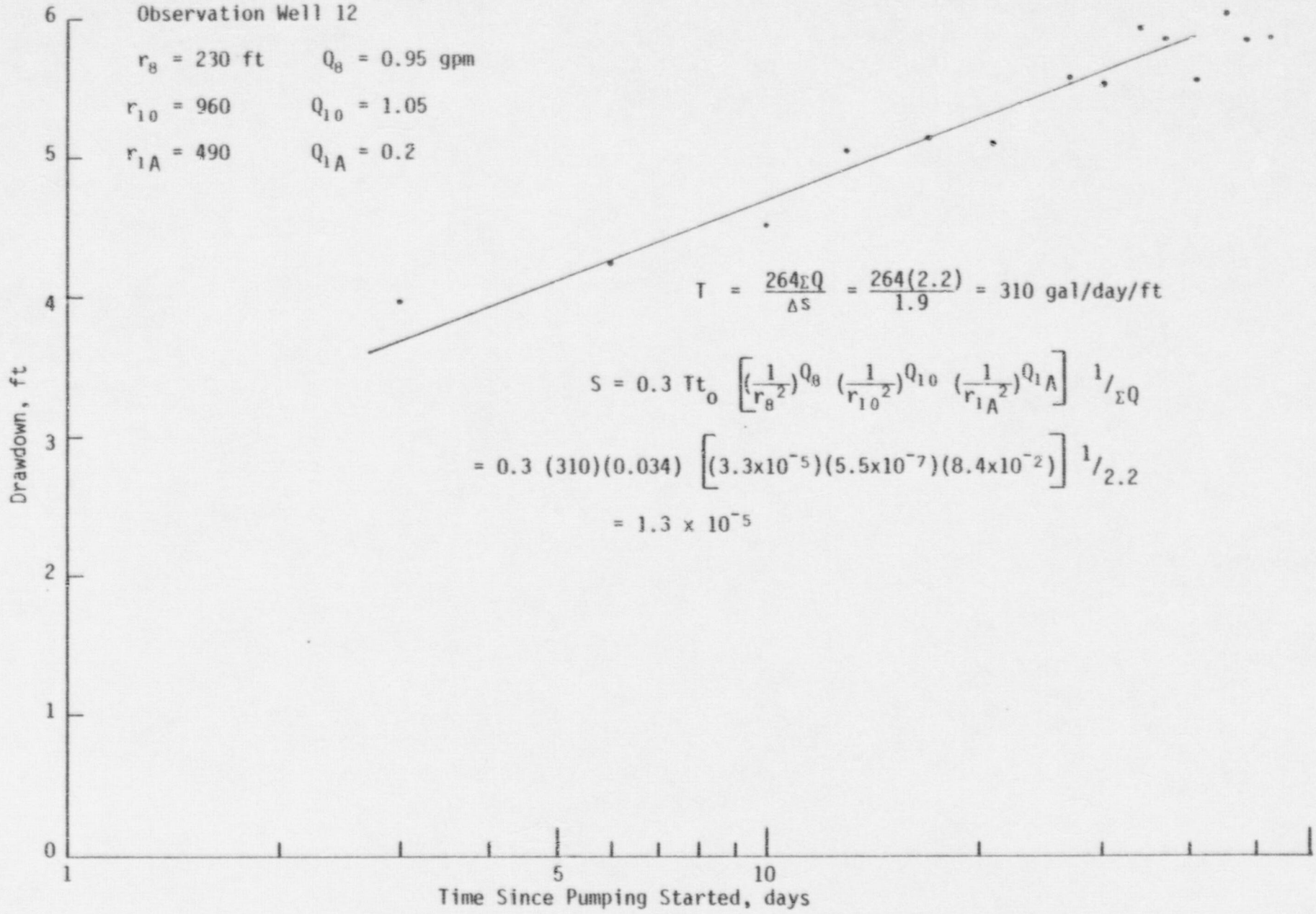


FIGURE 8. DRAWDOWN IN OBSERVATION WELL 12 (semi-log)

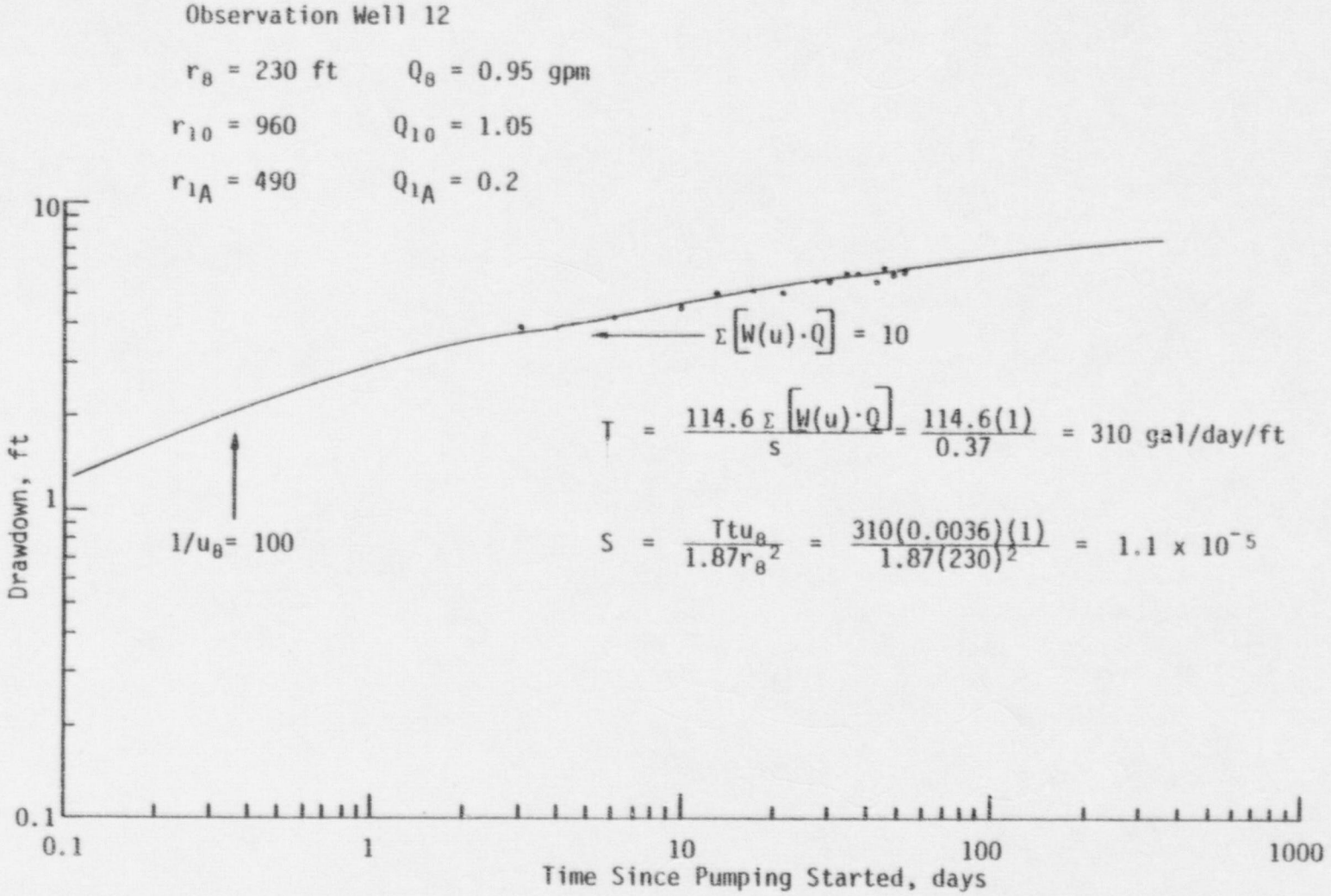


FIGURE 9. DRAWDOWN IN OBSERVATION WELL 12 AND TYPE CURVE FOR PUMPING WELLS 8, 10 AND 1A

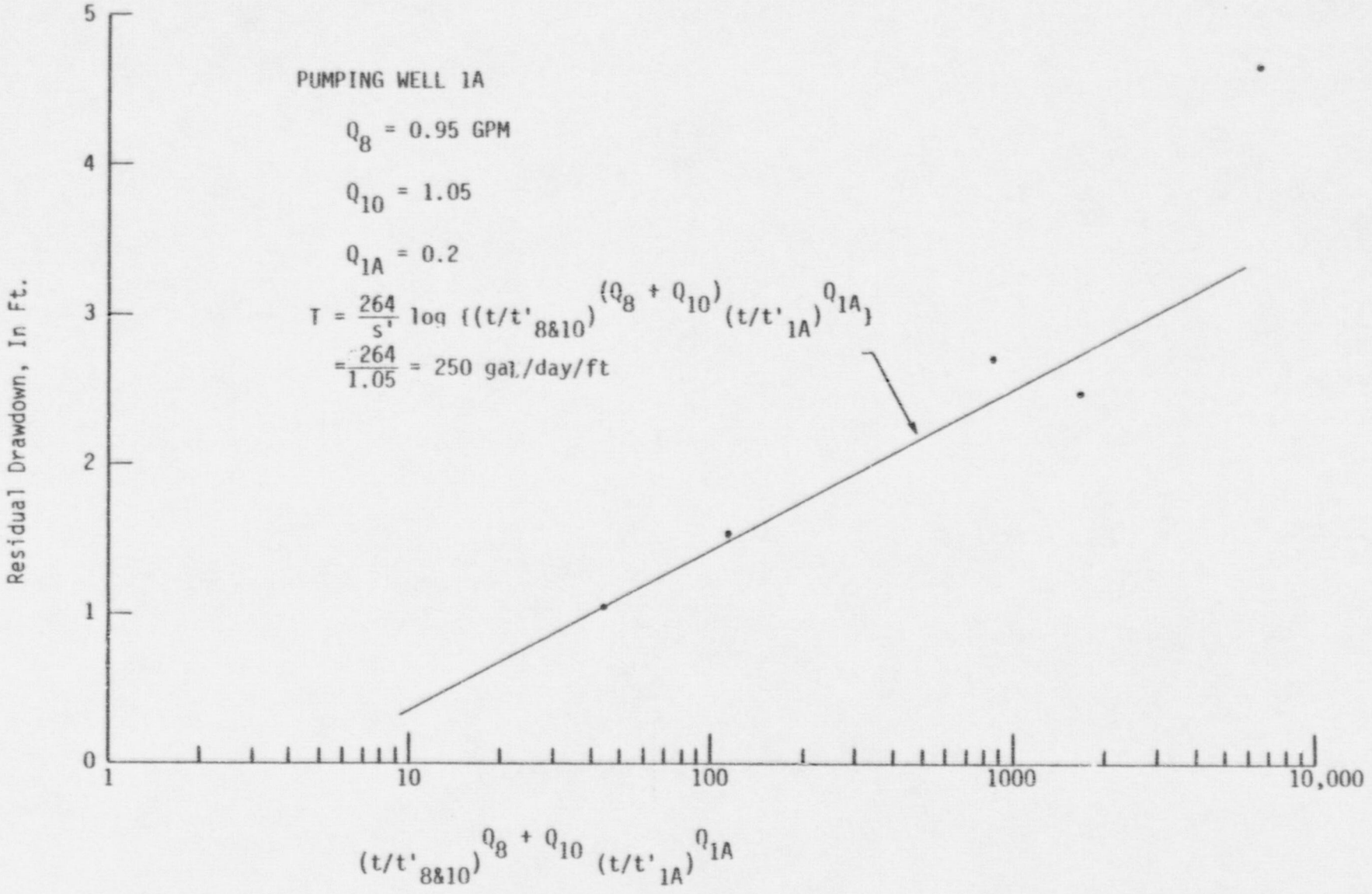


FIGURE 10 RECOVERY OF PUMPING WELL 1A.

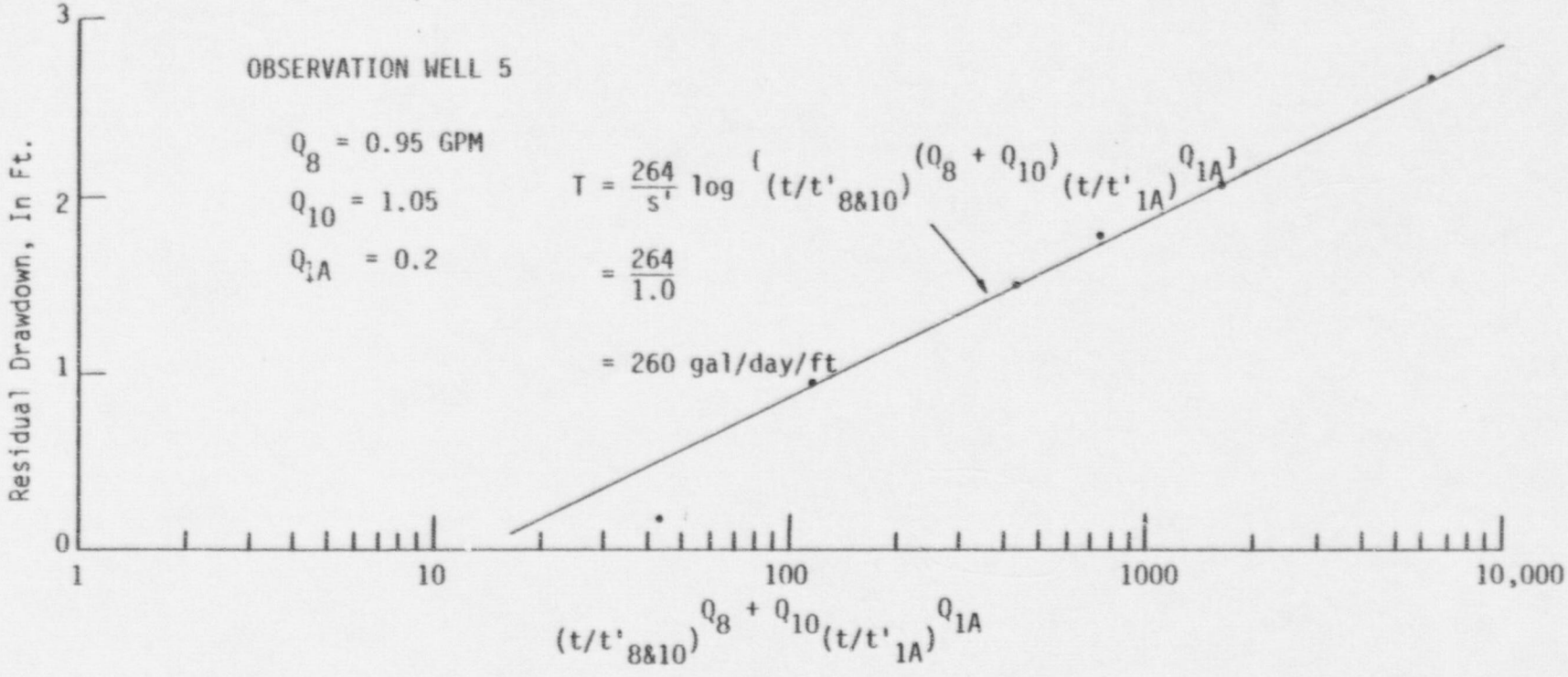


FIGURE 11 RECOVERY OF OBSERVATION WELL 5

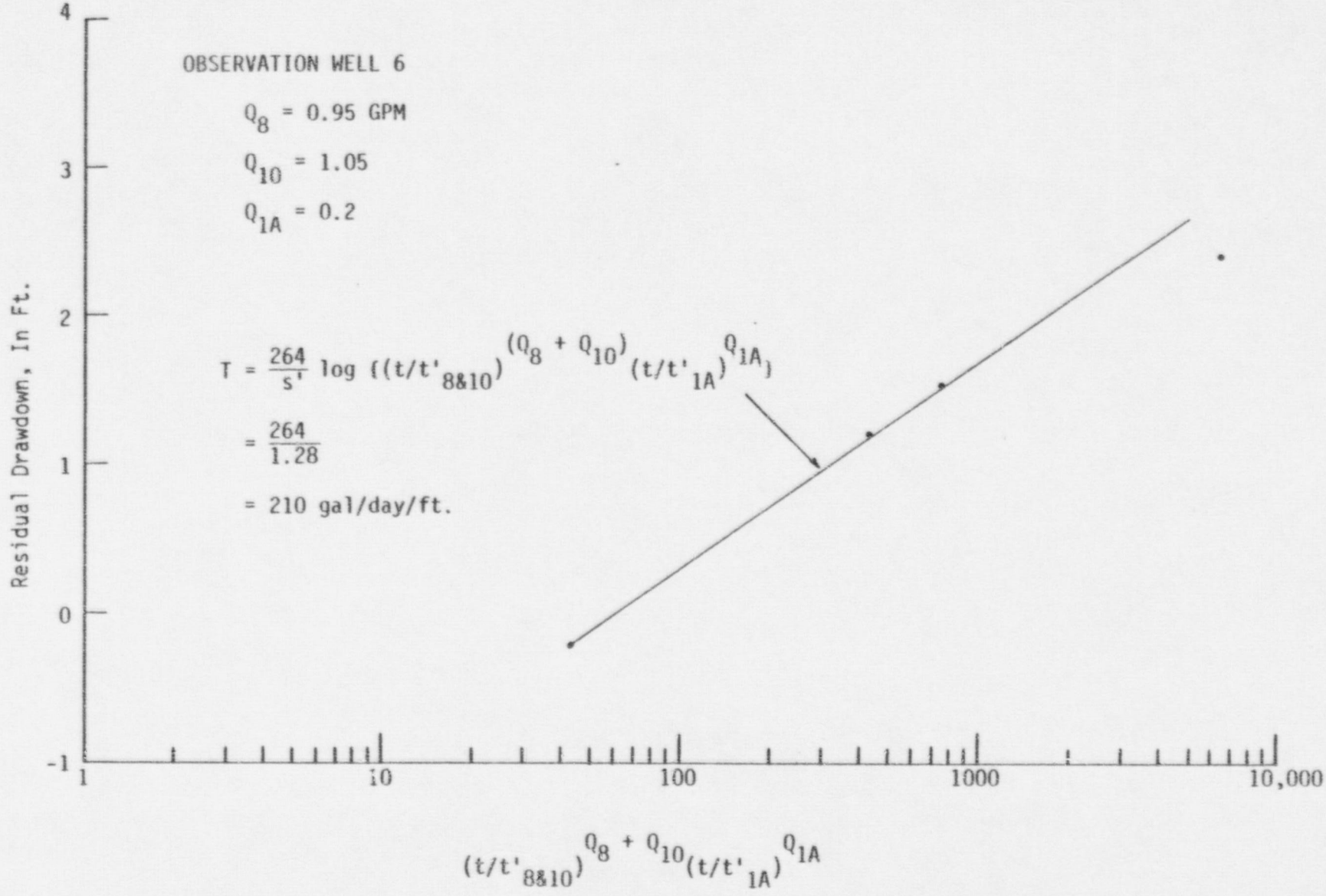


FIGURE 12 RECOVERY OF OBSERVATION WELL 6

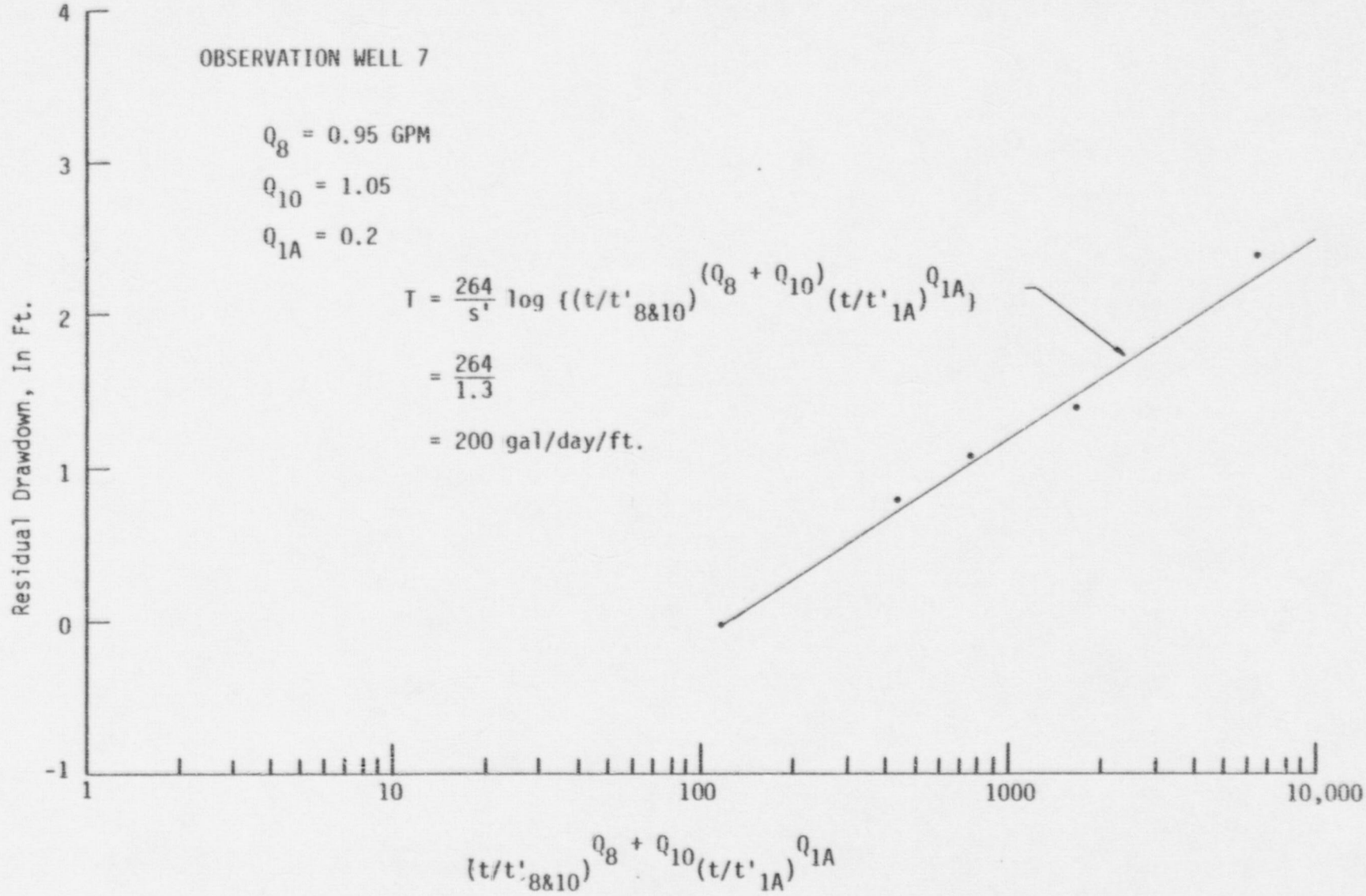


FIGURE 13 RECOVERY OF OBSERVATION WELL 7

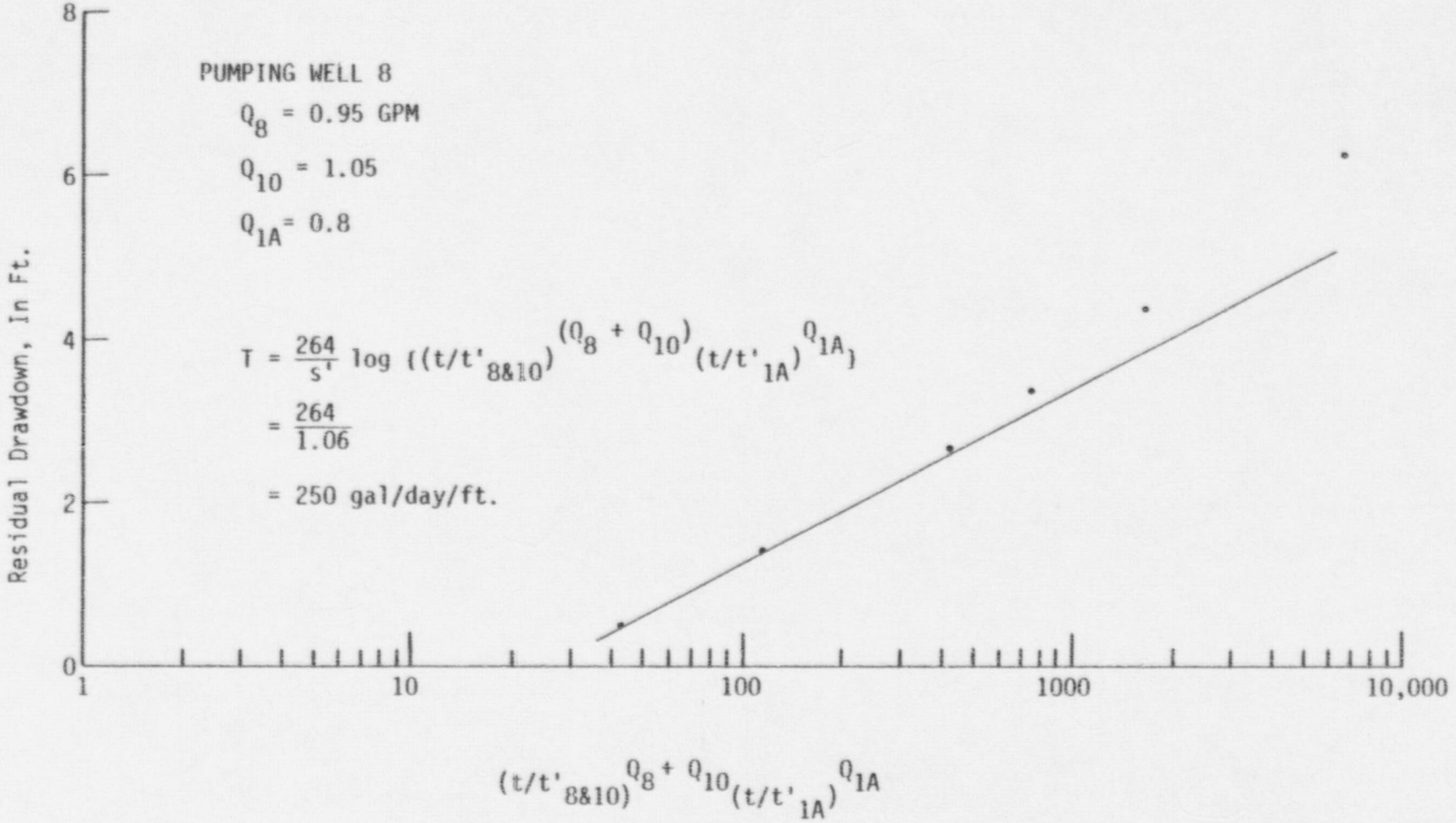


FIGURE 14 RECOVERY OF PUMPING WELL 8

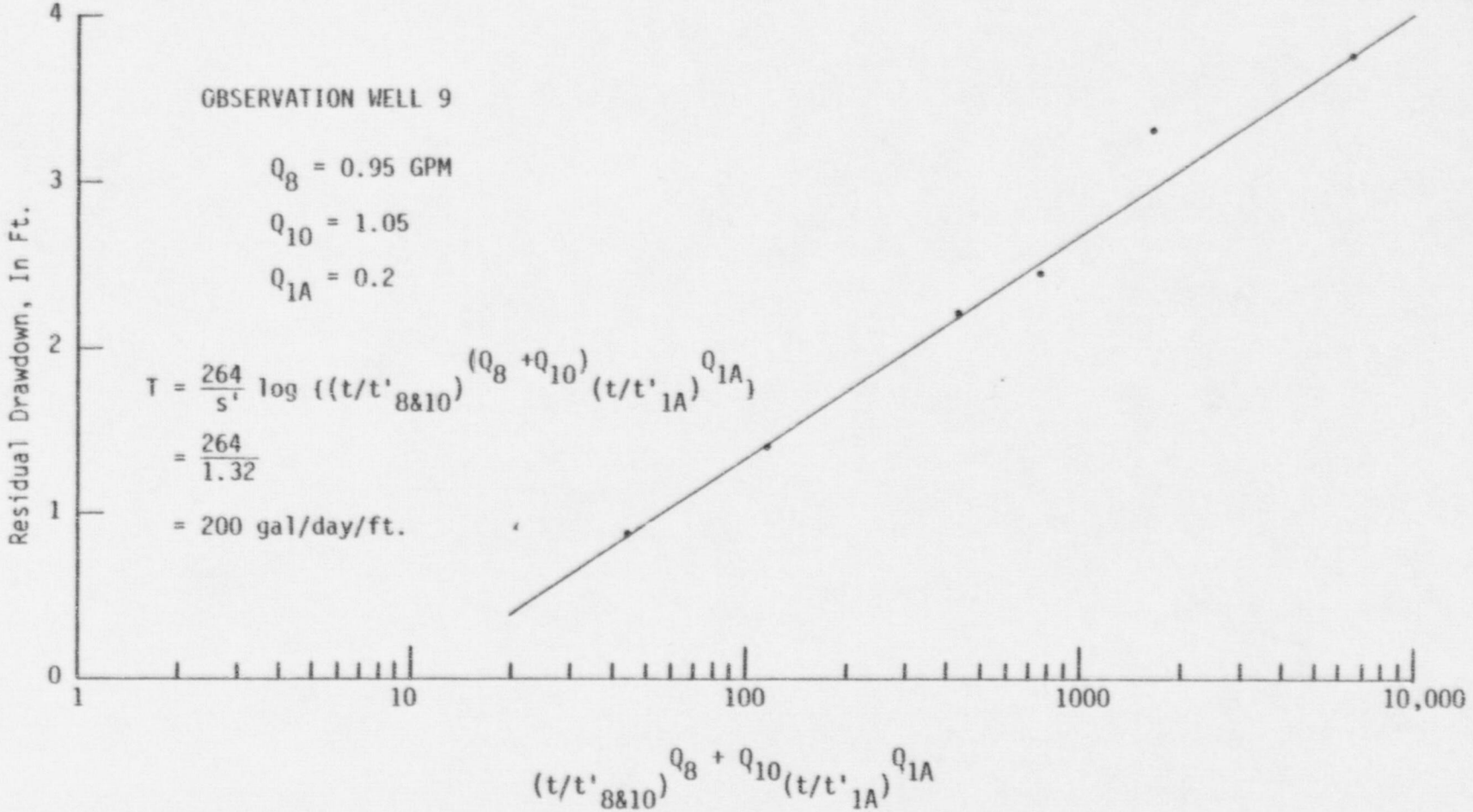


FIGURE 15 RECOVERY OF OBSERVATION WELL 9

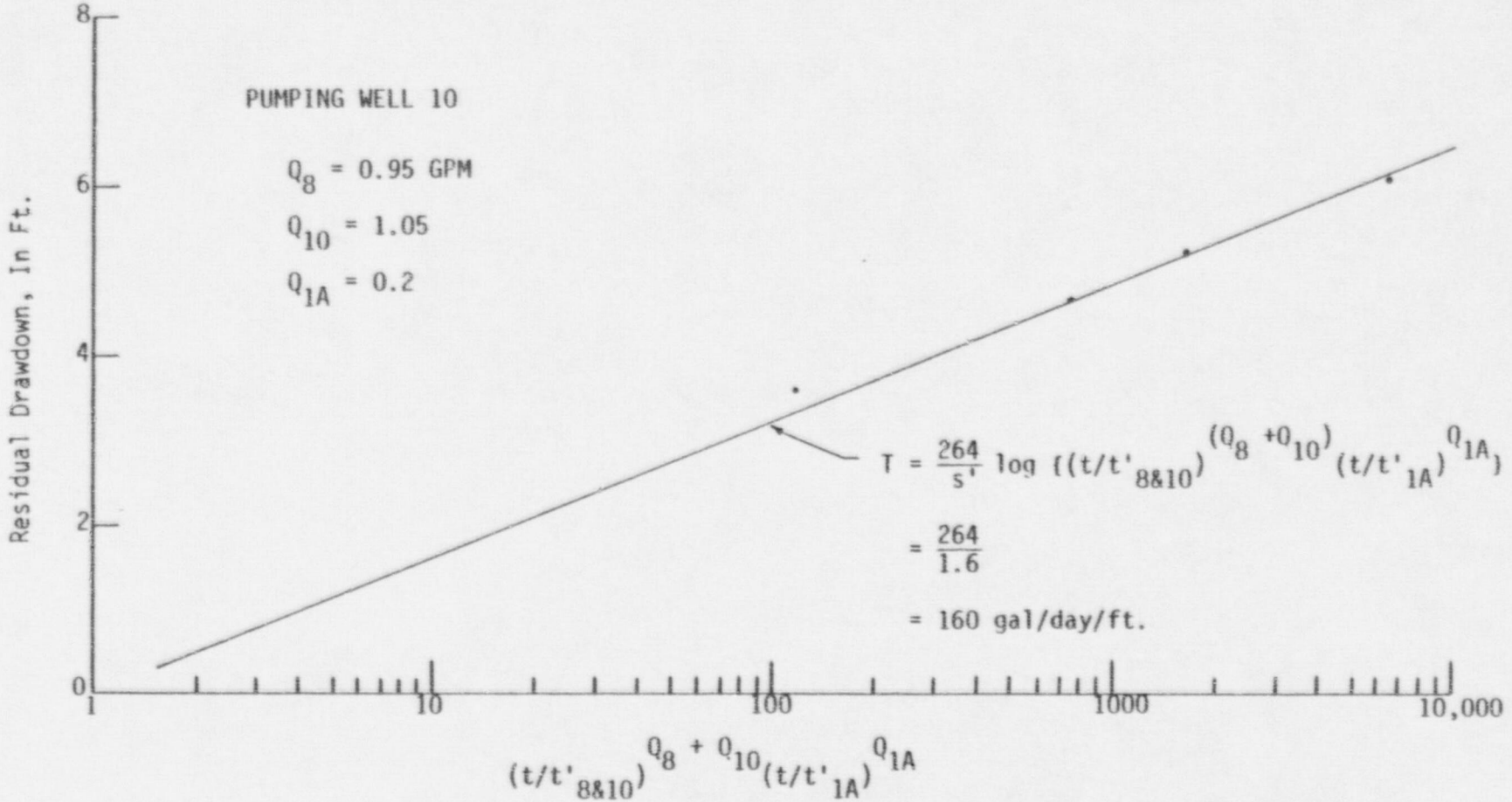


FIGURE 16 RECOVERY OF PUMPING WELL 10.

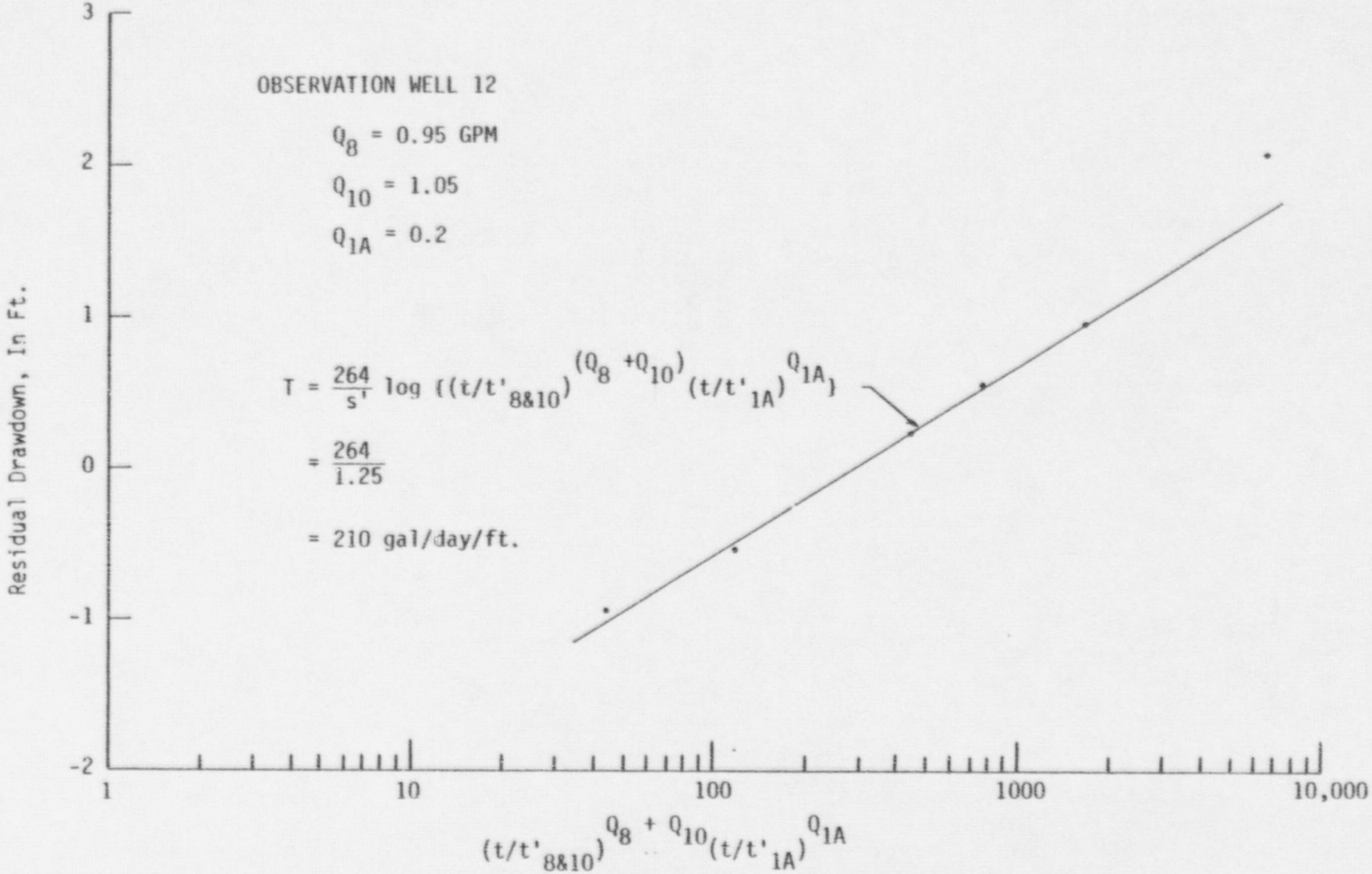


FIGURE 17 RECOVERY OF OBSERVATION WELL 12

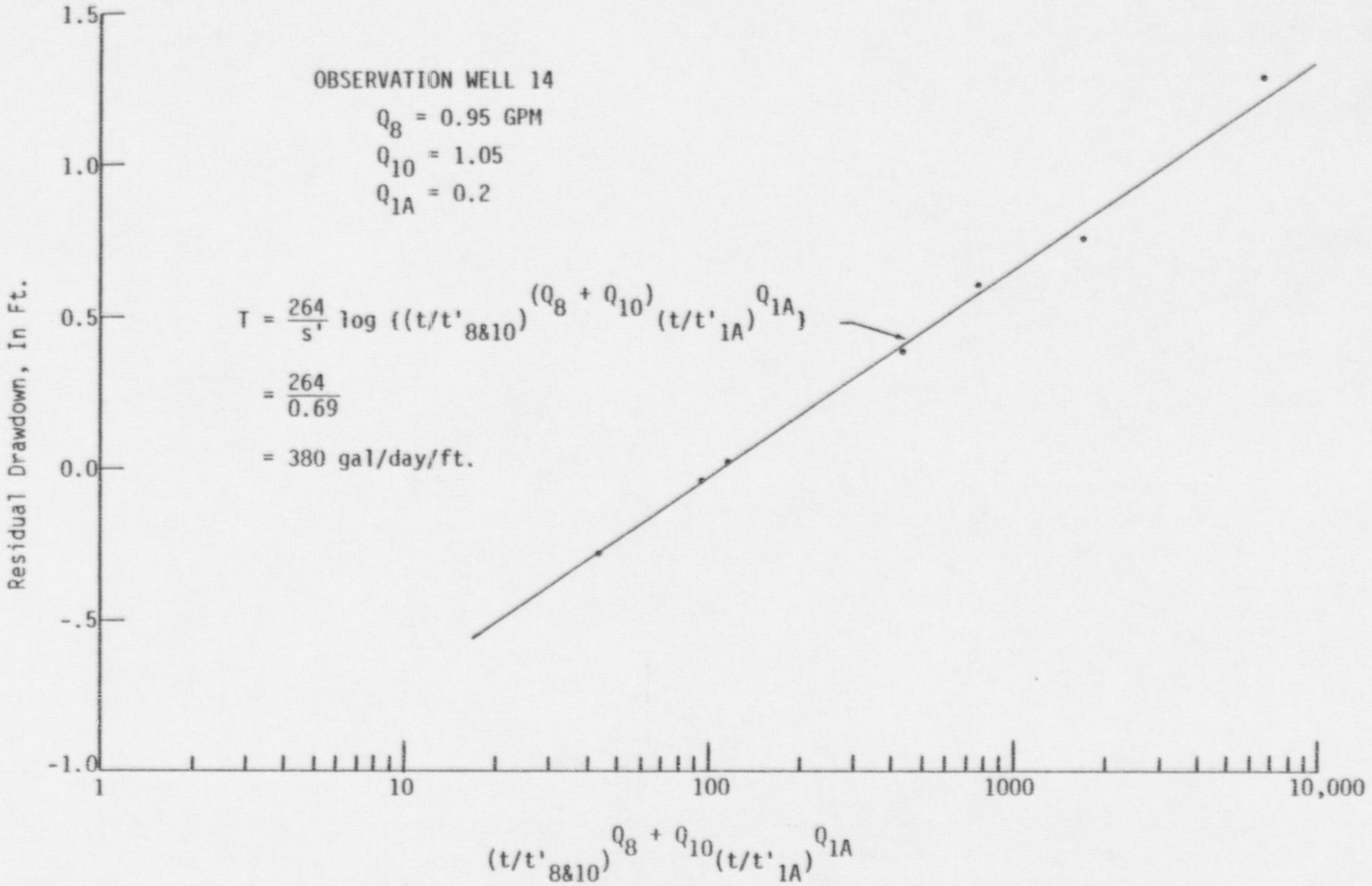


FIGURE 18 RECOVERY OF OBSERVATION WELL 14

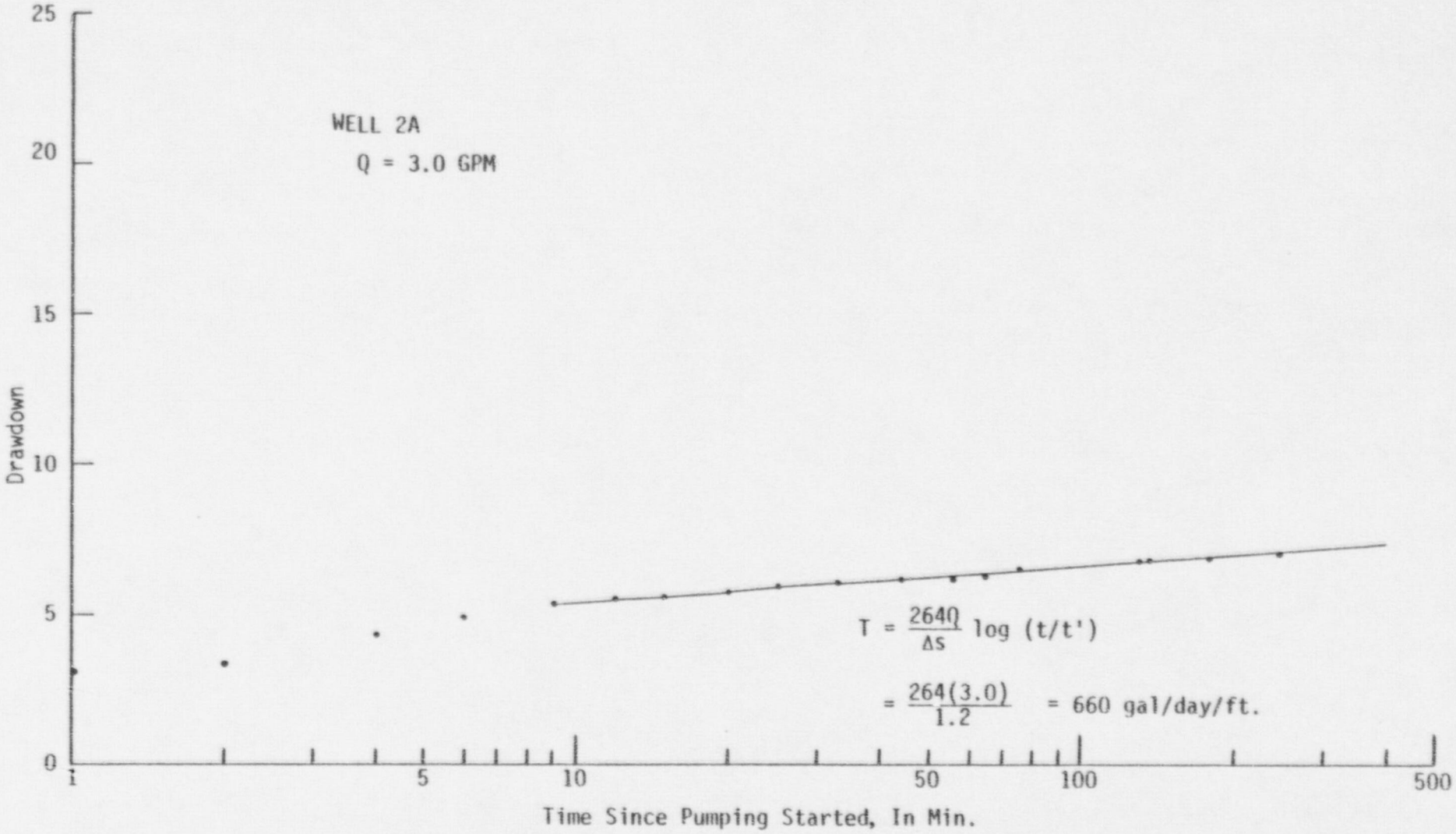


FIGURE 19 DRAWDOWN IN WELL 2A.

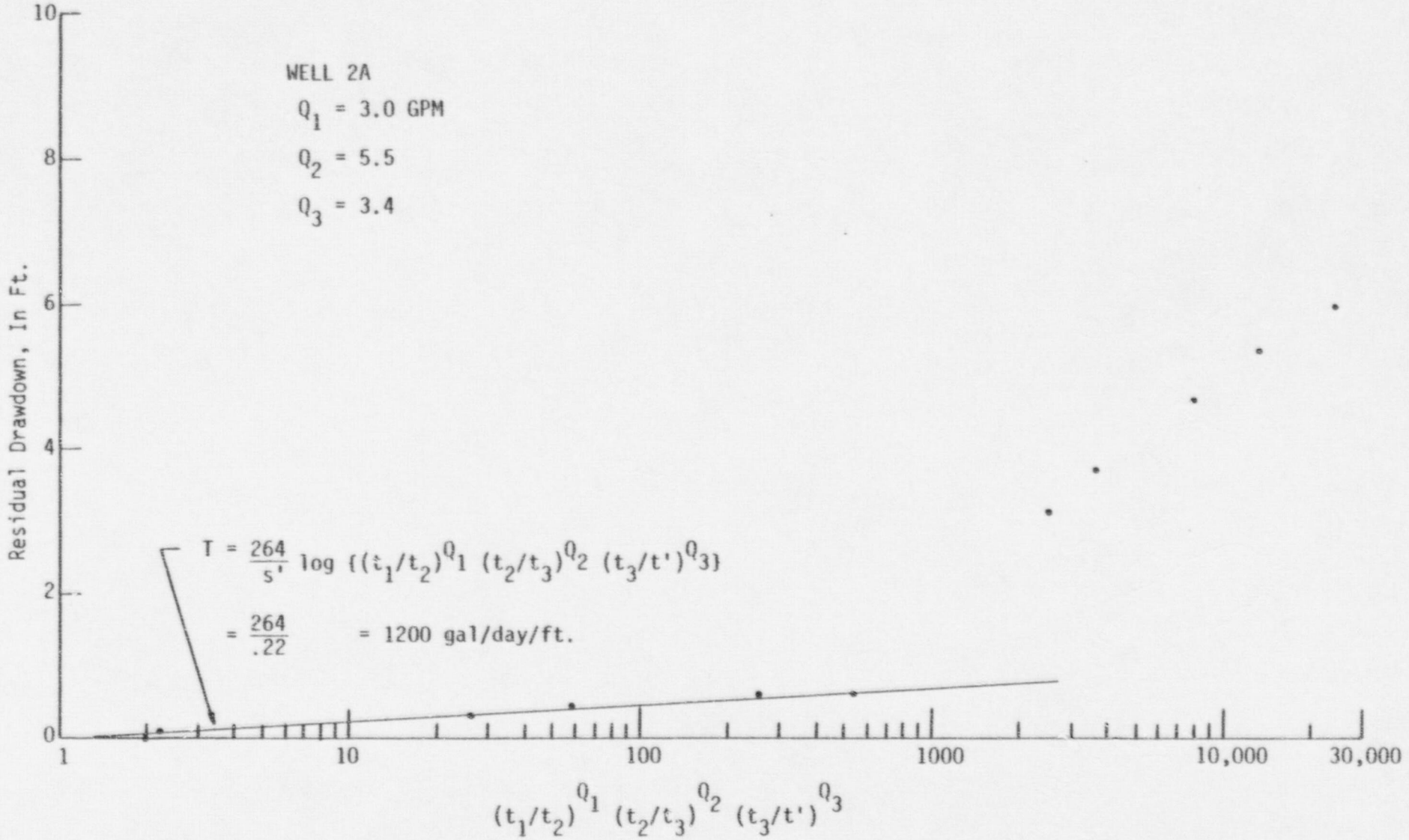


FIGURE 20 RECOVERY OF PUMPING WELL 2A

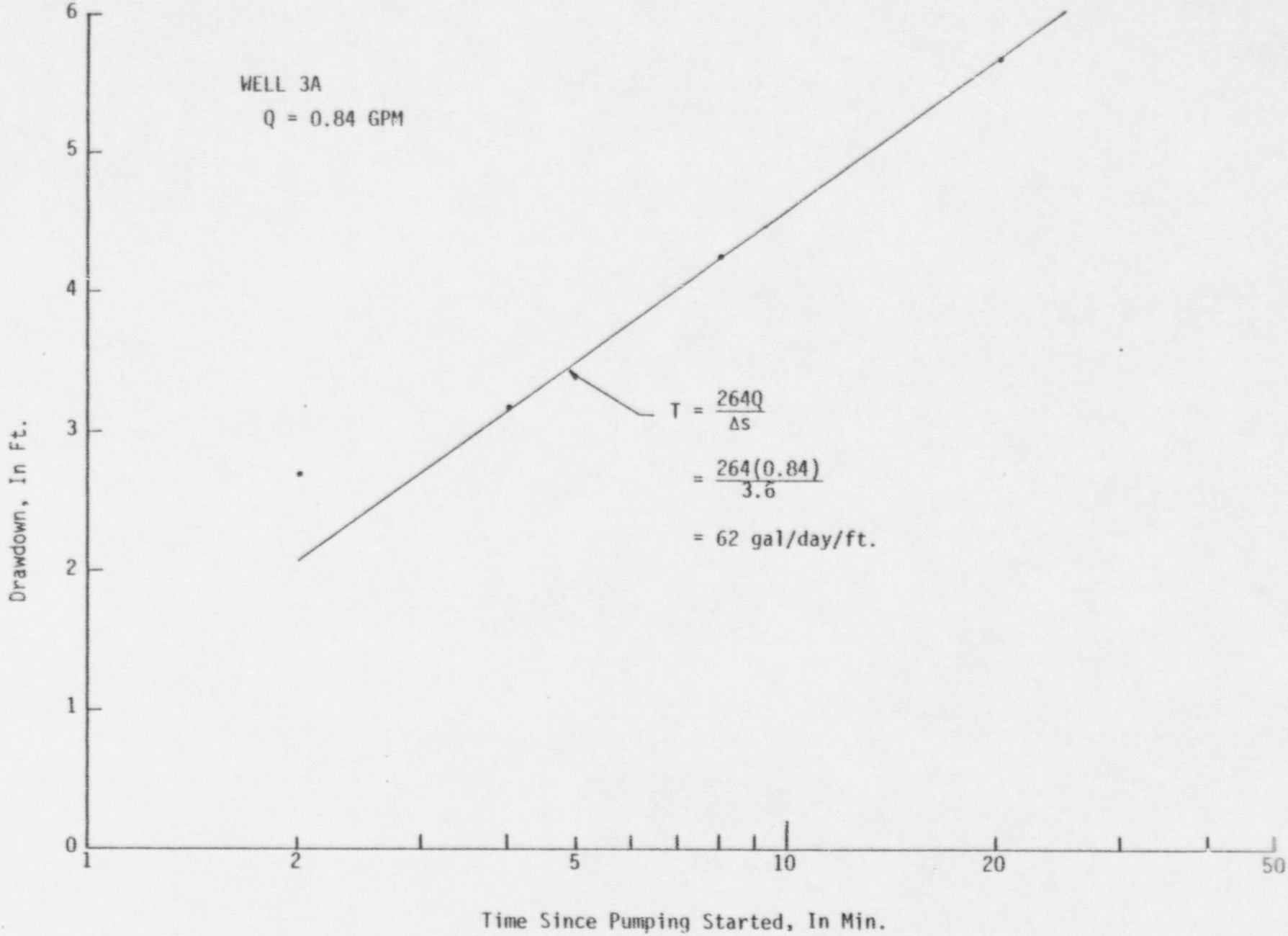


FIGURE 21 DRAWDOWN IN PUMPING WELL 3A

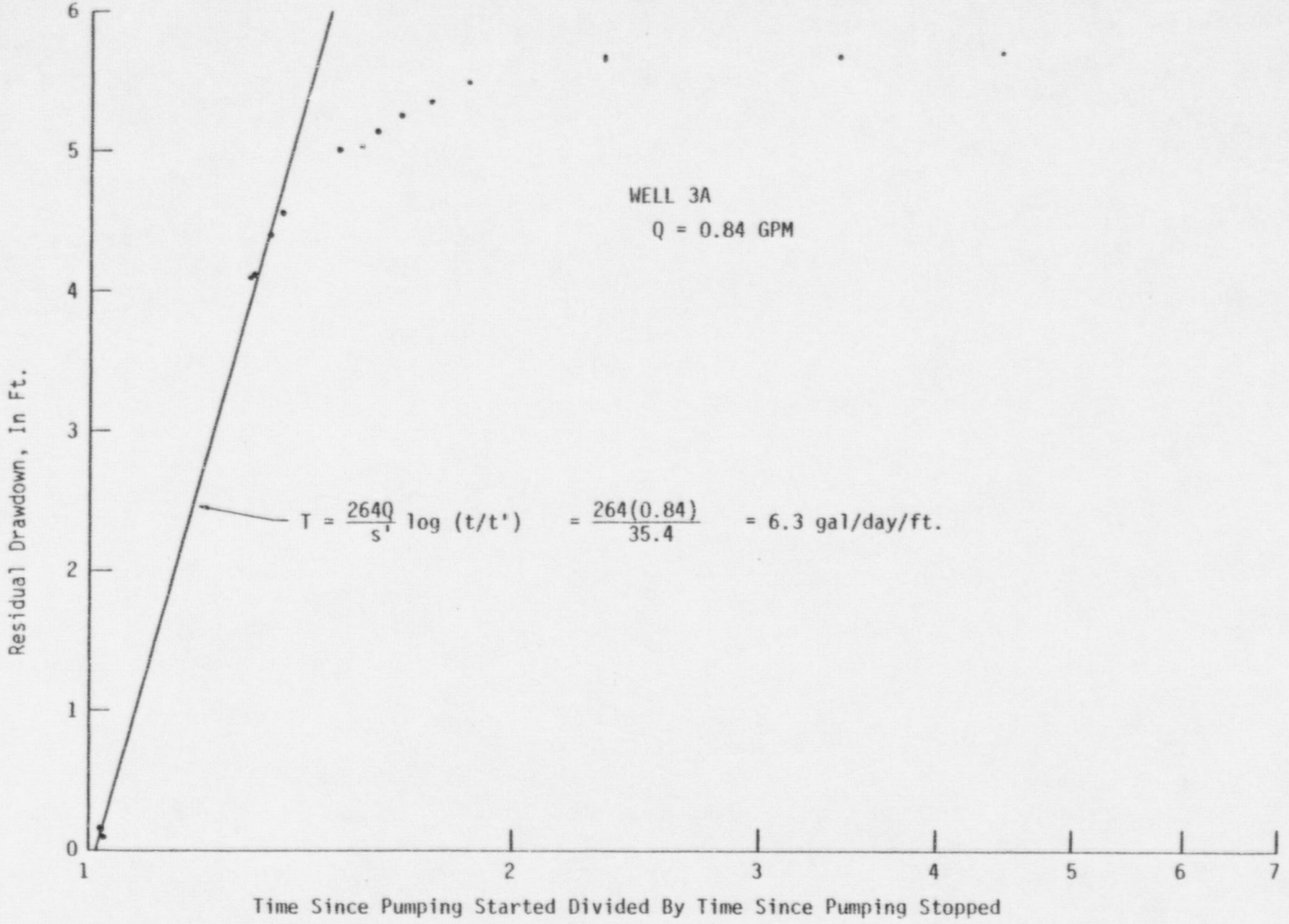


FIGURE 22 RECOVERY OF WELL 3A

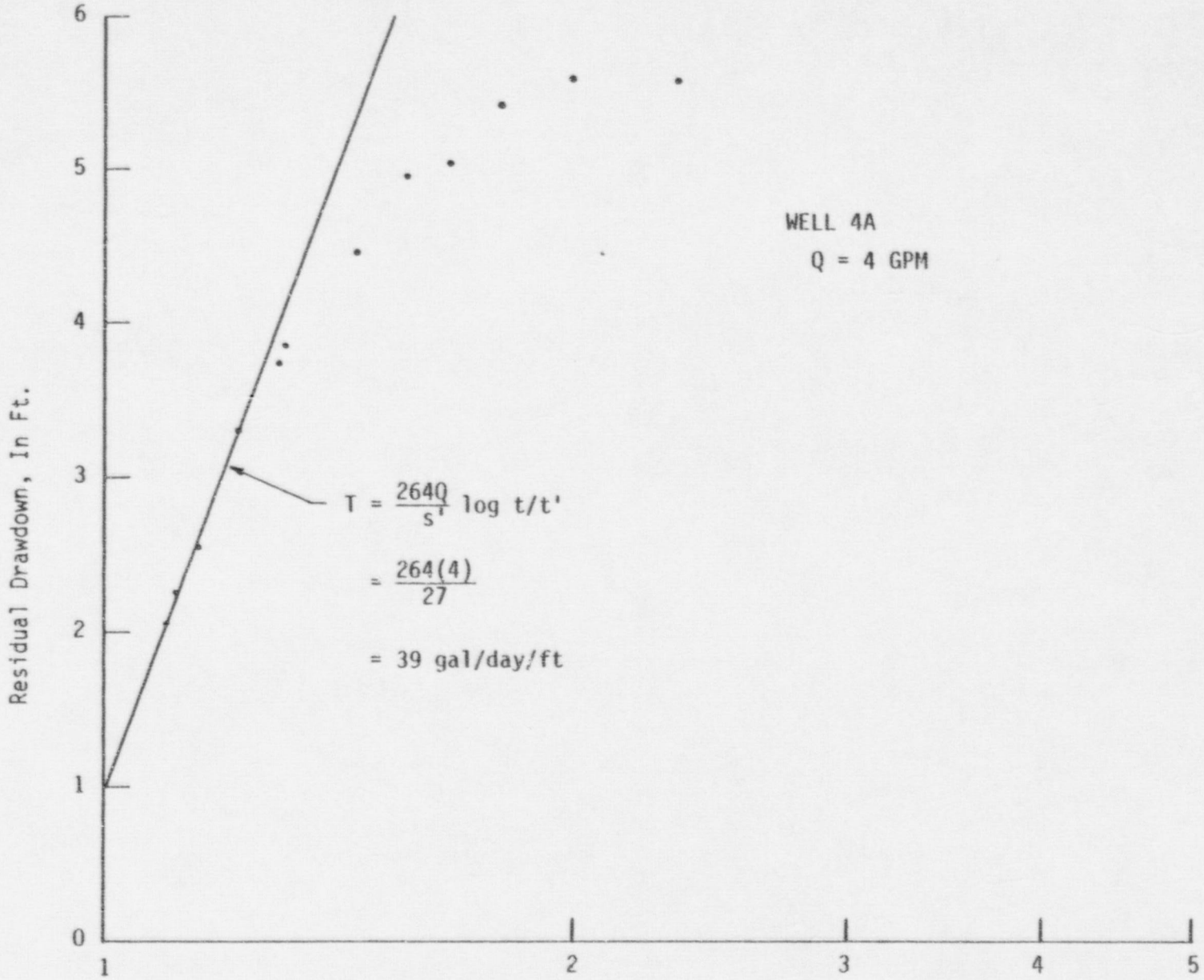


FIGURE 23 RECOVERY OF WELL 4A.

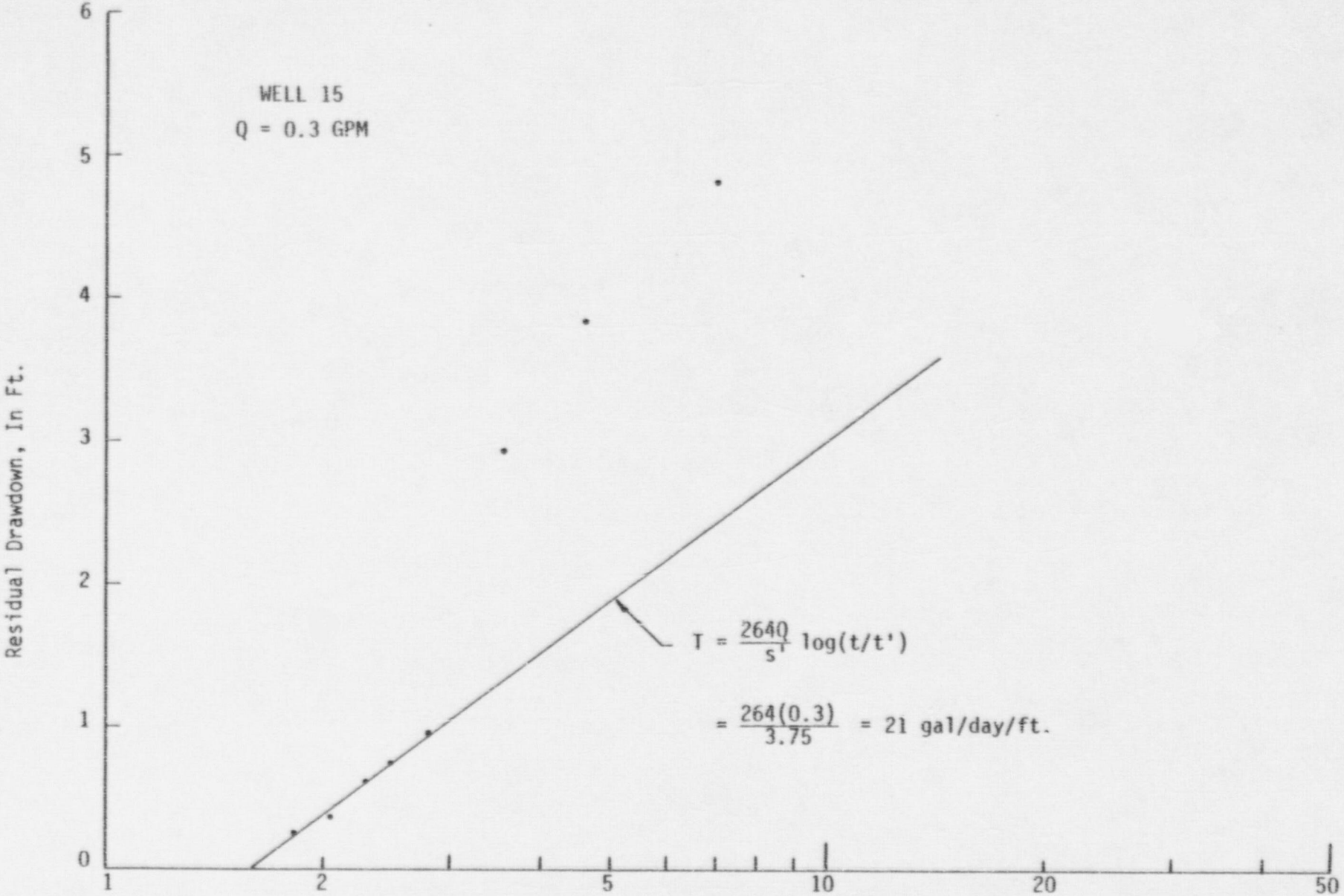


FIGURE 24 RECOVERY OF WELL 15.

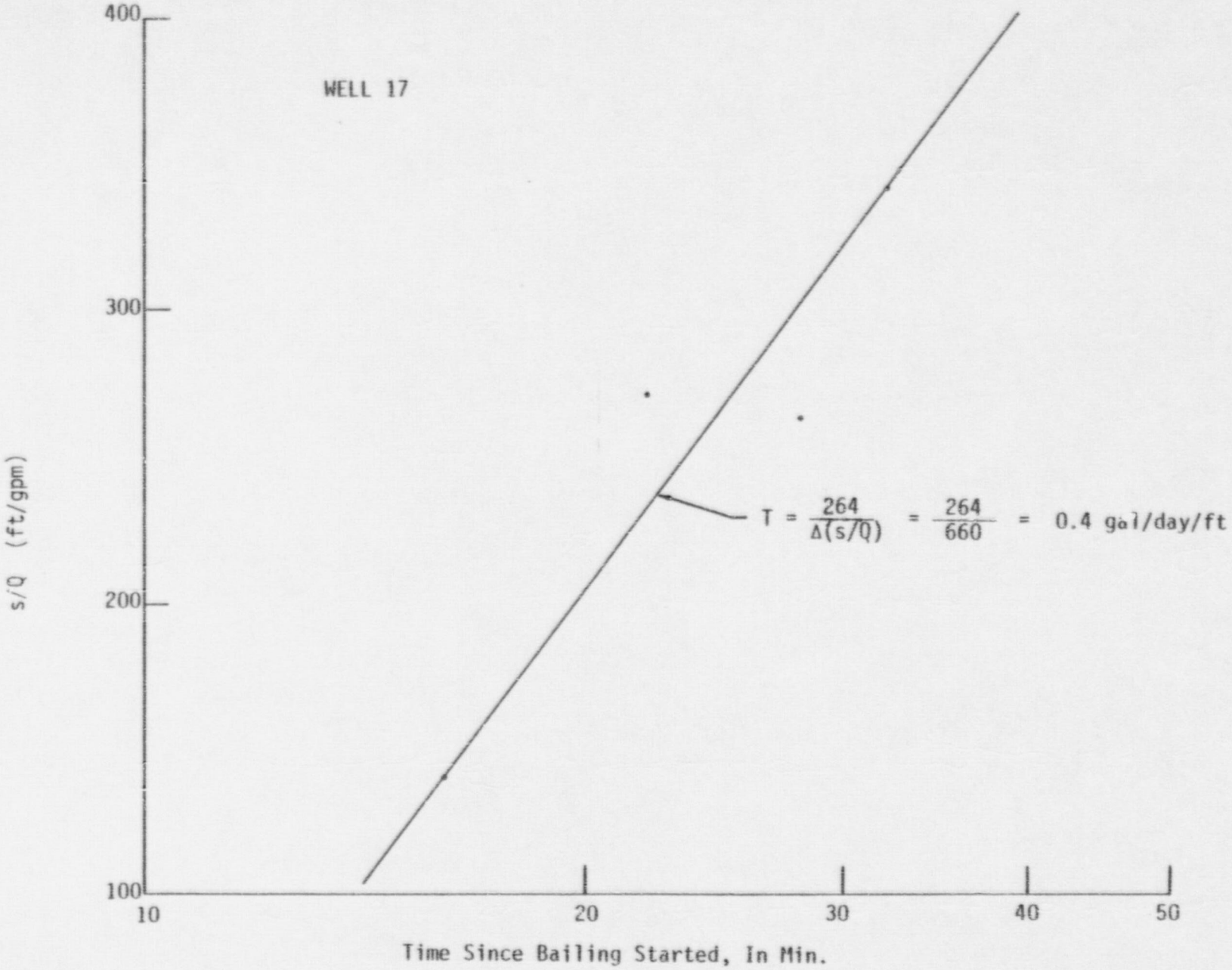


FIGURE 25 FILLING OF WELL 17

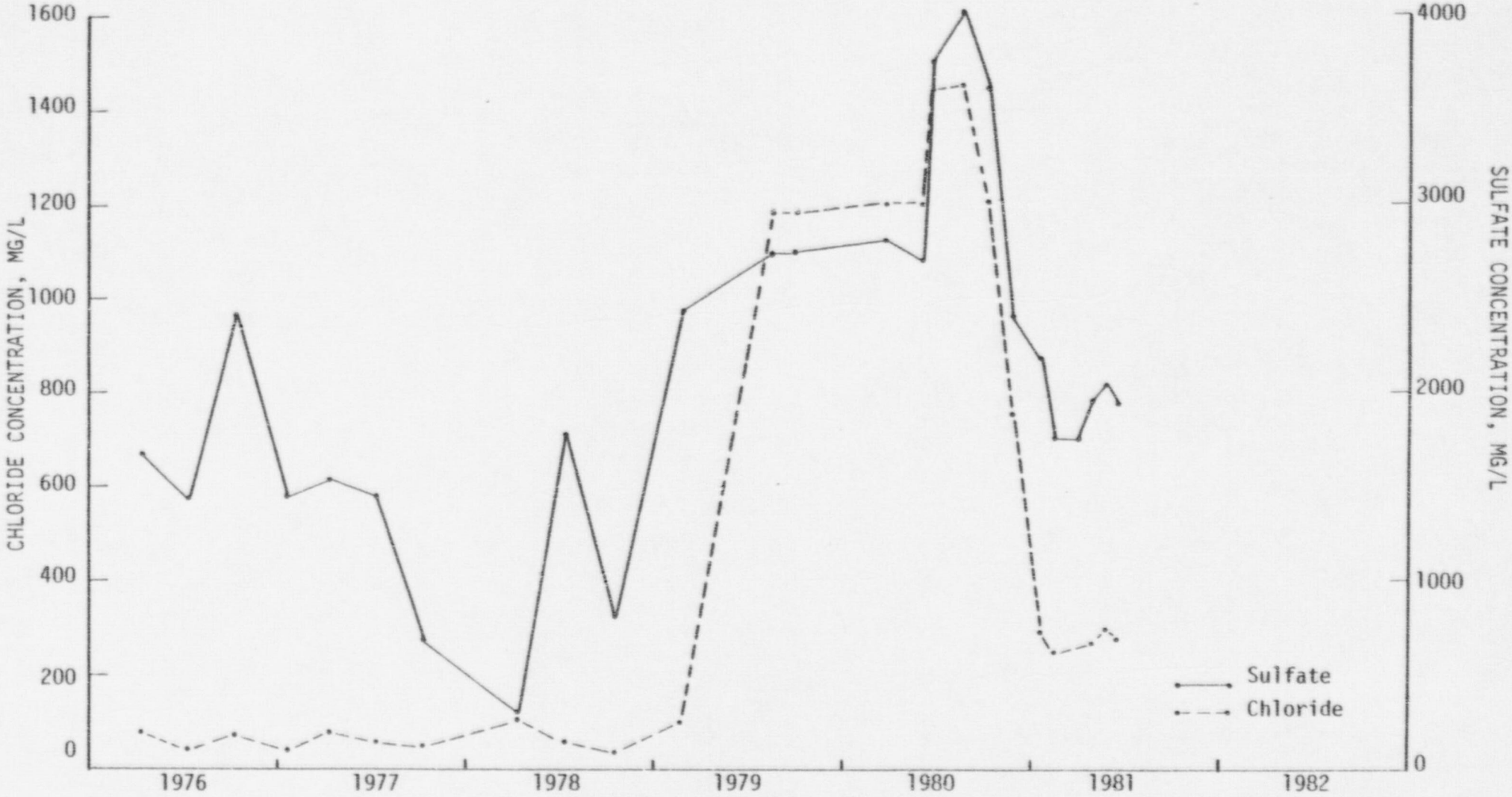


FIGURE 26. WATER-QUALITY HYDROGRAPH FOR WELL 1A

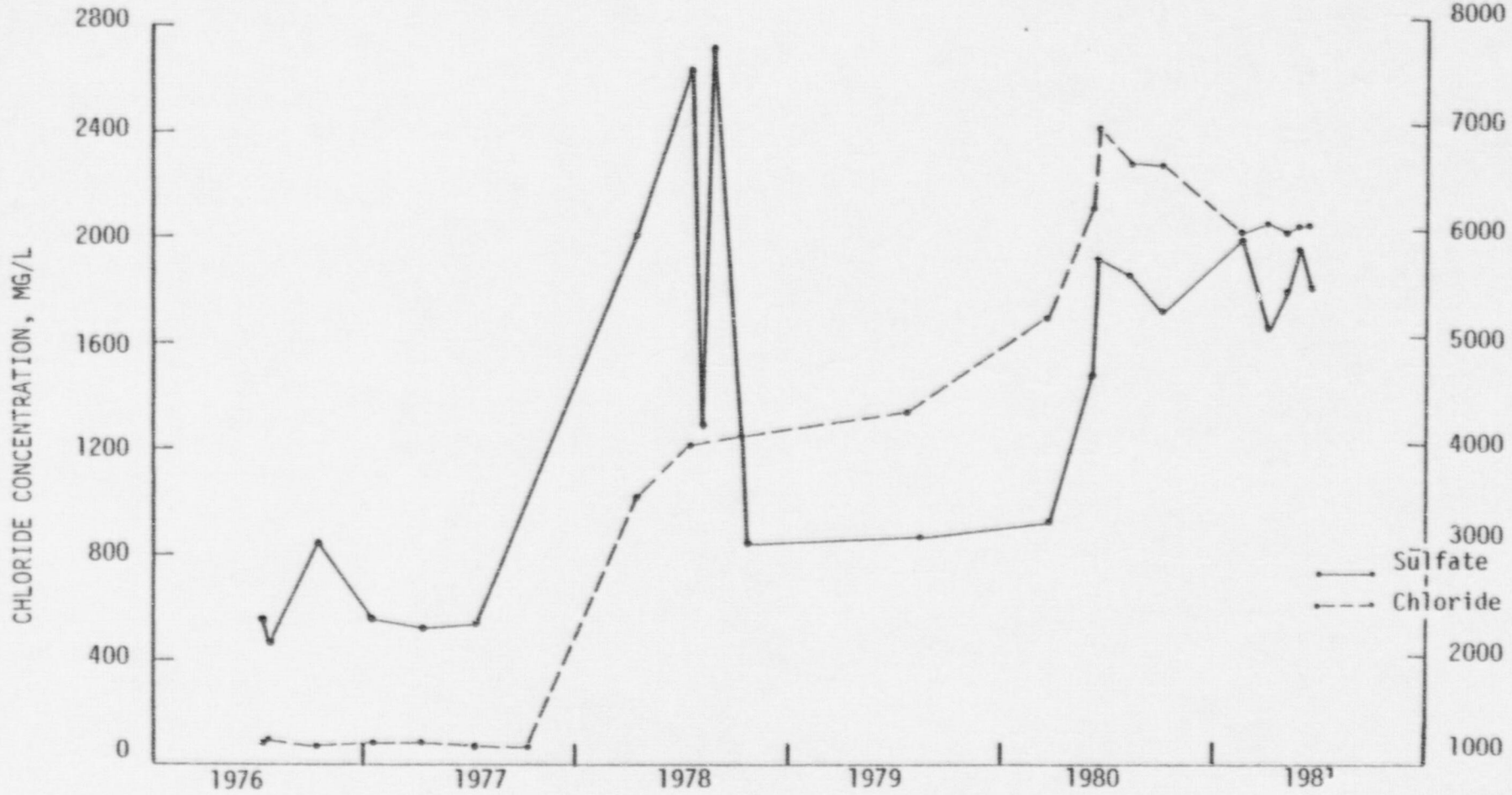


FIGURE 27. WATER-QUALITY HYDROGRAPH FOR WELL 2A

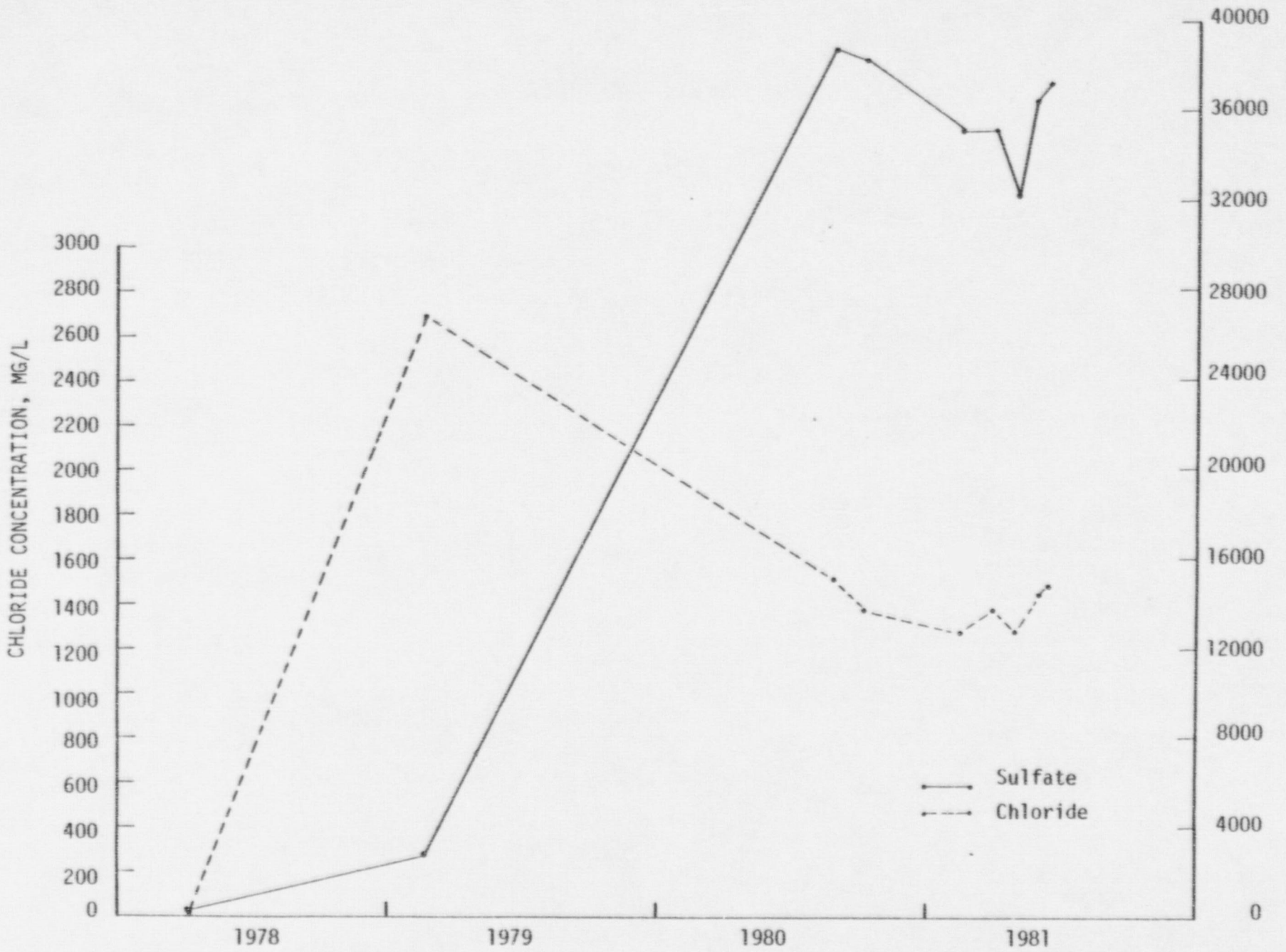


FIGURE 28. WATER-QUALITY HYDROGRAPH FOR WELL 3A

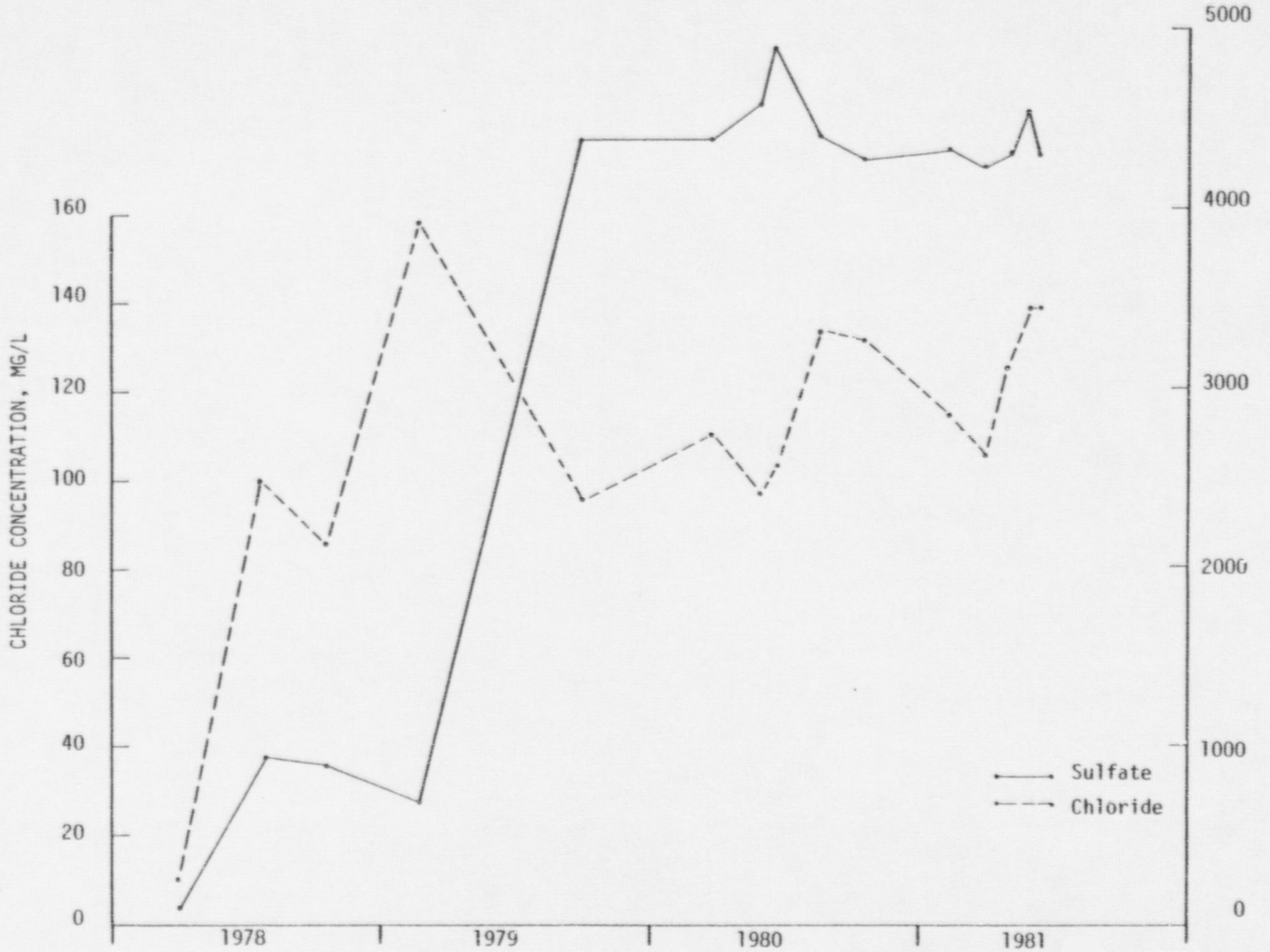


FIGURE 29. WATER-QUALITY HYDROGRAPH FOR WELL 4A

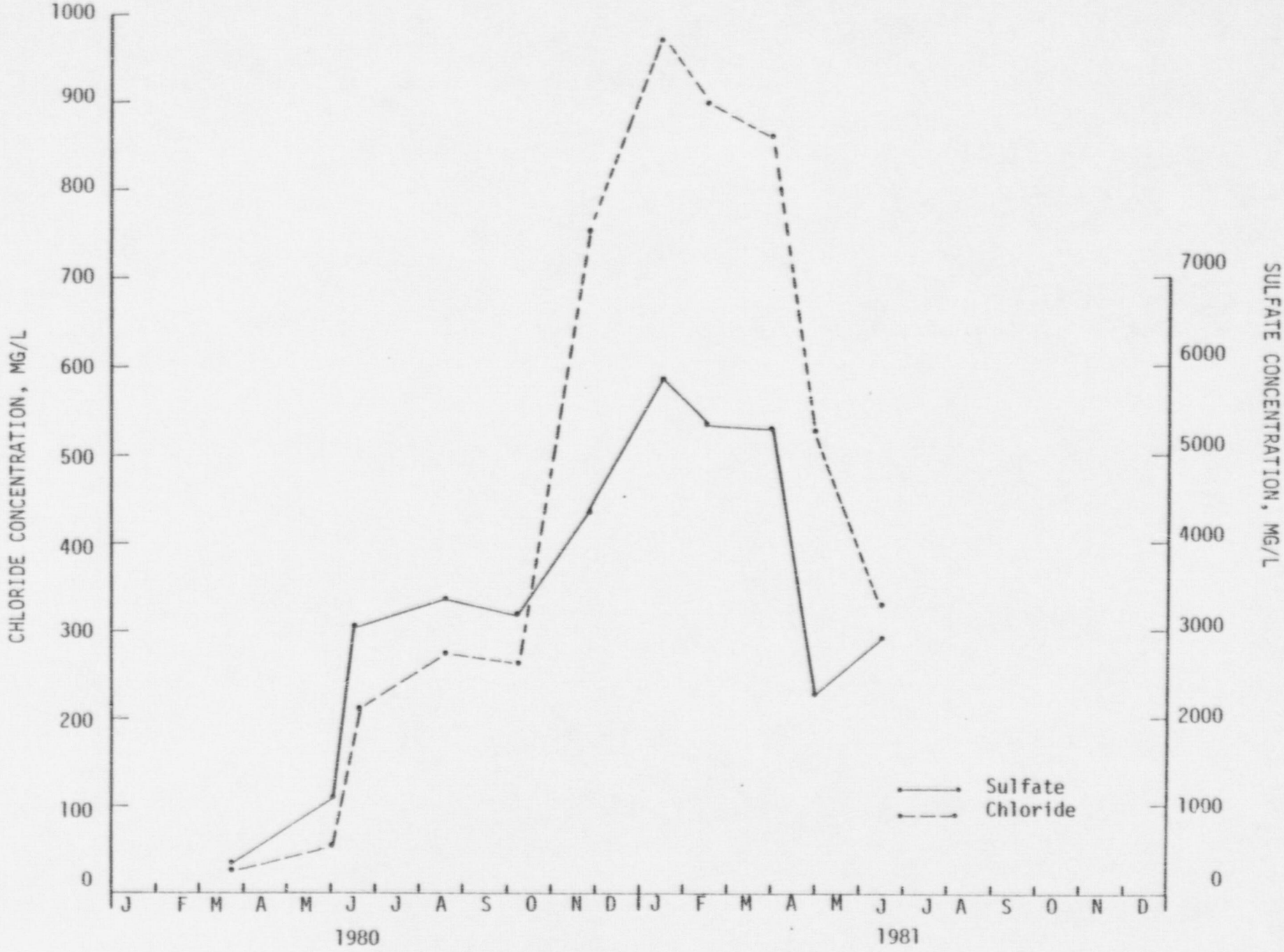


FIGURE 30. WATER-QUALITY HYDROGRAPH FOR WELL 5

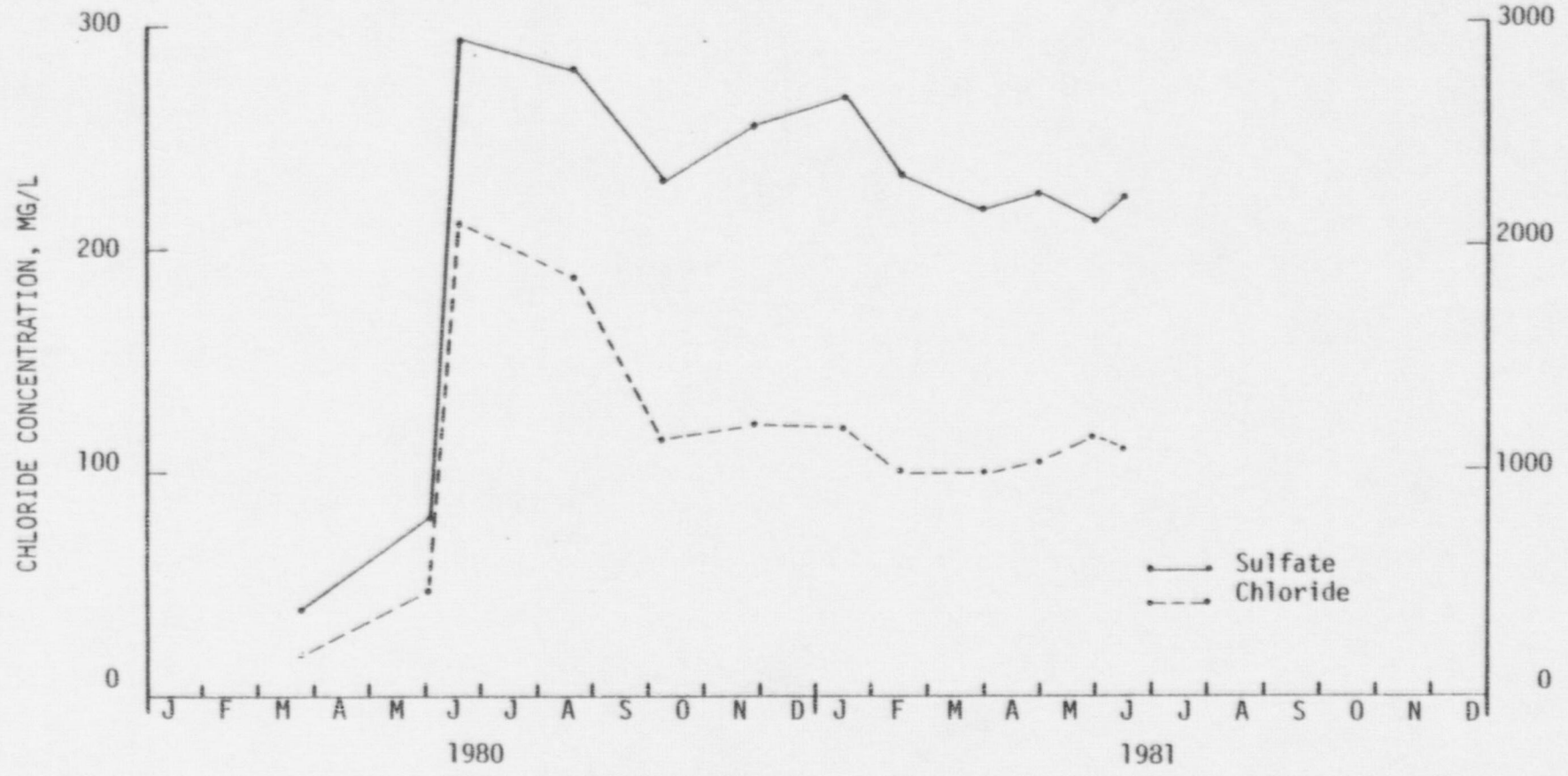


FIGURE 31. WATER-QUALITY HYDROGRAPH FOR WELL 6

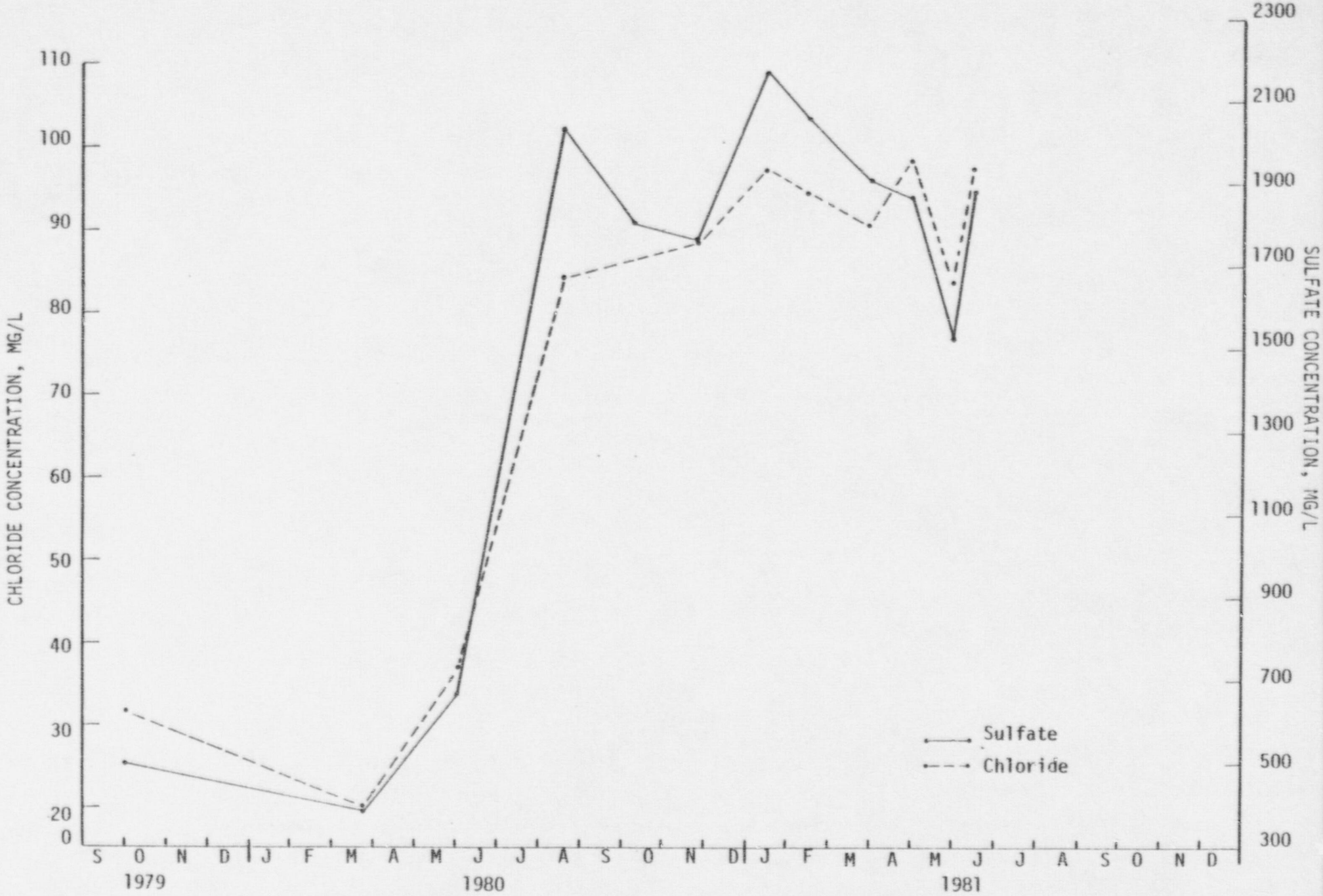


FIGURE 32. WATER-QUALITY HYDROGRAPH FOR WELL 7

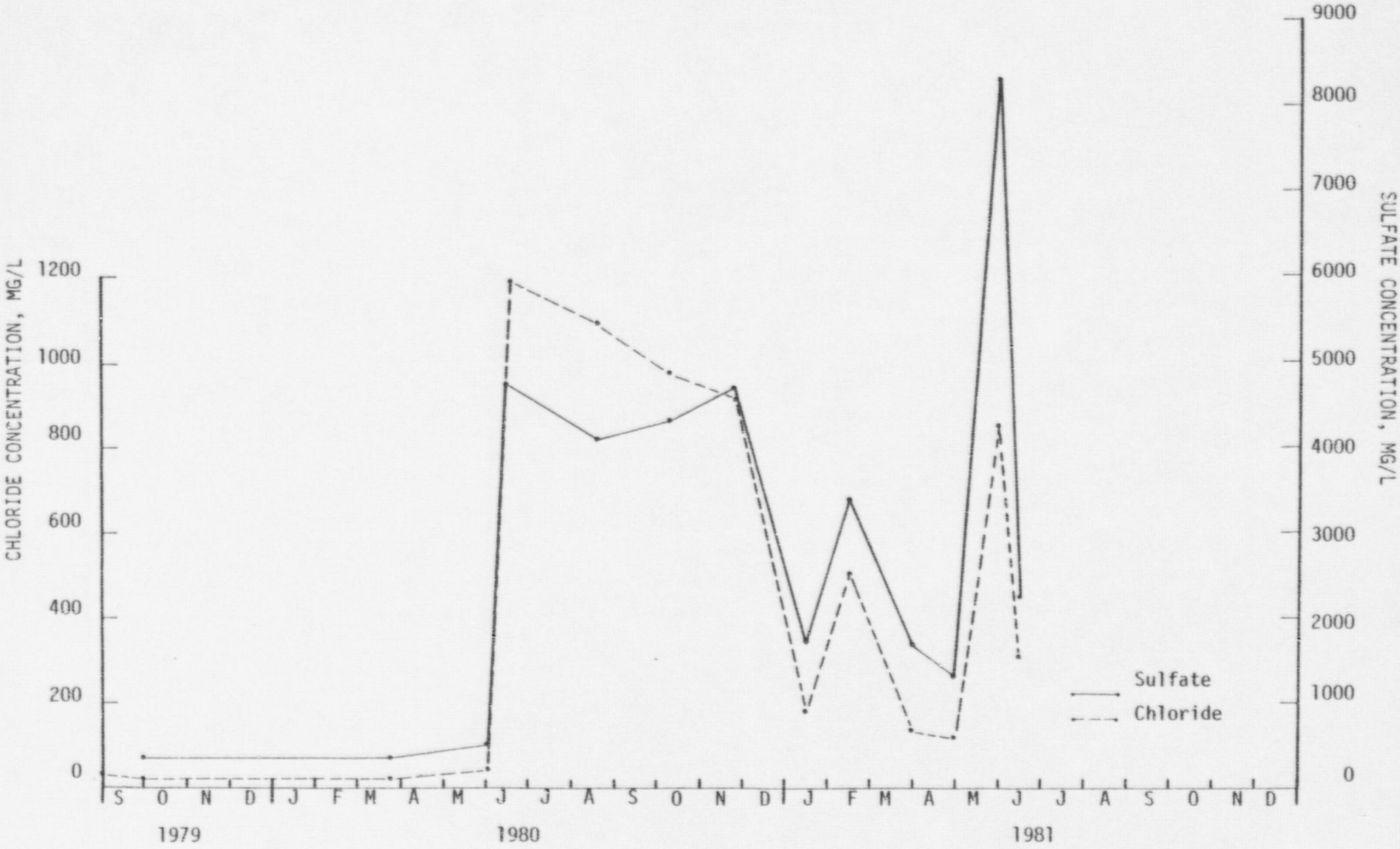


FIGURE 33. WATER-QUALITY HYDROGRAPH FOR WELL 8

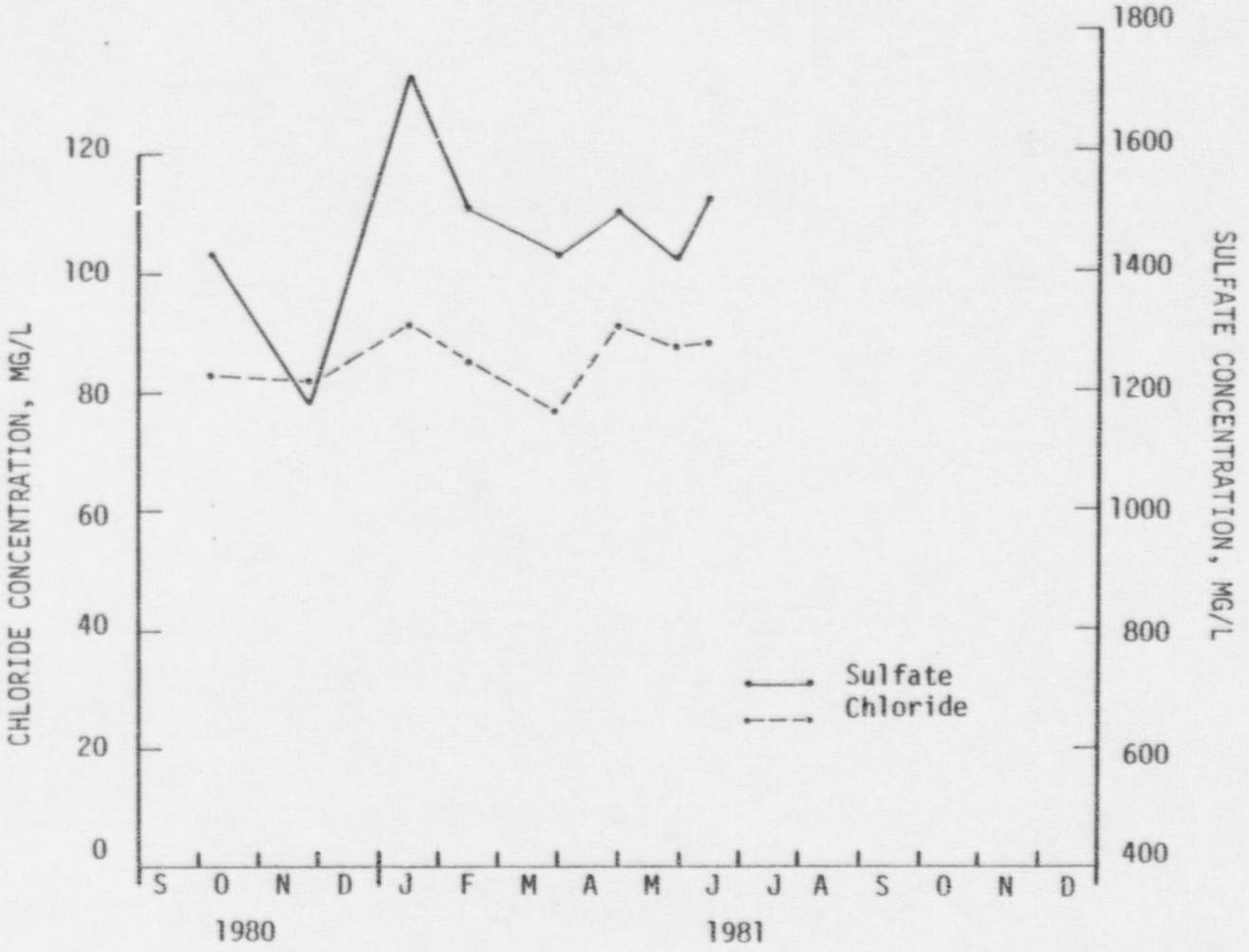


FIGURE 34. WATER-QUALITY HYDROGRAPH FOR WELL 9

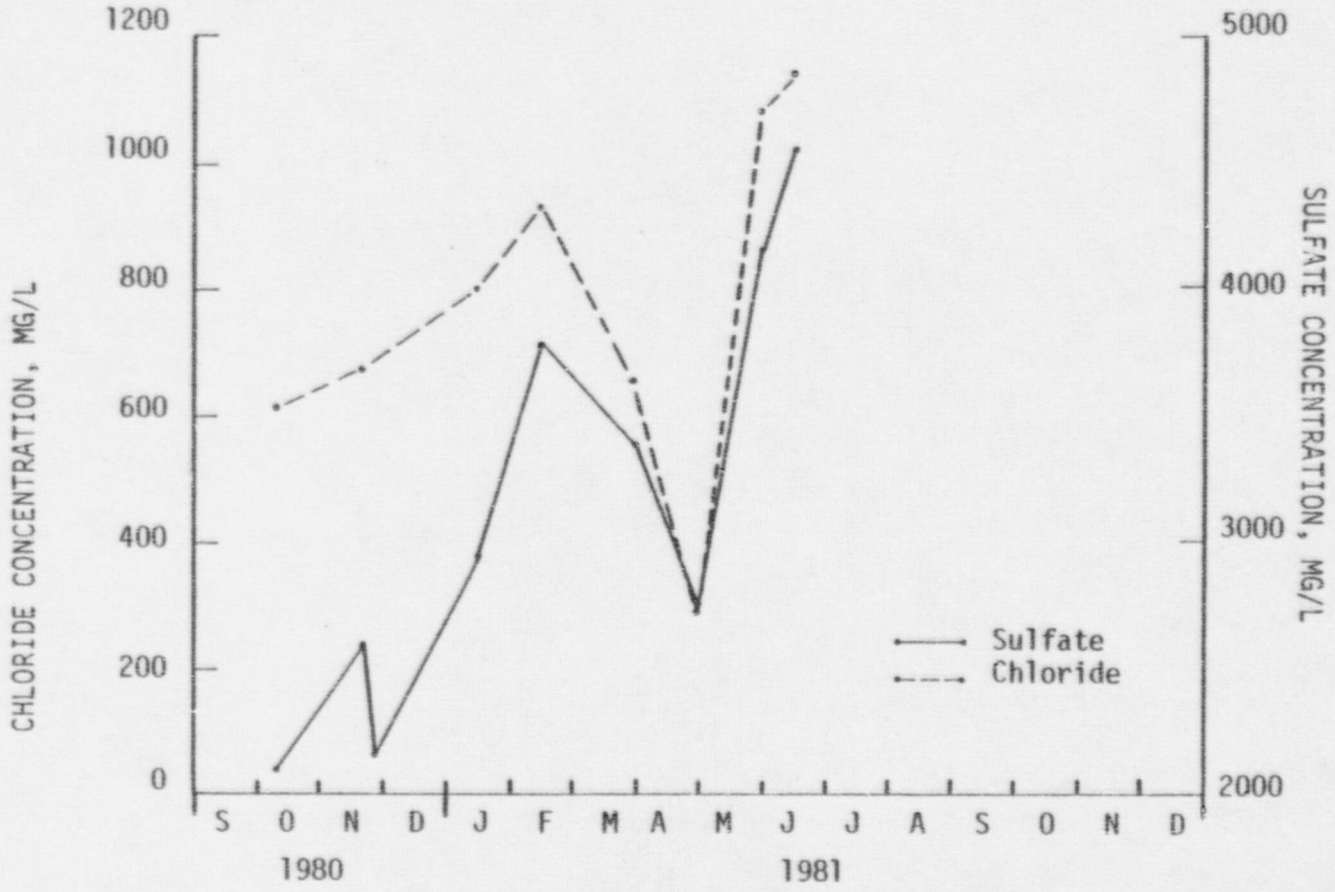


FIGURE 35. WATER-QUALITY HYDROGRAPH FOR WELL 10

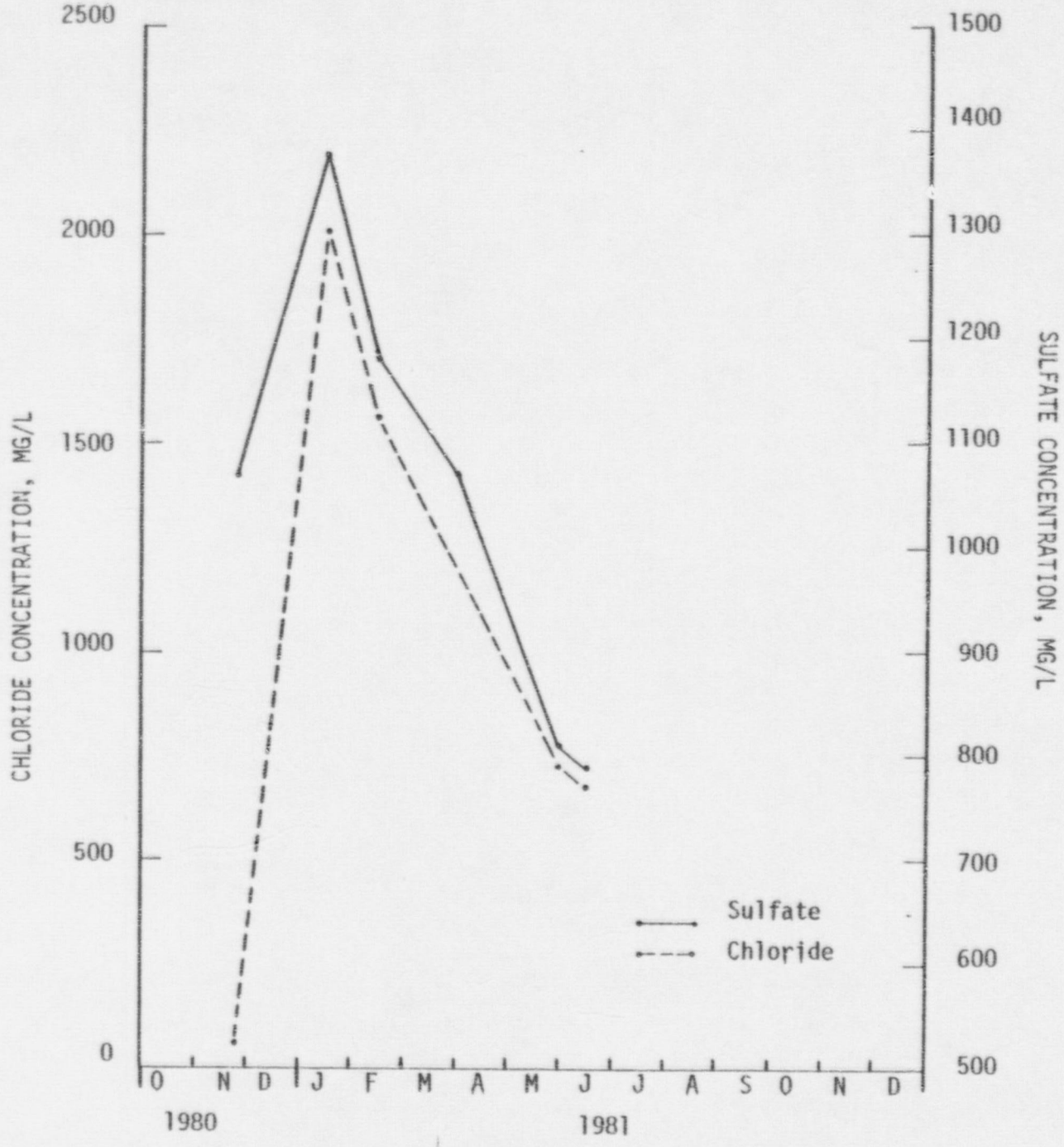


FIGURE 36. WATER-QUALITY HYDROGRAPH FOR WELL 11

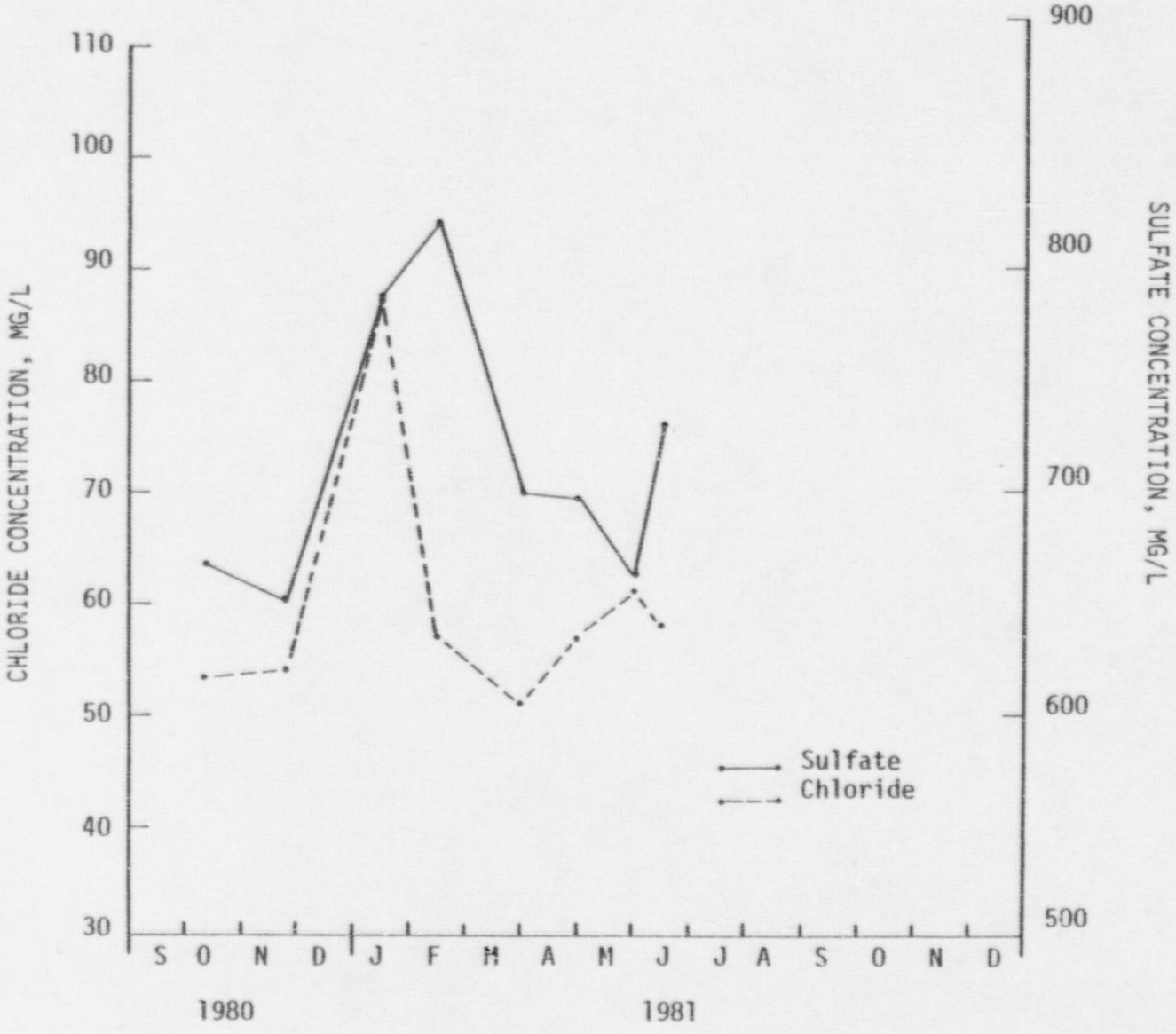


FIGURE 37. WATER-QUALITY HYDROGRAPH FOR WELL 12

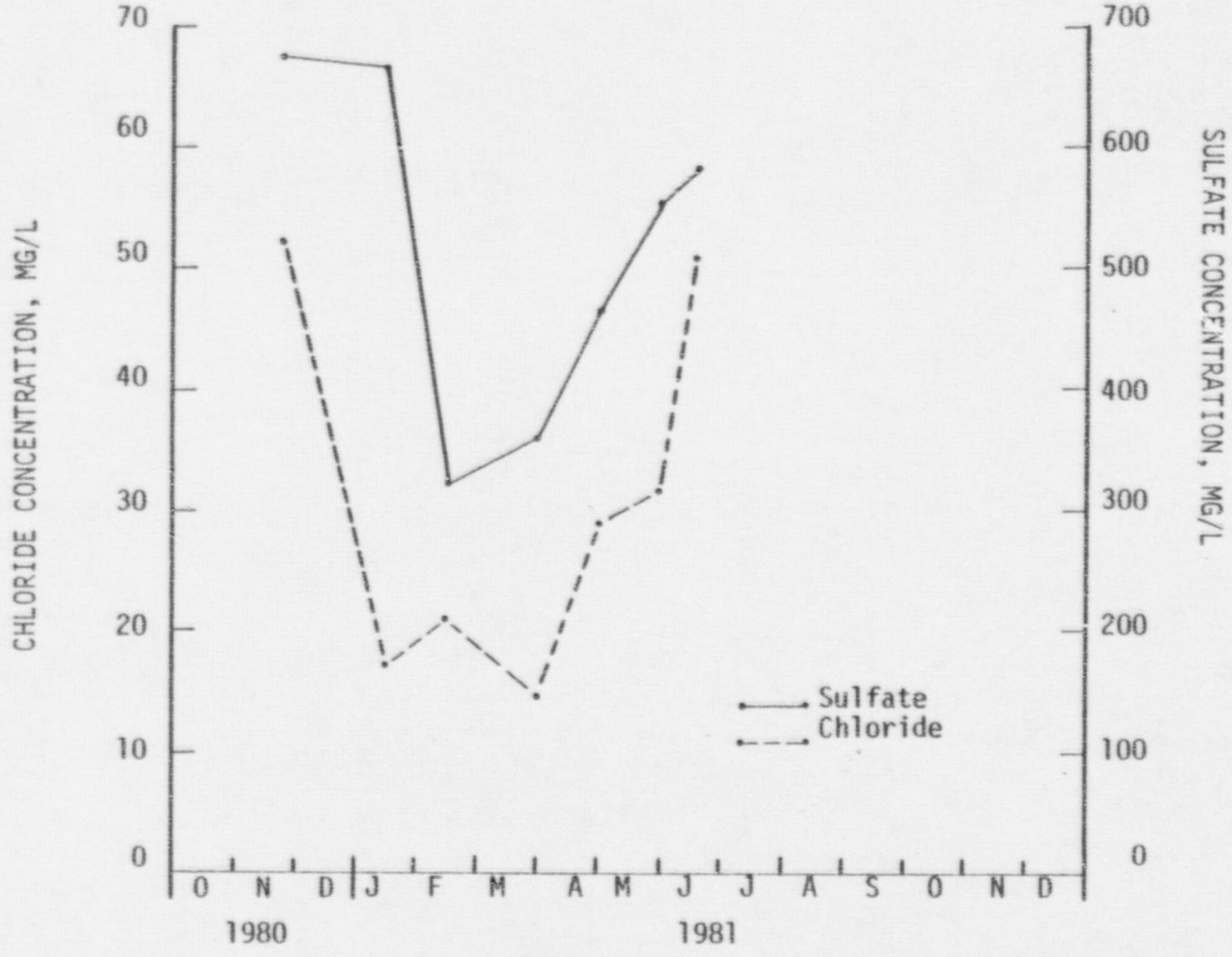


FIGURE 38. WATER-QUALITY HYDROGRAPH FOR WELL 13

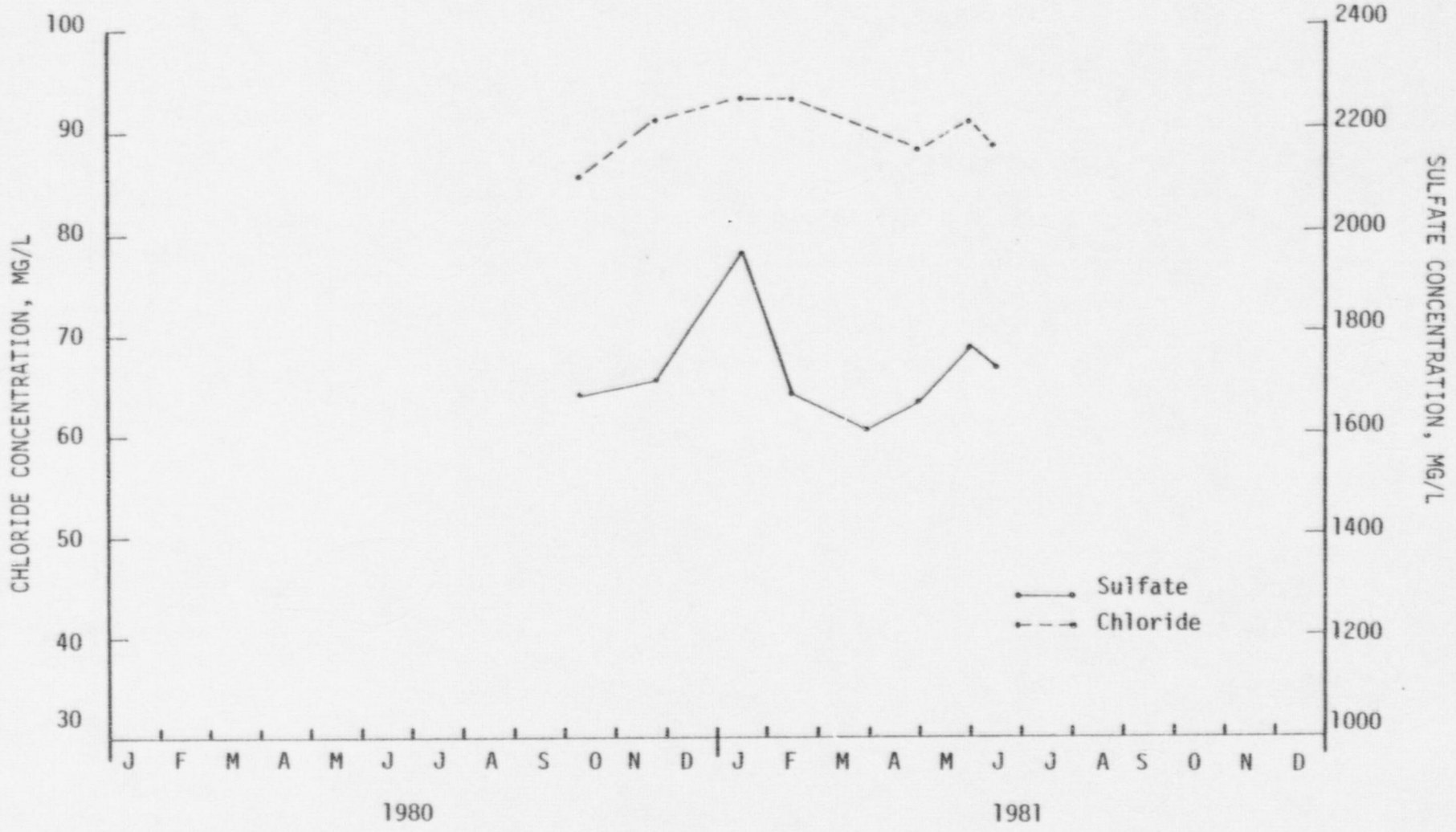


FIGURE 39. WATER-QUALITY HYDROGRAPH FOR WELL 14

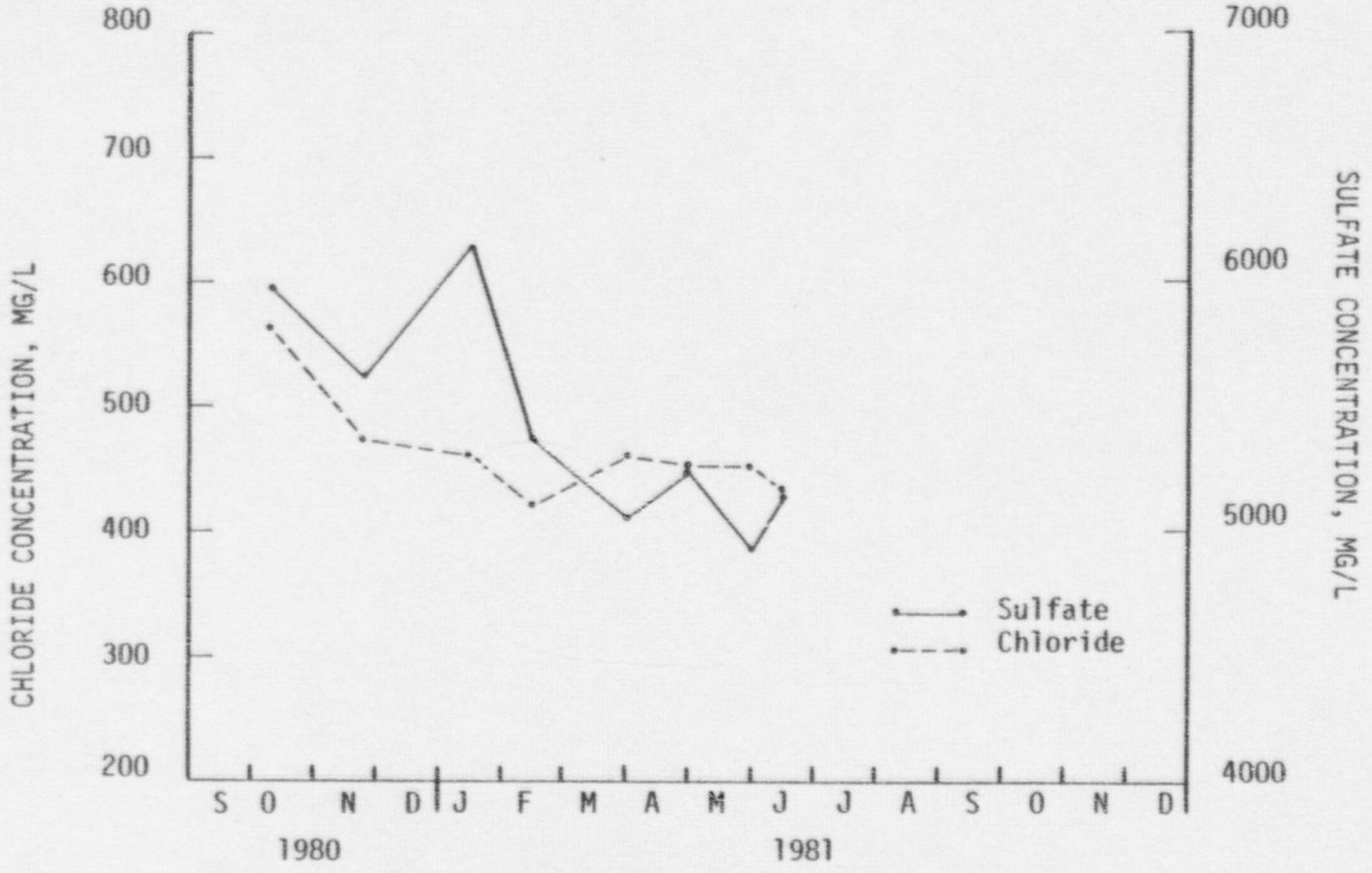


FIGURE 40. WATER-QUALITY HYDROGRAPH FOR WELL 15

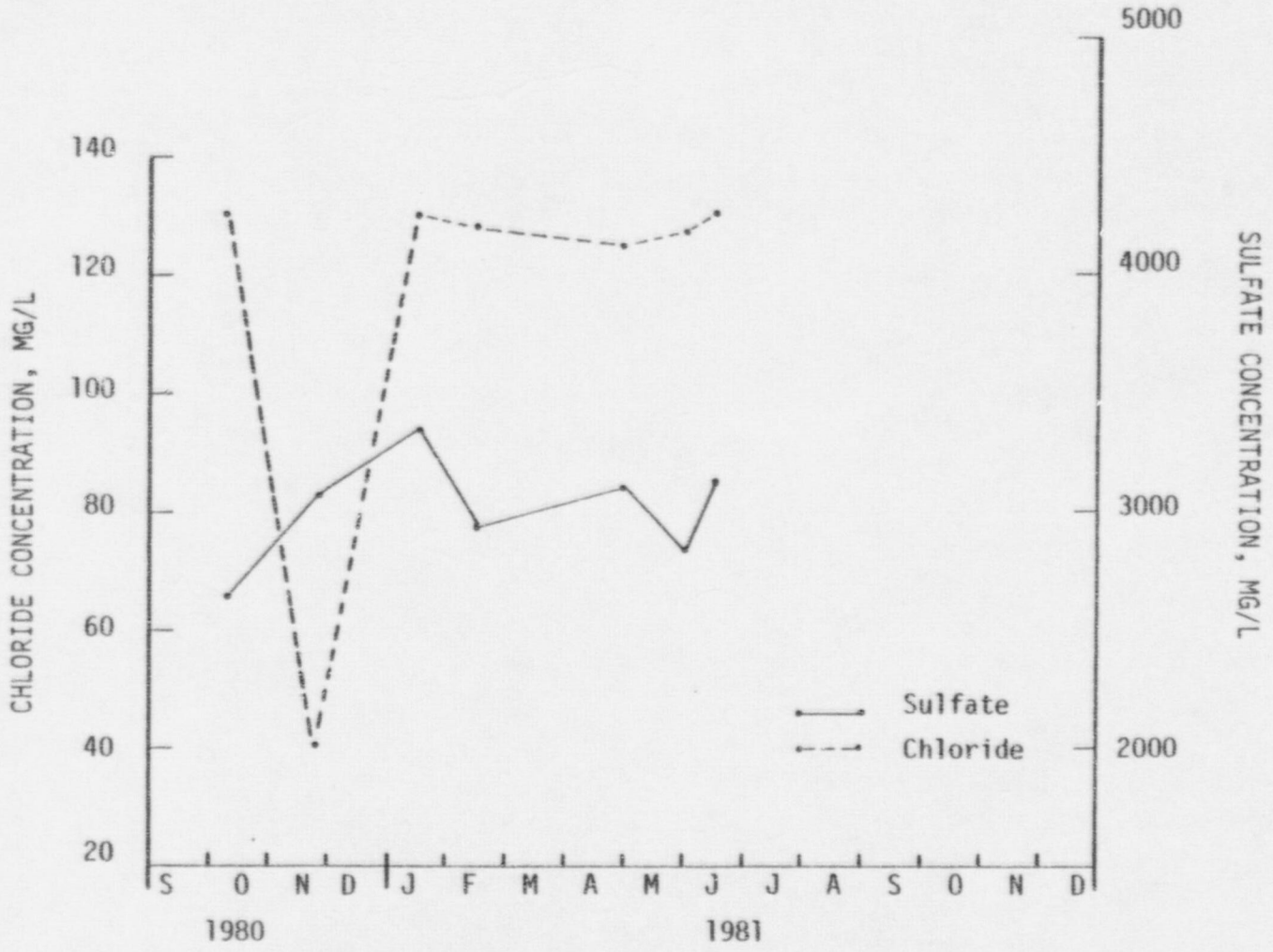


FIGURE 41. WATER-QUALITY HYDROGRAPH FOR WELL 17

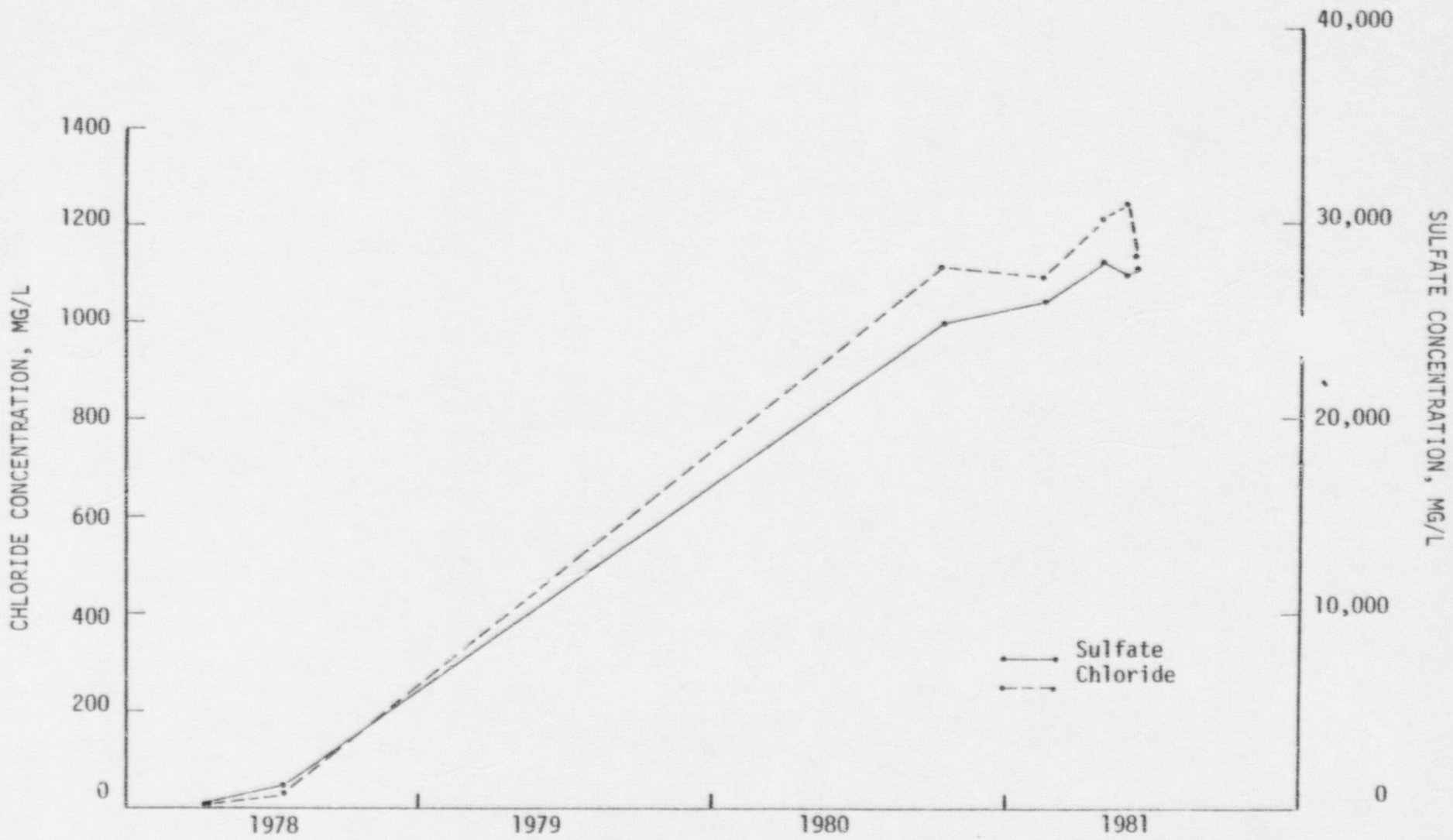


FIGURE 42. WATER-QUALITY HYDROGRAPH FOR WELL 3B

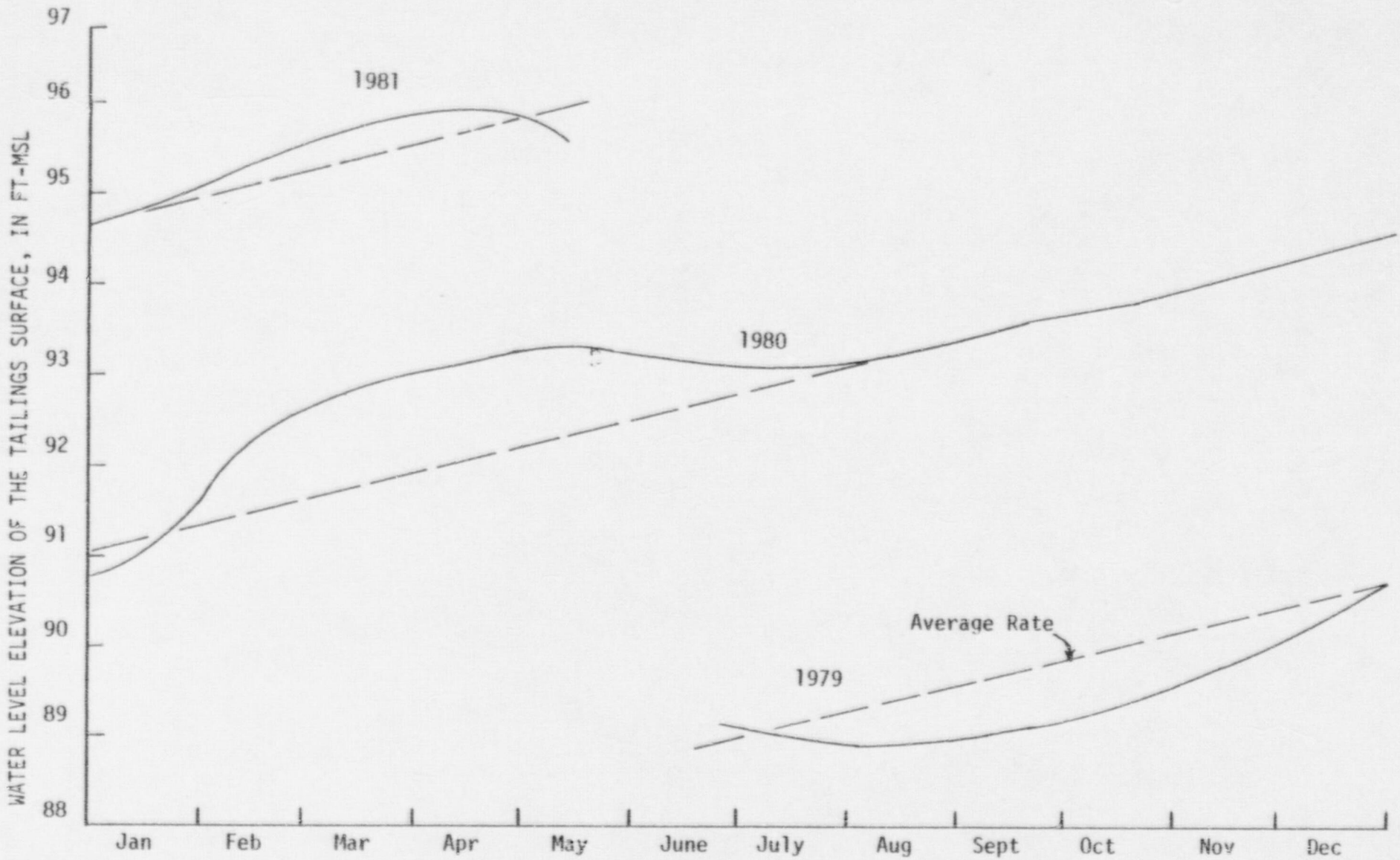


FIGURE 43. WATER-LEVEL ELEVATION OF THE TAILINGS POND 6/79 - 5/81.

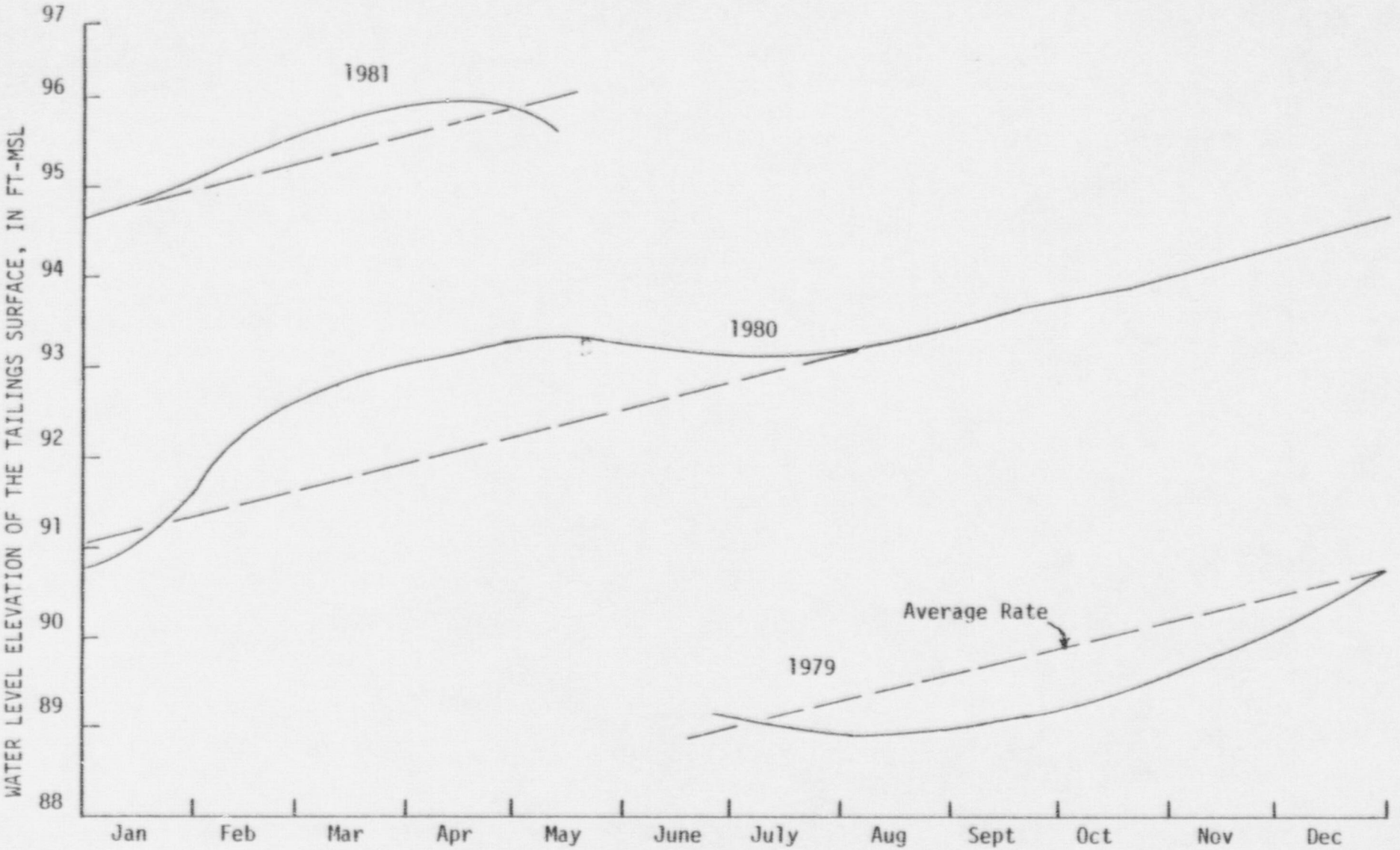


FIGURE 43. WATER-LEVEL ELEVATION OF THE TAILINGS POND 6/79 - 5/81.

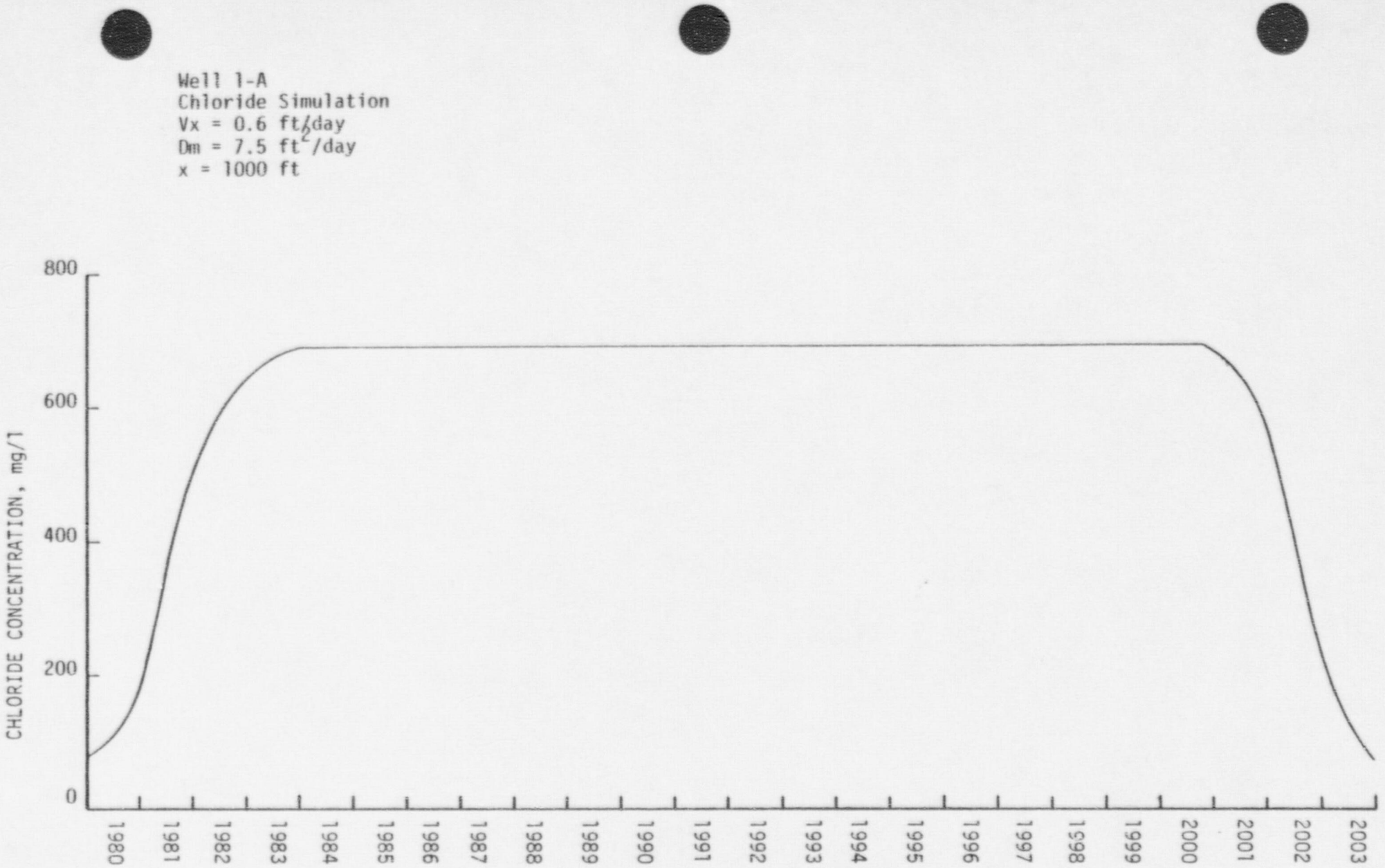


FIGURE 44. PREDICTED CHLORIDE CONCENTRATION WITH TIME AT WELL 1-A.

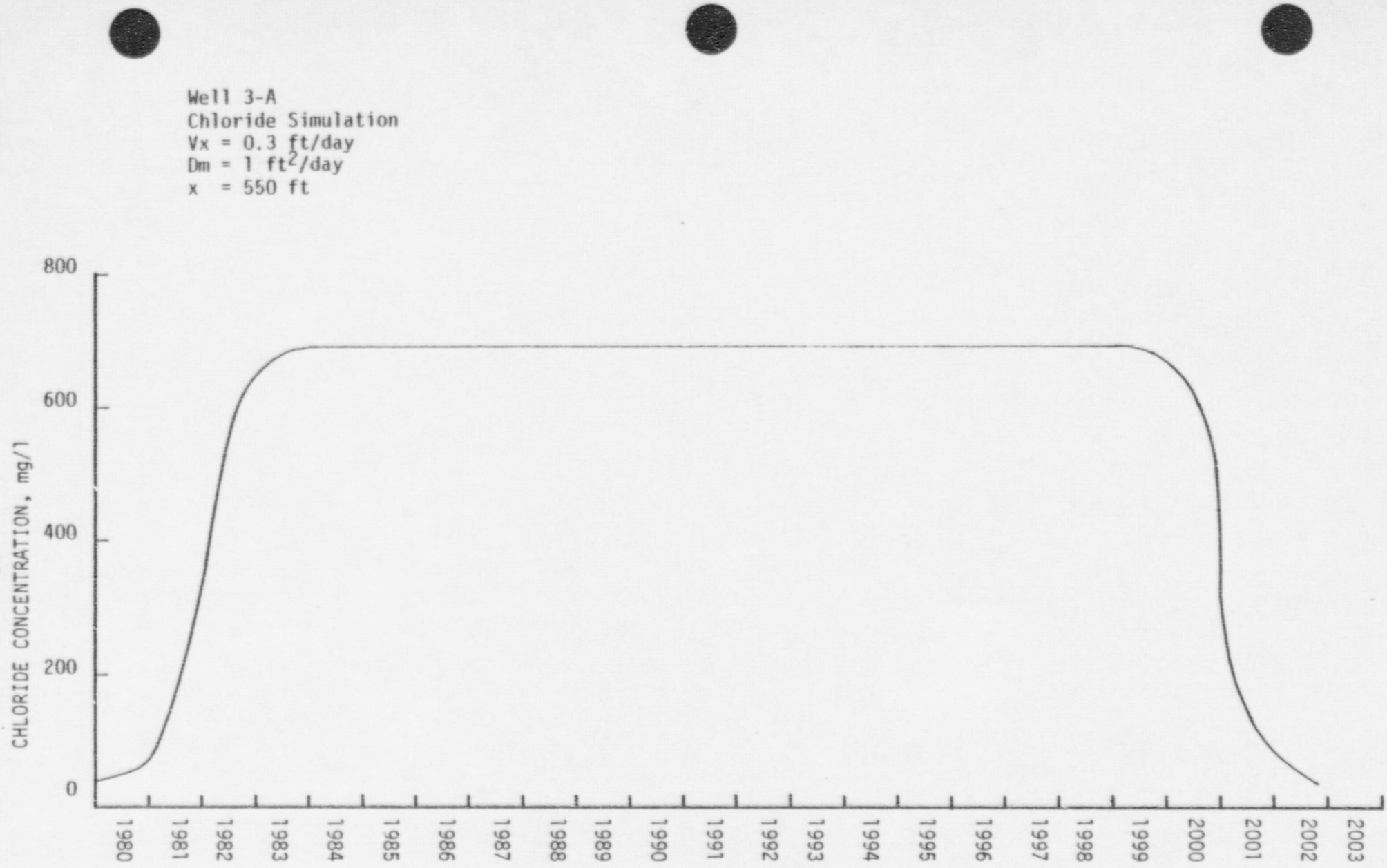


FIGURE 45. PREDICTED CHLORIDE CONCENTRATION WITH TIME AT WELL 3-A.

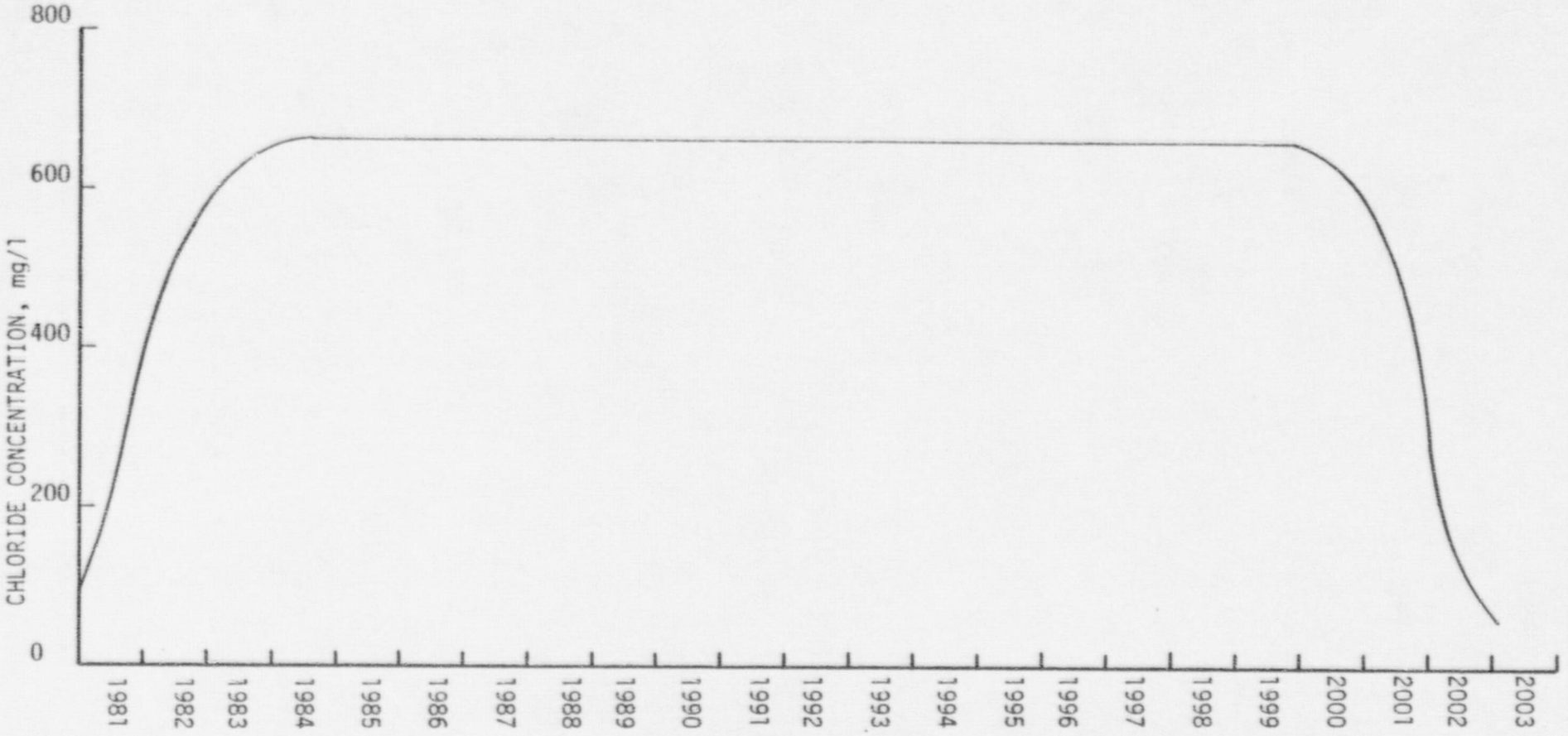


FIGURE 46. PREDICTED CHLORIDE CONCENTRATION WITH TIME AT WELL 5.

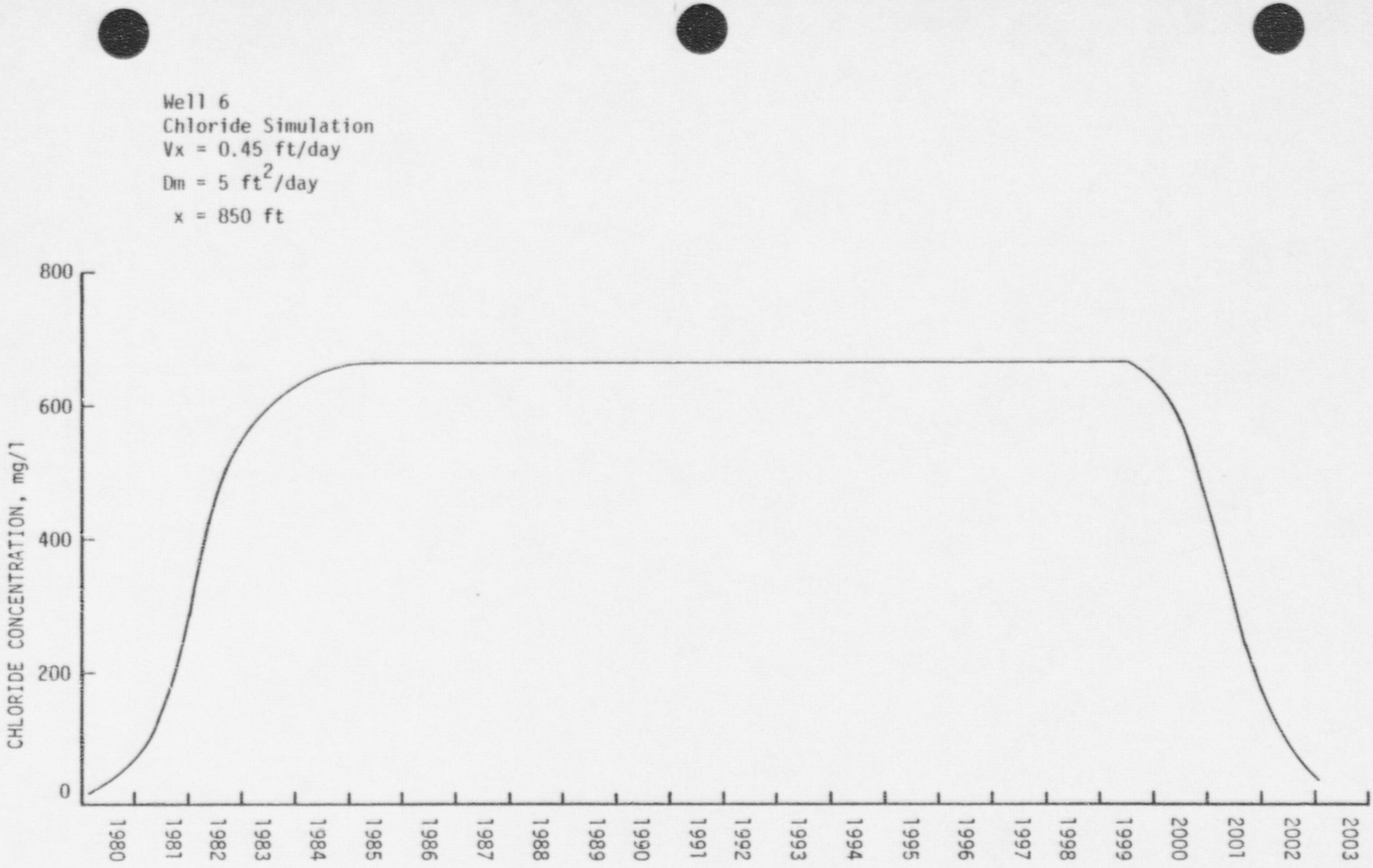


FIGURE 47. PREDICTED CHLORIDE CONCENTRATION WITH TIME AT WELL 6.

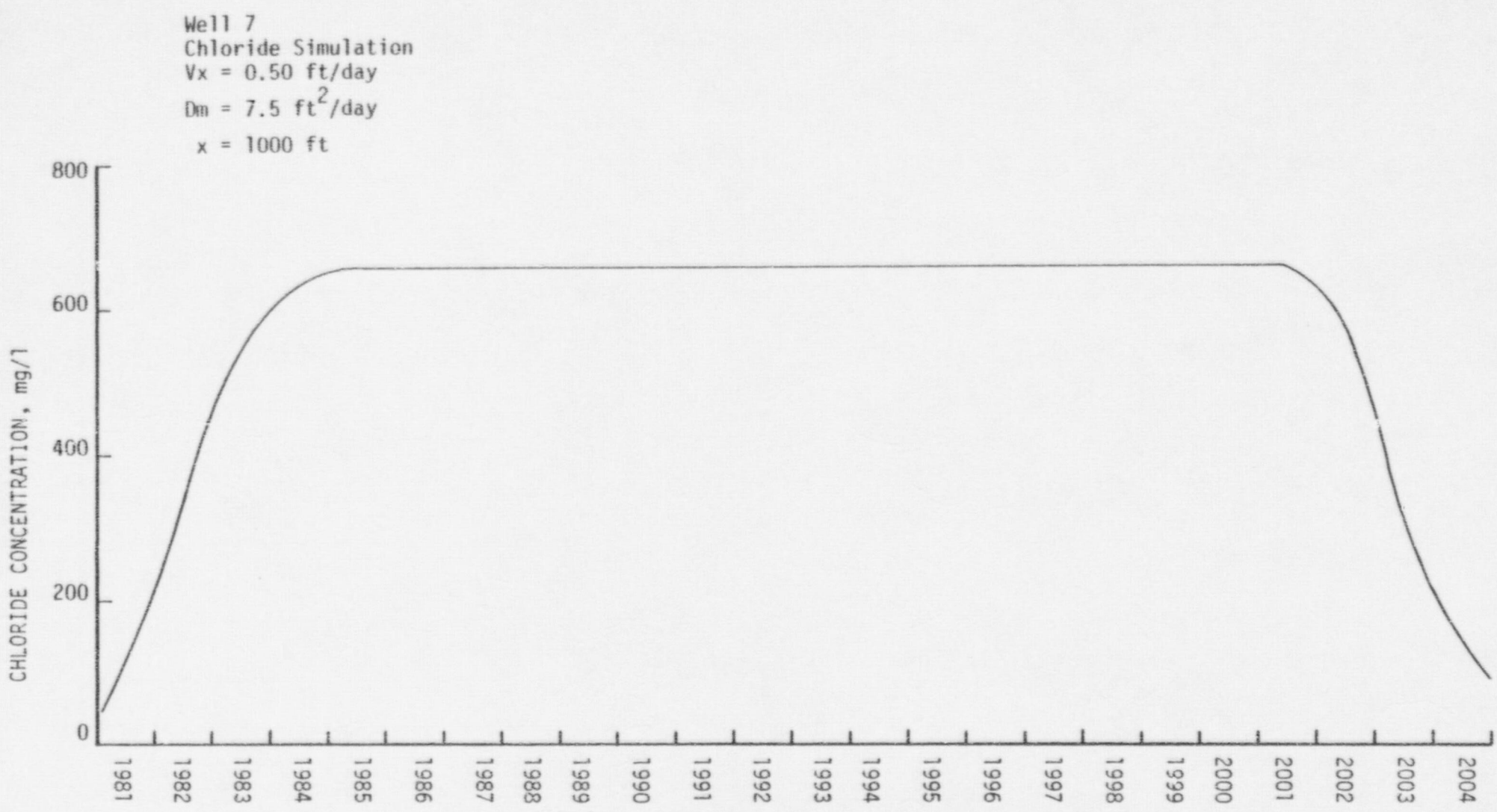


FIGURE 48. PREDICTED CHLORIDE CONCENTRATION WITH TIME AT WELL 7.

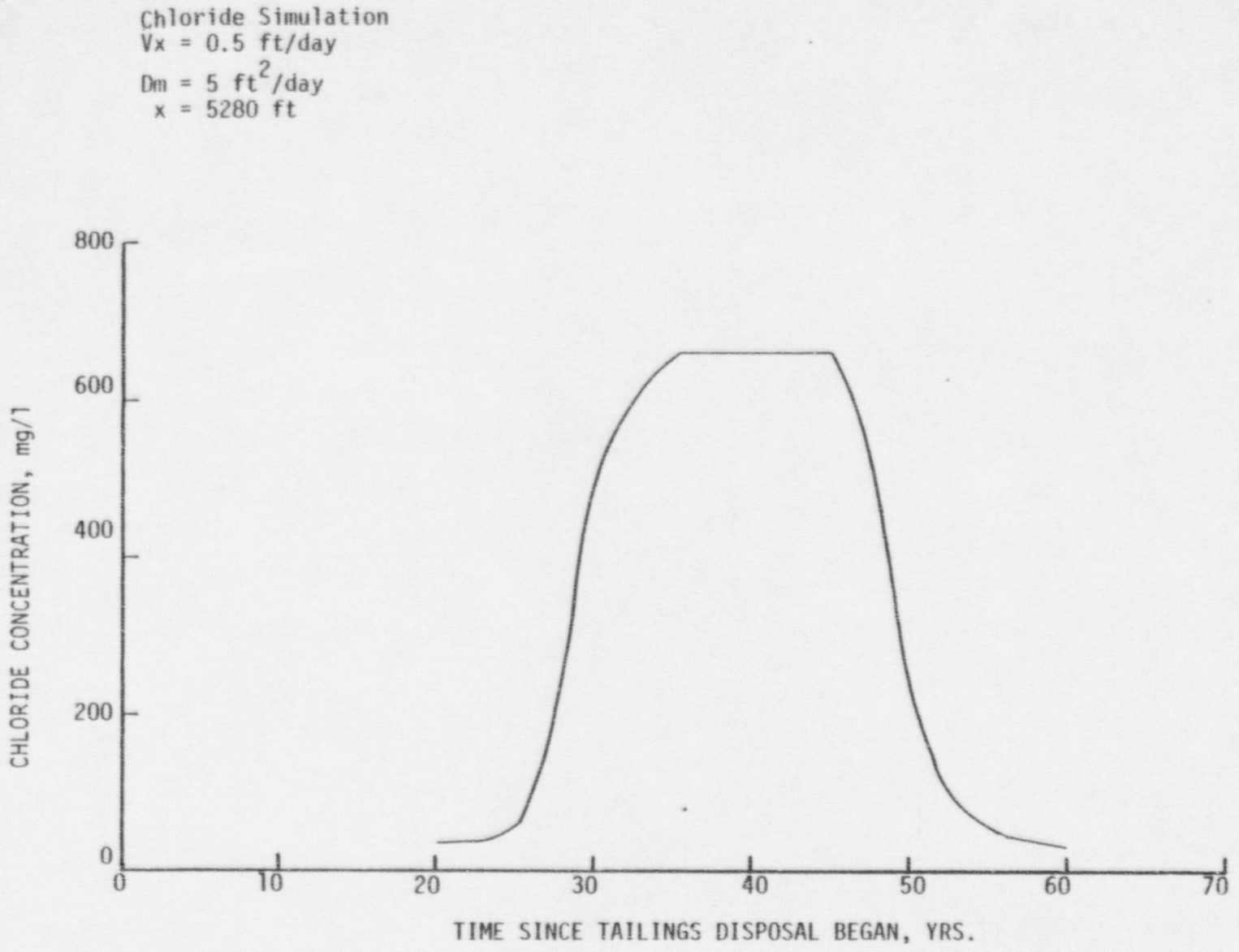


FIGURE 49. PREDICTED CHLORIDE CONCENTRATION WITH TIME ONE MILE DOWN GRADIENT FROM THE L-BAR TAILINGS DISPOSAL SITE.

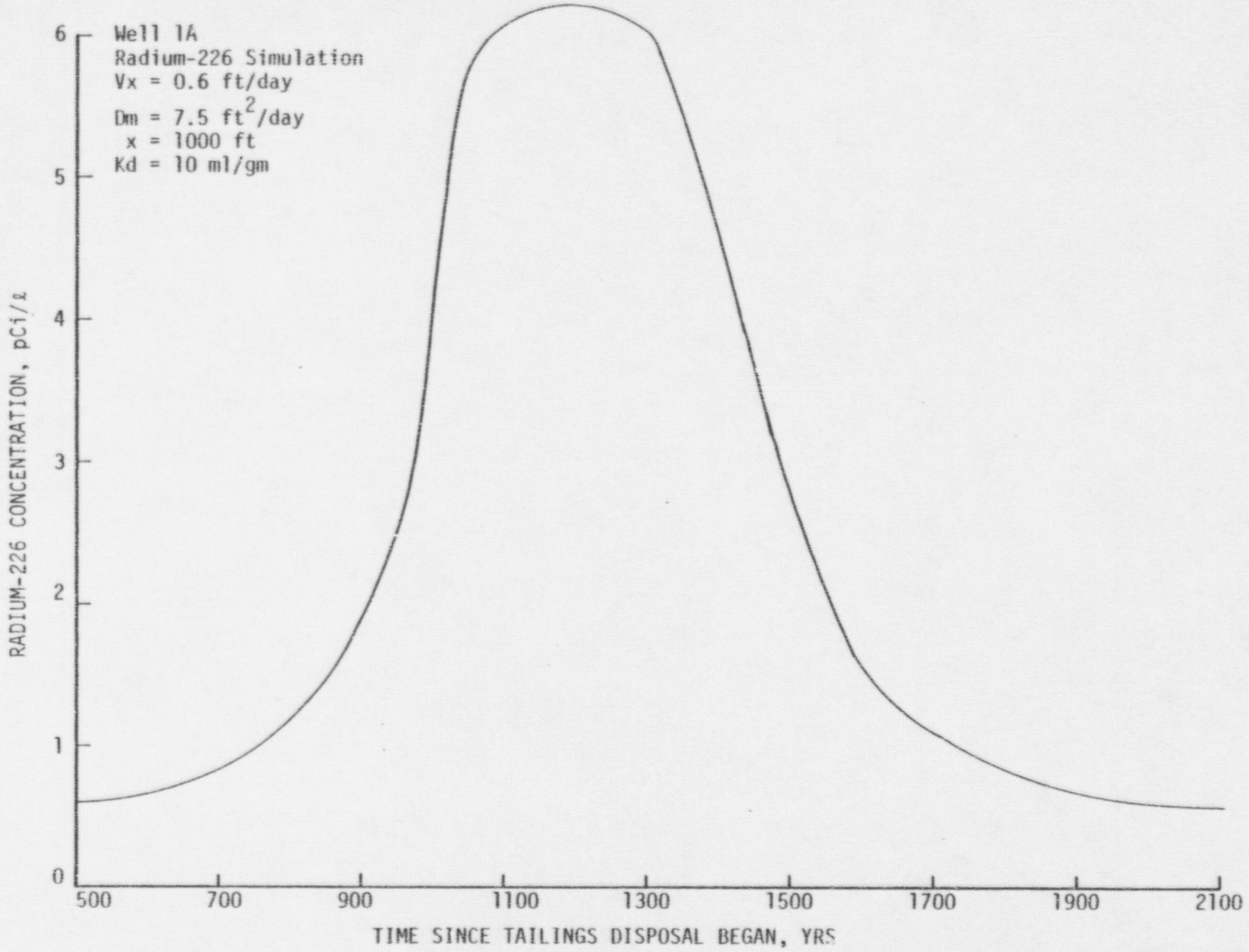


FIGURE 50. PREDICTED RADIUM-226 CONCENTRATION WITH TIME AT WELL 1A.

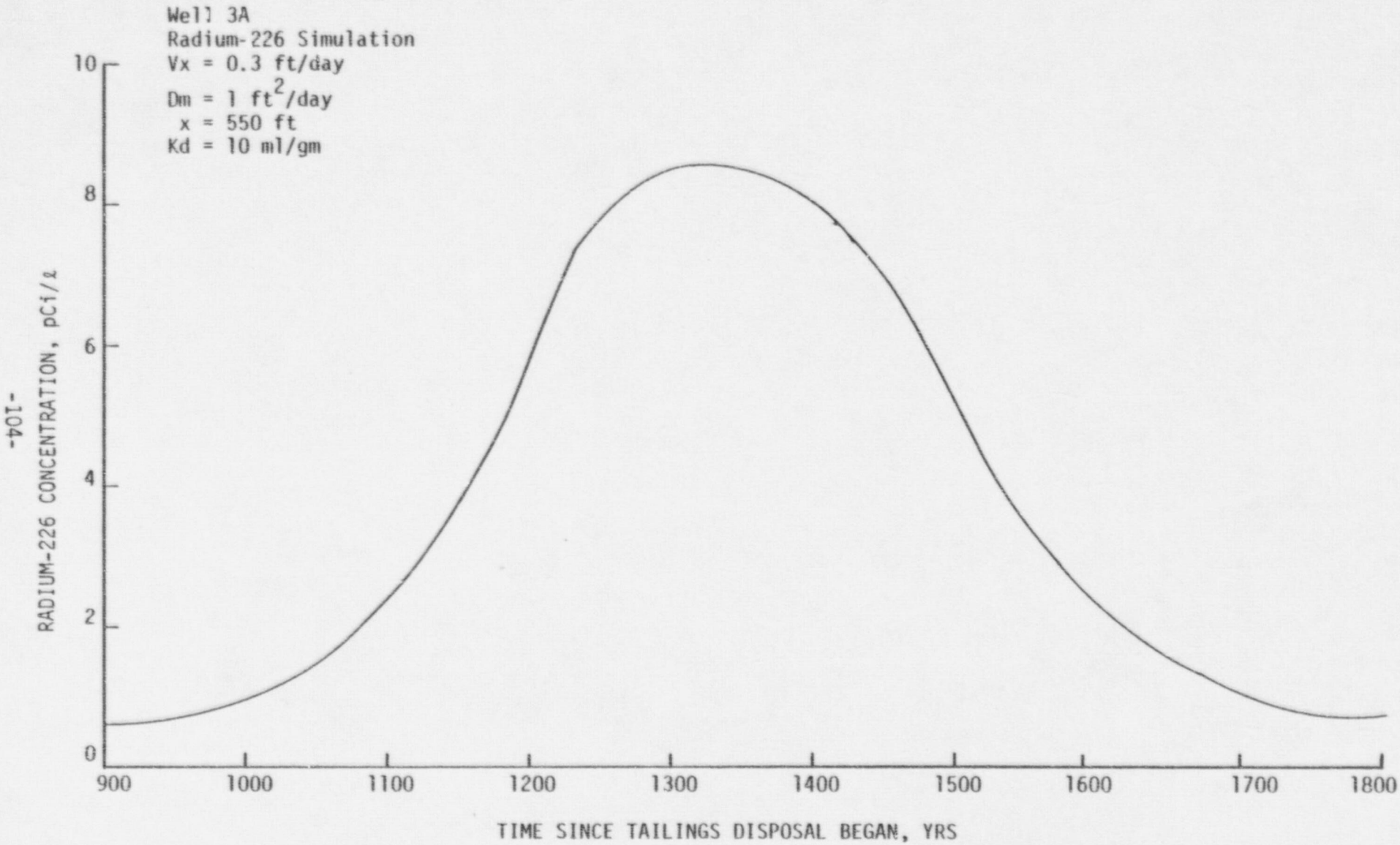


FIGURE 51. PREDICTED RADIUM-226 CONCENTRATION WITH TIME AT WELL 3A.

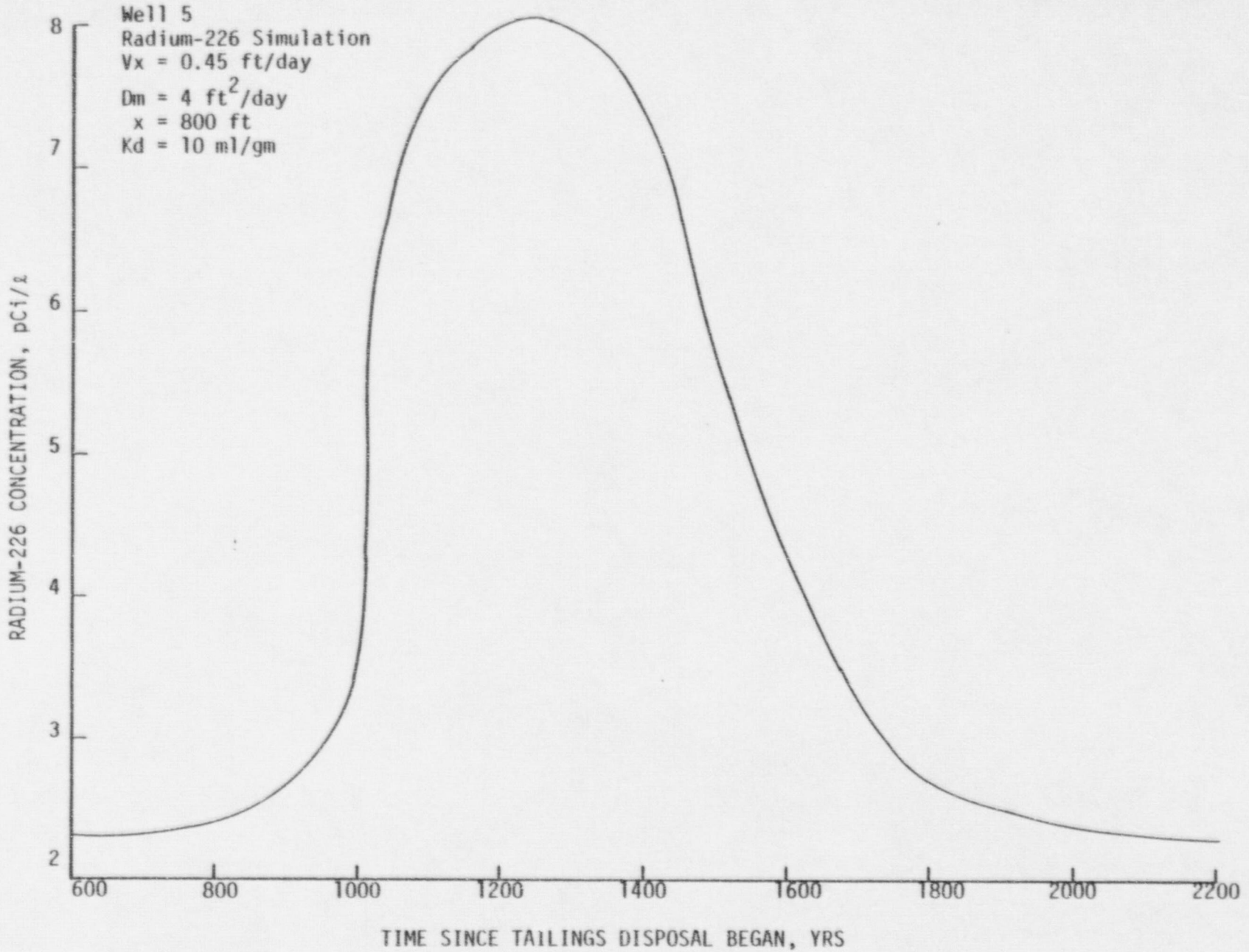


FIGURE 52. PREDICTED RADIUM-226 CONCENTRATION WITH TIME AT WELL 5.

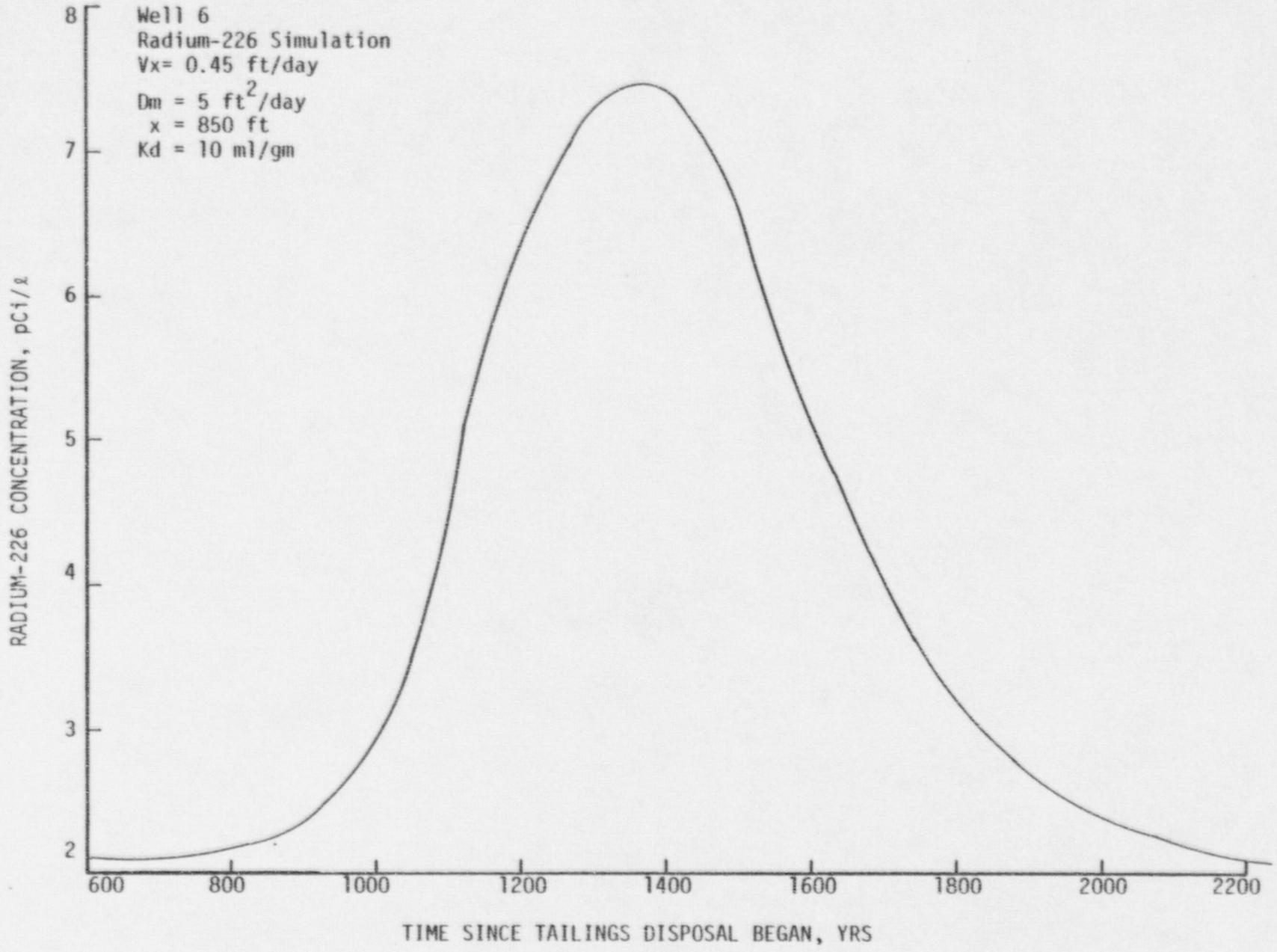


FIGURE 53. PREDICTED RADIUM-226 CONCENTRATION WITH TIME AT WELL 6.

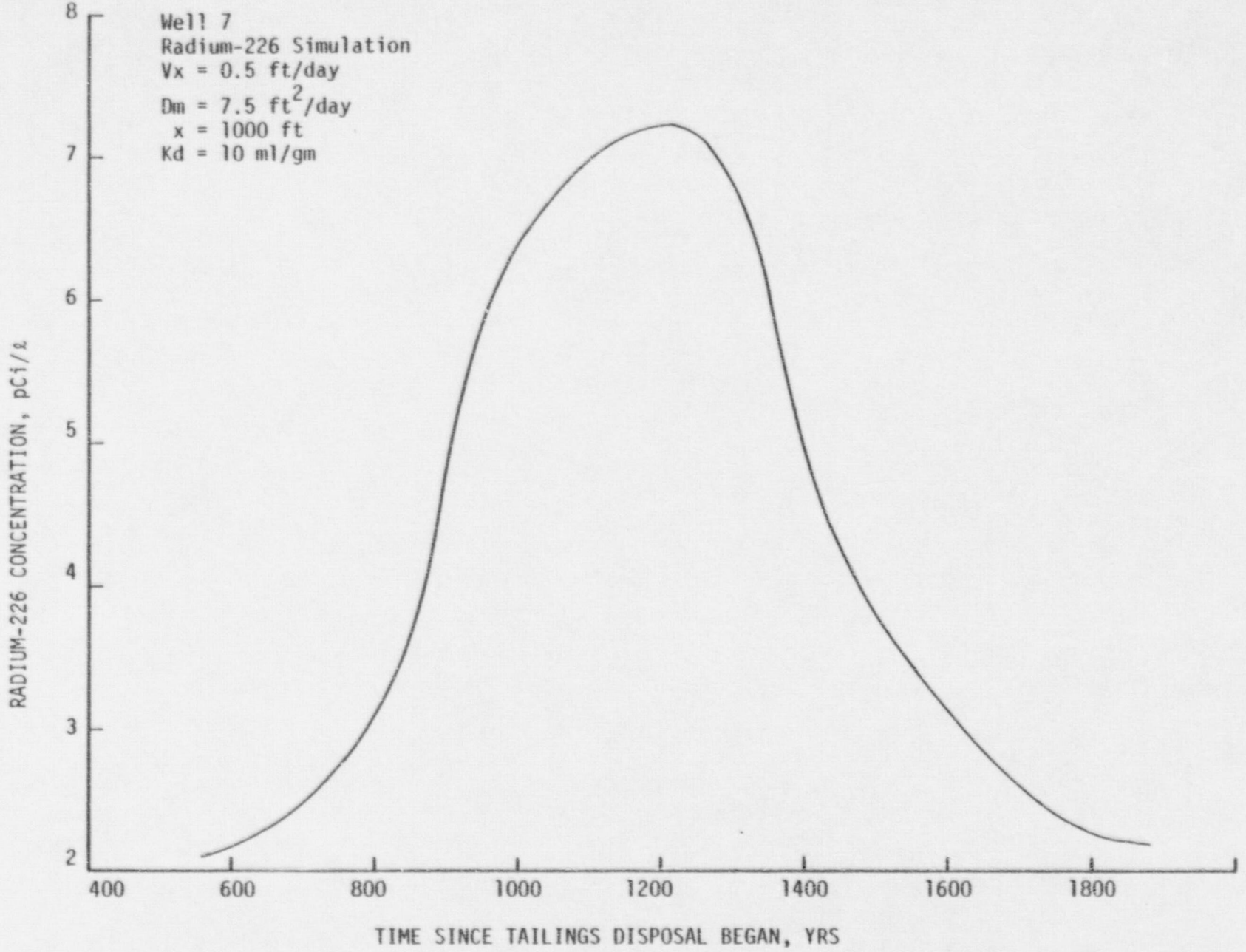


FIGURE 54. PREDICTED RADIUM-226 CONCENTRATION WITH TIME AT WELL 7.

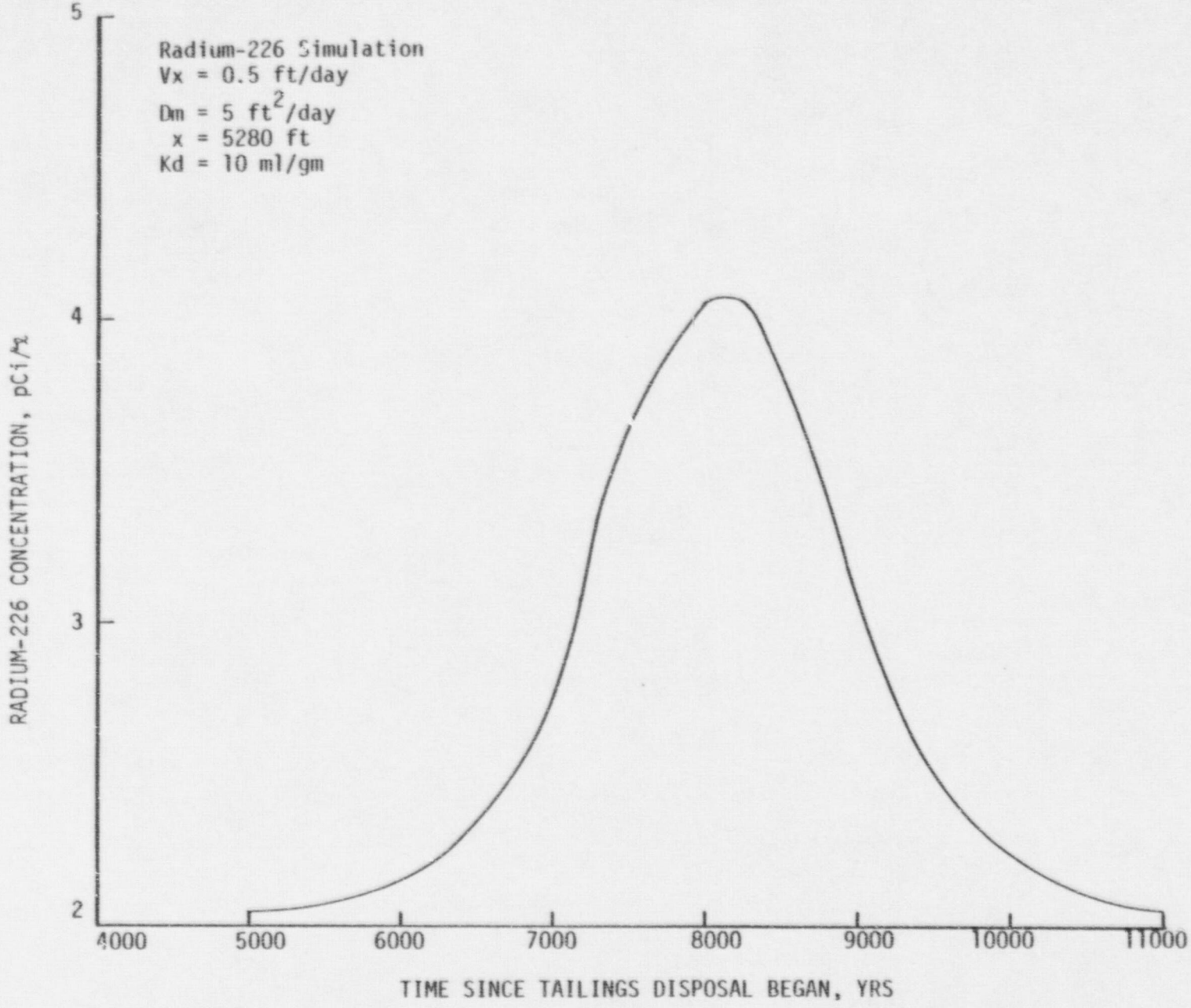


FIGURE 55. PREDICTED RADIUM-226 CONCENTRATION WITH TIME ONE MILE DOWN GRADIENT FROM THE L-BAR TAILINGS DISPOSAL SITE.

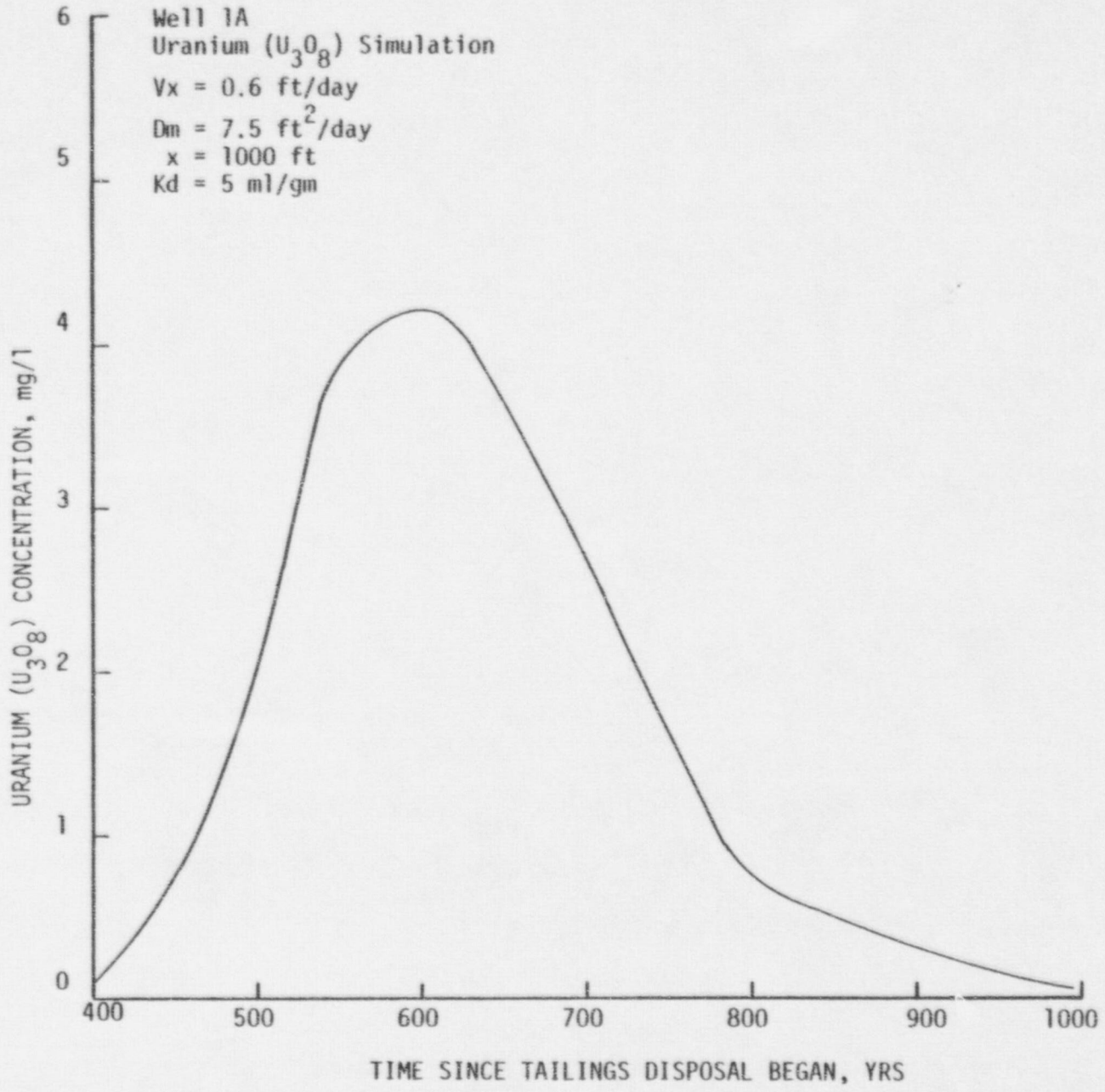


FIGURE 56. PREDICTED URANIUM (U_3O_8) CONCENTRATION WITH TIME AT WELL 1A.

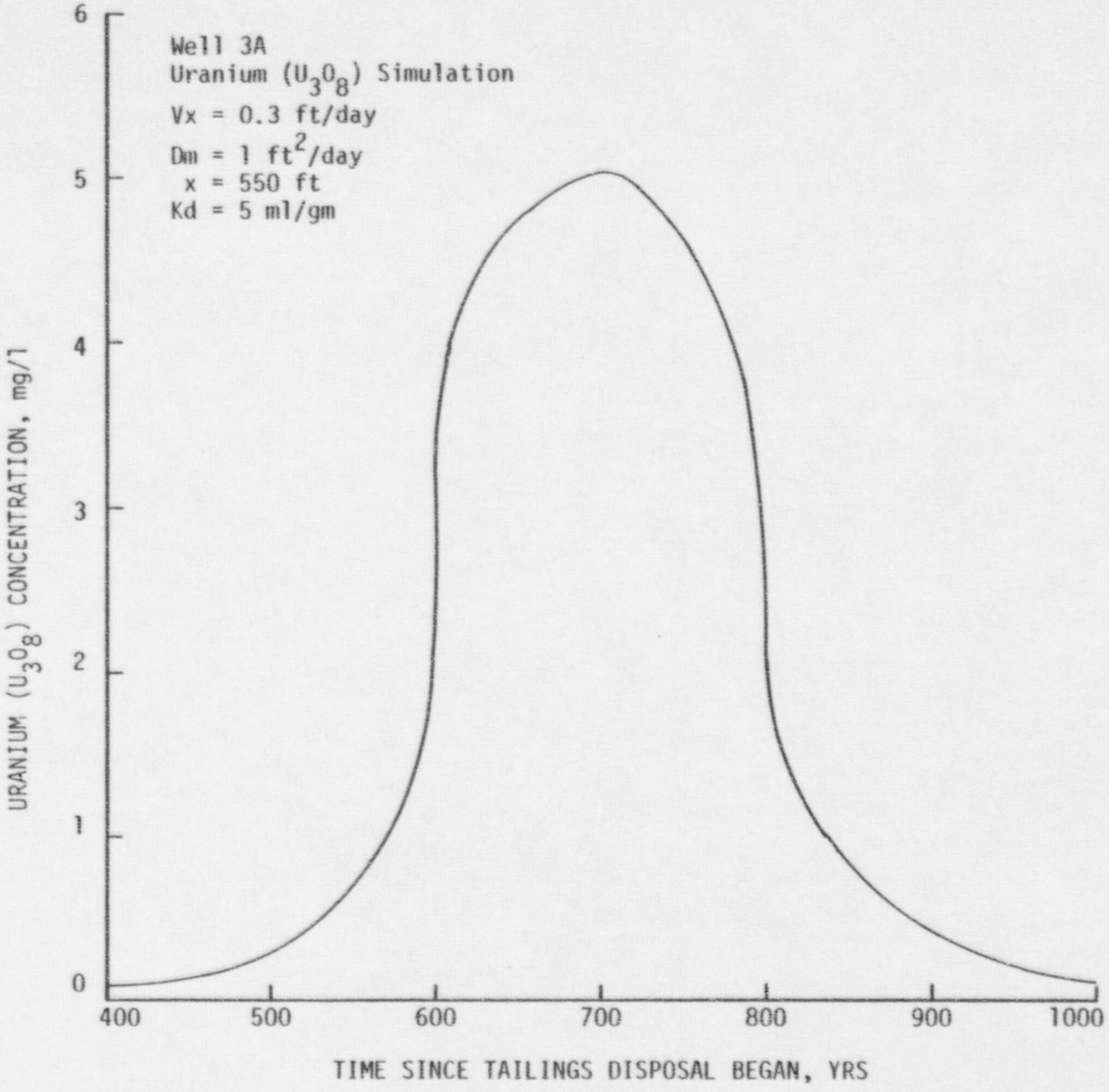


FIGURE 57. PREDICTED URANIUM (U_3O_8) CONCENTRATION WITH TIME AT WELL 3A.

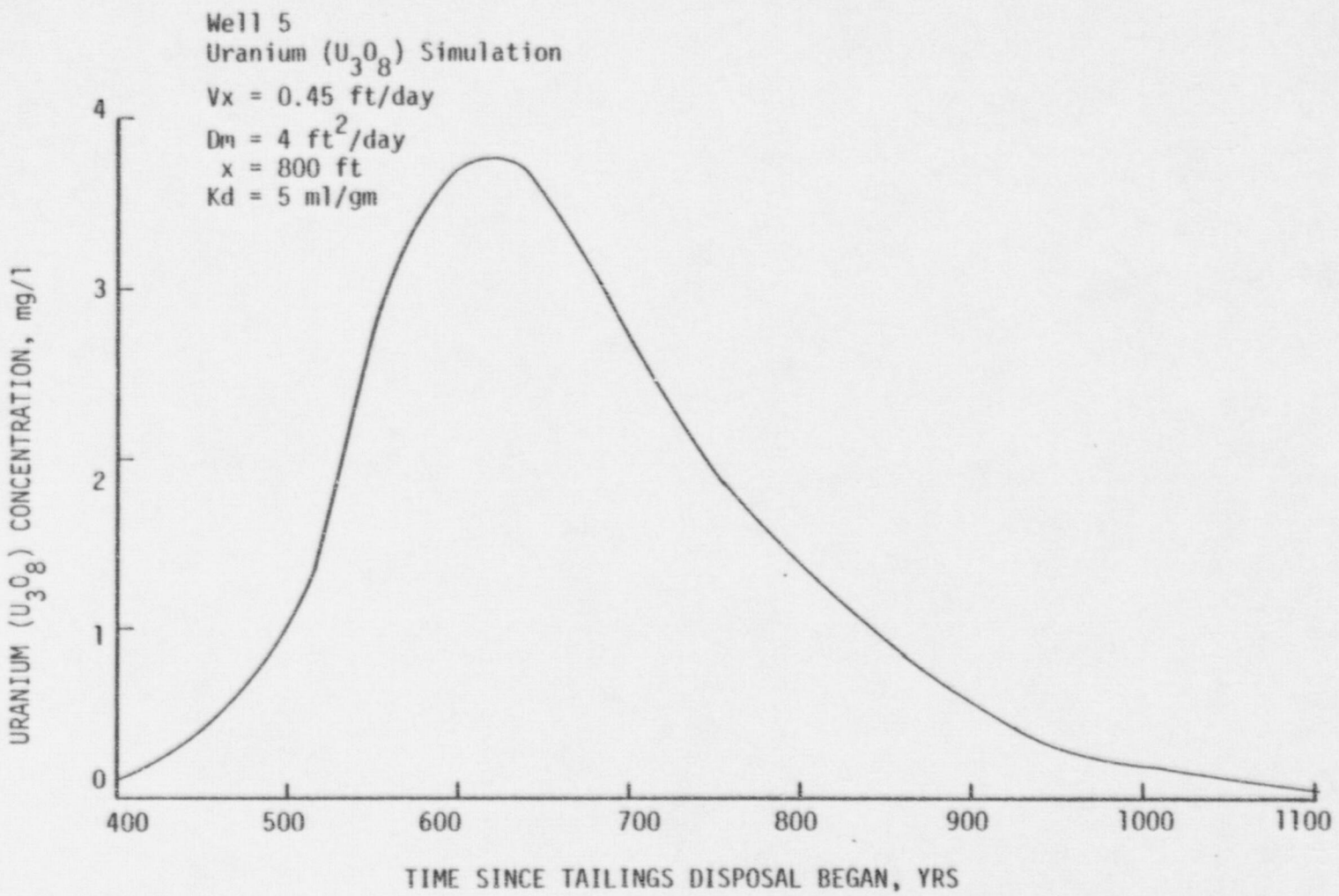


FIGURE 58. PREDICTED URANIUM (U_3O_8) CONCENTRATION WITH TIME AT WELL 5.

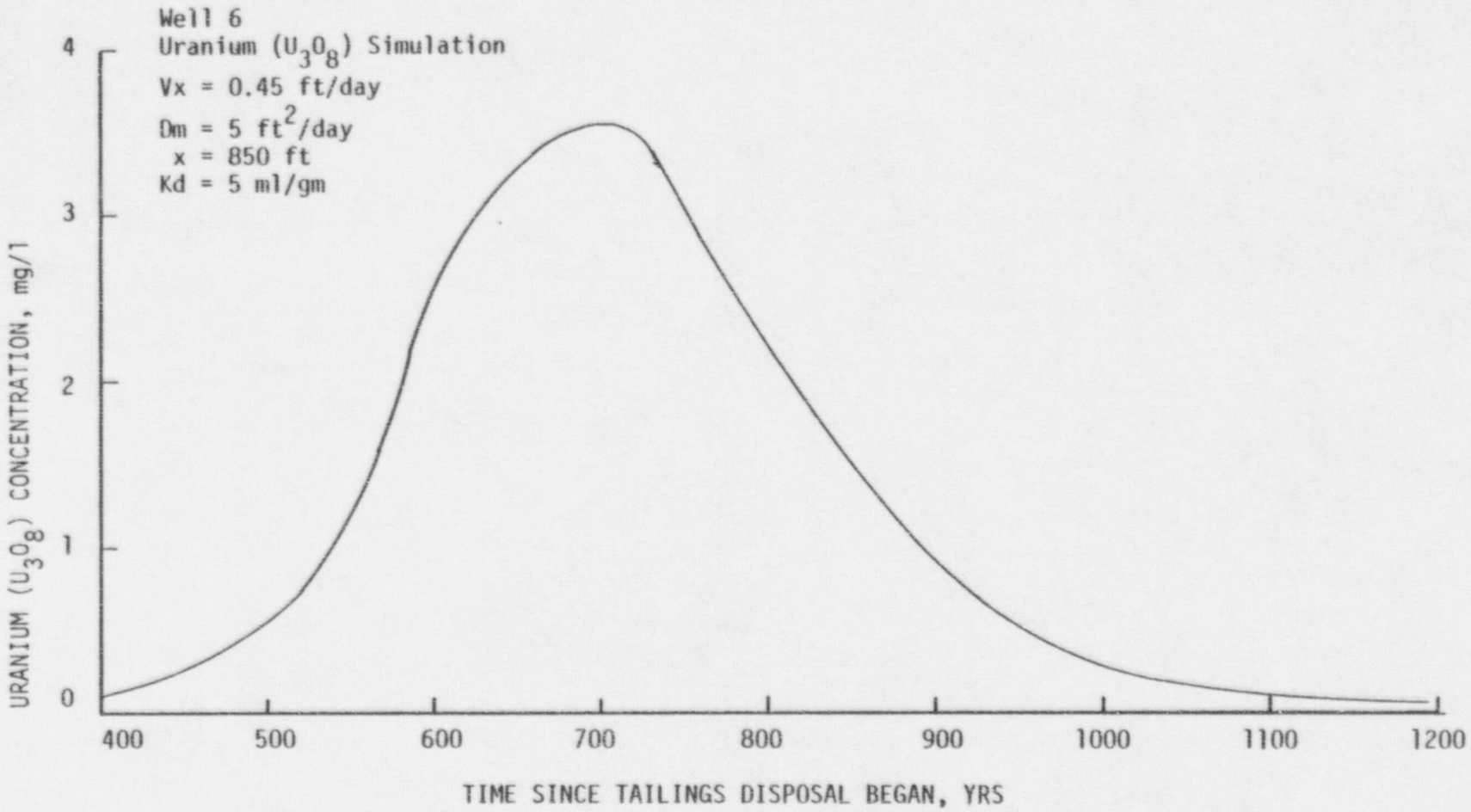


FIGURE 59. PREDICTED URANIUM (U_3O_8) CONCENTRATION WITH TIME AT WELL 6.

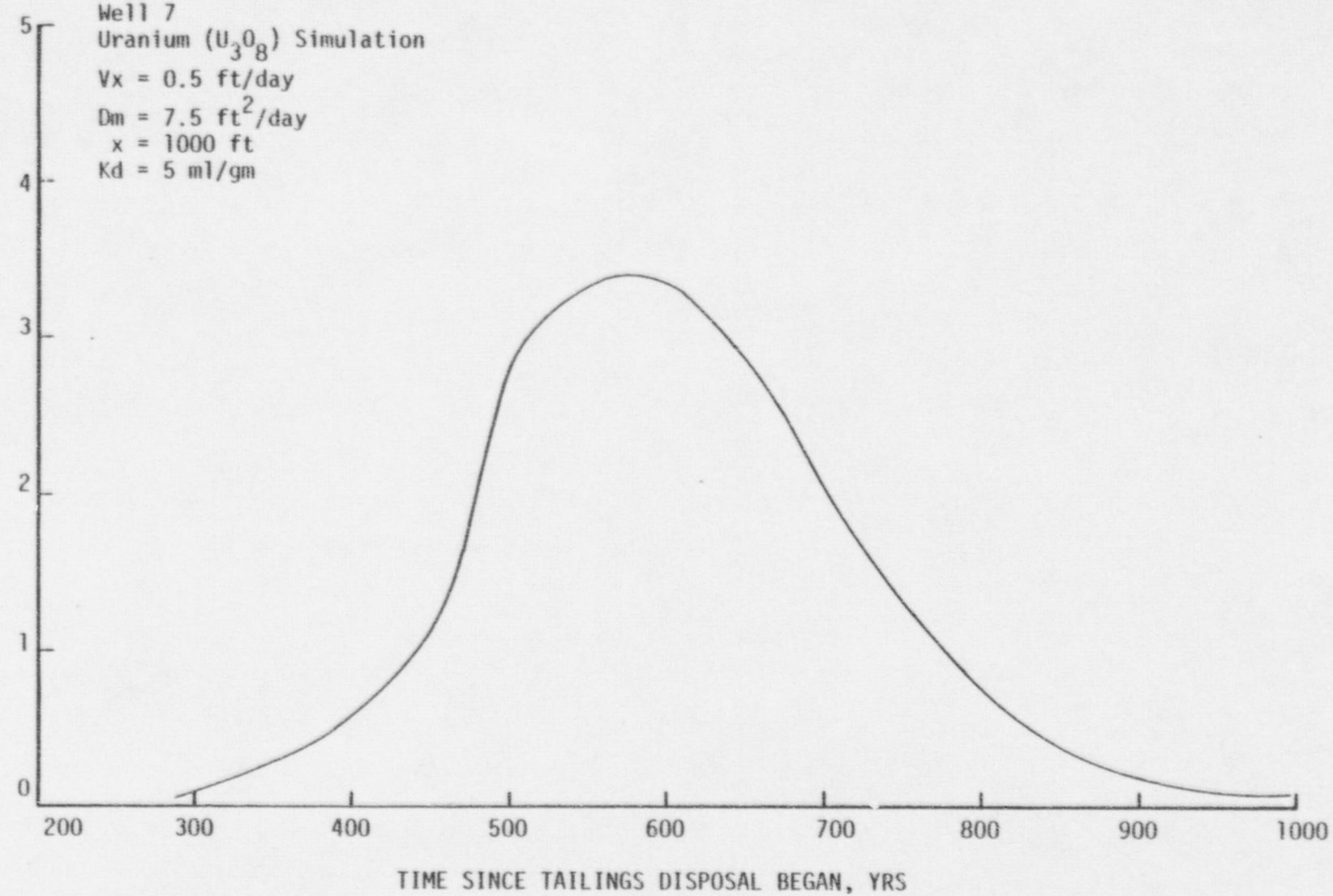


FIGURE 60. PREDICTED URANIUM (U_3O_8) CONCENTRATION WITH TIME AT WELL 7.

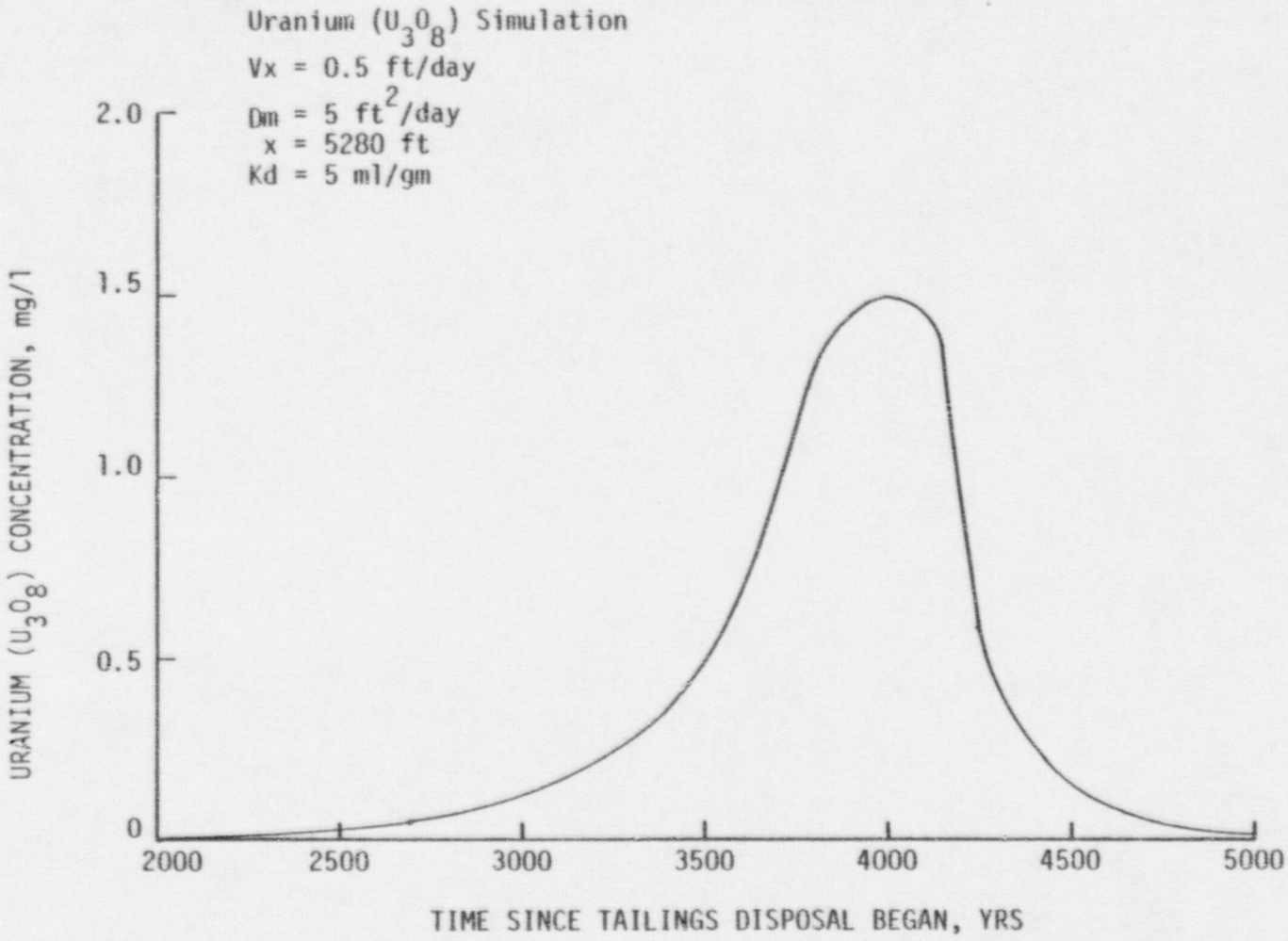


FIGURE 61. PREDICTED URANIUM (U_3O_8) CONCENTRATION WITH TIME ONE MILE DOWN GRADIENT FROM THE L-BAR TAILINGS DISPOSAL SITE.

TABLE 1. GROUND-WATER USE WITHIN FIVE MILES OF THE L-BAR TAILING SITE

LOCATION	AQUIFER	DEPTH (FT)	USE	USER
10N.4W.08.4	Alluvium	388	--	--
10N.5W.04.	--	--	--	--
10N.5W.10.110	--	--	--	--
11N.4W.09.233	--	--	--	Lobo Camp
11N.5W.01.120	Below Dakota	1150	Industrial	SOHIO
11N.5W.01.340	Below Dakota	1050	Industrial	SOHIO
11N.5W.08.110	Second Tres Hermanos	800	--	Cebolleta Land Grant
11N.5W.09.110	Mancos *	495	Domestic	D. Lopez
11N.5W.12.400	Second Tres Hermanos	240	Stock	A. Marquez
11N.5W.12.340	Westwater	535	Industrial	SOHIO
11N.5W.12.330	Westwater	473	Industrial	SOHIO
11N.5W.12.320	Westwater	540	Industrial	SOHIO
11N.5W.12.140	Westwater	450	Industrial	SOHIO
11N.5W.12.441	Below Dakota	855	Industrial	SOHIO
11N.5W.12.414	Below Dakota	1000	Industrial	SOHIO
11N.5W.12.424	Below Dakota	800	Industrial	SOHIO
11N.5W.13.112	Below Mancos	--	Industrial	SOHIO
11N.5W.14.241	Below Mancos	3474	Industrial	SOHIO
11N.5W.16.330	Westwater	550	Domestic	Town of Moquino
11N.5W.17.330	Westwater	450	Domestic	Town of Bibo
11N.5W.17.3	First Tres Hermanos	320	Domestic	Leupold Marquez
11N.5W.17.330	Dakota	410	Domestic	E.C. Marquez
11N.5W.20.122	Second Tres Hermanos	350	Domestic	Jimmy Michael
11N.5W.24.213	--	--	--	--
11N.5W.30.422	Dakota	466	--	--
11N.5W.32.230	Alluvium	79	--	--
11N.5W.32.234	Alluvium	79	Abandomed	Pueblo
12N.4W.21.420	Westwater	918	Exploration	Exxon
12N.4W.21.420	Westwater	899	Exploration	Exxon
12N.4W.21.420	Westwater	898	Exploration	Exxon
12N.4W.21.420	Westwater	915	Exploration	Exxon
12N.4W.31.221	Below Dakota	1215	Industrial	SOHIO

TABLE 1. GROUND-WATER USE WITHIN
FIVE MILES OF THE L-BAR TAILING SITE (CONT.)

LOCATION	AQUIFER	DEPTH (FT)	USE	USER
12N.4W.31.311	Below Dakota	1660	Industrial	SOHIO
12N.4W.31.143	Below Dakota	1110	Industrial	SOHIO
12N.4W.31.124	Below Dakota	1140	Industrial	SOHIO
12N.5W.33.3	Above Mancos	370	Domestic	Ross Davis
12N.5W.33.3	Above Mancos	200	Domestic	Jose E. Sena
12N.5W.36.433	Below Dakota	1120	Industrial	SOHIO
12N.5W.36.242	Below Dakota	1140	Industrial	SOHIO
12N.5W.36.223	Below Dakota	1116	Industrial	SOHIO

NOTE: * Above First Tres Hermanos Sandstone

TABLE 2 BASIC WELL DATA

WELL NO.	DEPTH (FT-MP)	PERFORATED INTERVAL (FT-LSD)	LITHOLOGIC UNIT	WATER LEVEL DATE	WATER LEVEL DEPTH (FT-MP)	WATER LEVEL ELEV. (FT-MSL)	MP ABOVE LSD	ELEVATION OF MP (FT-MSL)	DEPTH TO FIRST SS (FT-LSD)
1A	140.0	130-140	Kms3	6/17/81	93.64	6130.8	1.5	6224.4	130
1B	36.3	18-36	Qe	5/18/81	36.20	6189.3	2.2	6225.5	-
2A	79.7	66-76	Kms3	6/09/81	46.12	6141.5	3.3	6189.9	70
2B	37.0	15-35	Qe	6/10/81	36.49	6151.1	1.6	6187.6	-
3A	30.2	20-30	Kms3	6/10/81	22.89	6134.6	1.7	6157.5	20
3B	20.3	7-17	Qe	6/12/81	16.11	6142.9	2.0	6159.0	-
4A	34.2	20-30	Kms3	6/11/81	25.97	6134.8	1.5	6160.8	20
4B	17.0	6-15	Qe	6/12/81	16.59	6145.6	2.1	6162.2	-
5	107.2	90-110	Kms3	6/15/81	40.50	6130.7	2.3	6171.2	45
6	102.7	90-110	Kms3	6/15/81	53.06	6130.6	2.4	6183.7	55
7	142.2	100-140	Kms3	6/09/81	65.70	6130.4	2.6	6196.2	70
8	160.0	110-150	Kms3	6/09/81	73.95	6134.2	3.0	6208.2	90
9	216.0	195-216	Kms3	6/25/81	145.63	6129.1	2.2	6274.7	195
10	156.0	139-156	Kms3	6/17/81	104.60	6136.0	1.1	6240.6	139
11	302	278-300	Kms2	6/17/81	213.01	5996.8	1.9	6209.8	278
12	121.6	98-120	Kms3	6/15/81	80.44	6129.5	1.3	6209.9	98
13	242	219-240	Kms2	6/17/81	198.61	5959.3	2.1	6157.9	219
14	51.3	27-48	Kms3	6/15/81	26.30	6129.4	1.6	6155.7	27
15	37.5	11-37	Kms3	6/15/81	19.96	6132.7	0.9	6152.7	11
16	59	38-58	Kms3	6/17/81	DRY	6149.8	1.2	6208.8	38
17	80.6	56-78	Kms3	6/11/81	75.65	6131.8	2.0	6207.5	56
18	8.1	1-6	Qe	6/12/81	7.76	6137.2	2.7	6145	6
19	13.3	7-12	Qe	6/29/81	DRY	6134.7	1.8	6148	-
20	14.1	7-12	Qe	6/29/81	12.44	6135.6	2.4	6148	12

NOTE: MP = Measuring Point = Top of Casing

LSD = Land Surface Datum

MSL = Mean Sea Level

Kms3 = First Tres Hermanos Sandstone (Highest Stratigraphically)

Kms2 = Second Tres Hermanos Sandstone

Qe = Alluvium

Casing is PVC, all wells are 4" dia. except the A & B well which are 6".

TABLE 3 BASIC PUMP TEST DATA

OBSERVATION	PUMPING WELL NO(S).	TYPE OF TEST	LENGTH OF TEST (min.)	(days)
5	1A, 8 & 10	PUMPING		69
6	1A, 8 & 10	PUMPING		69
7	1A, 8 & 10	PUMPING		69
9	1A, 8 & 10	PUMPING		69
12	1A, 8 & 10	PUMPING		69
1A	1A, 8 & 10	RECOVERY		14
5	1A, 8 & 10	RECOVERY		14
6	1A, 8 & 10	RECOVERY		14
7	1A, 8 & 10	RECOVERY		14
8	1A, 8 & 10	RECOVERY		14
9	1A, 8 & 10	RECOVERY		14
10	1A, 8 & 10	RECOVERY		14
12	1A, 8 & 10	RECOVERY		14
14	1A, 8 & 10	RECOVERY		14
2A	2A	PUMPING	325	
2A	2A	RECOVERY	1493	
3A	3A	PUMPING	24	
3A	3A	RECOVERY	1147	
4A	4A	RECOVERY	43	
15	15	RECOVERY	22	
17	17	FILLING	32	

NOTE: All of these wells are completed in the First Tres Hermanos aquifer.

TABLE 4 DRAWDOWN DATA FOR OBSERVATION WELL 5

DATE	TIME SINCE PUMPING STARTED (days)	WATER LEVEL (ft below MP)	DRAWDOWN (ft)	
12/12/80	-	40.85	-	
03/30/81	20	43.66	2.8	
04/27/81	48	44.40	3.6	
05/01/81	52	44.57	3.7	(Well 1A turned off)
05/05/81	56	44.45	3.6	
05/08/81	59	44.06	3.2	
05/11/81	62	44.15	3.3	
05/15/81	66	44.13	3.3	
05/18/81	69	44.24	3.4	

TABLE 5 DRAWDOWN DATA FOR OBSERVATION WELL 6

DATE	TIME SINCE PUMPING STARTED (days)	WATER LEVEL (ft below MP)	DRAWDOWN (ft)	
03/10/81	0	53.85	-	
03/13/81	3	56.00	2.15	
03/16/81	6	56.06	2.21	
03/20/81	10	56.30	2.45	
03/23/81	13	56.86	3.01	
03/27/81	17	56.86	3.01	
03/31/81	21	56.88	3.03	
04/06/81	27	57.23	3.38	
04/09/81	30	57.30	3.45	
04/13/81	34	57.48	3.63	
04/16/81	37	57.70	3.85	
04/20/81	41	57.30	3.45	
04/24/81	45	57.49	3.64	
04/27/81	48	57.56	3.71	
04/28/81	49	57.57	3.72	
05/01/81	52	57.68	3.81	(Well 1A turned off)
05/05/81	56	57.55	3.70	
05/08/81	59	57.40	3.55	
05/11/81	62	57.41	3.56	
05/15/81	66	57.31	3.46	
05/18/81	69	57.34	3.49	

TABLE 6 DRAWDOWN DATA FOR OBSERVATION WELL 7

DATE	TIME SINCE PUMPING STARTED (days)	WATER LEVEL (ft below MP)	DRAWDOWN (ft)	
03/10/81	-	66.98	-	
03/13/81	3	69.85	2.87	
03/16/81	6	70.09	3.11	
03/20/81	10	70.38	3.40	
03/23/81	13	71.04	4.06	
03/27/81	17	70.95	3.97	
03/31/81	21	71.26	4.28	
04/06/81	27	71.36	4.38	
04/09/81	30	71.42	4.44	
04/13/81	34	71.46	4.48	
04/16/81	37	71.75	4.77	
04/20/81	41	71.06	4.08	
04/24/81	45	71.61	4.63	
04/27/81	48	71.70	4.72	
04/28/81	49	71.68	4.70	
05/01/81	52	71.79	4.81	(Well 1A turned off)
05/05/81	56	71.44	4.46	
05/08/81	59	71.37	4.39	
05/11/81	62	71.33	4.35	
05/15/81	66	71.24	4.26	
05/18/81	69	71.49	4.51	

TABLE 7 DRAWDOWN DATA FOR OBSERVATION WELL 9

DATE	TIME SINCE PUMPING STARTED (days)	WATER LEVEL (ft below MP)	DRAWDOWN (ft)	
03/10/81	-	145.13	-	
03/13/81	3	147.09	1.96	
03/16/81	6	146.97	1.84	
03/20/81	10	148.57	3.44	
03/23/81	13	149.57	4.44	
03/27/81	17	149.16	4.03	
03/31/81	21	149.88	4.75	
04/06/81	27	149.84	4.71	
04/09/81	30	149.63	4.50	
04/13/81	34	150.39	5.26	
04/16/81	37	150.15	5.02	
04/20/81	41	149.74	4.61	
04/24/81	45	150.22	5.09	
04/27/81	48	150.11	4.98	
04/28/81	49	150.10	4.97	
05/01/81	52	150.29	5.16	(Well 1A turned off)
05/05/81	56	149.96	4.83	
05/08/81	59	150.10	4.97	
05/11/81	62	149.53	4.40	
05/15/81	66	149.83	4.70	
05/18/81	69	149.66	4.53	

TABLE 8 DRAWDOWN DATA FOR OBSERVATION WELL 12

DATE	TIME SINCE PUMPING STARTED (days)	WATER LEVEL (ft below MP)	DRAWDOWN (ft)	
03/10/81	-	82.23	-	
03/13/81	3	86.20	3.97	
03/16/81	6	86.45	4.22	
03/20/81	10	86.73	4.50	
03/23/81	13	87.26	5.03	
03/27/81	17	87.35	5.12	
03/31/81	21	87.31	5.08	
04/06/81	27	87.78	5.55	
04/09/81	30	87.73	5.50	
04/13/81	34	88.13	5.90	
04/16/81	37	88.05	5.82	
04/20/81	41	87.76	5.53	
04/24/81	45	88.25	6.02	
04/27/81	48	88.04	5.81	
05/01/81	52	88.08	5.85	(Well 1A turned off)
05/05/81	56	87.84	5.61	
05/08/81	59	87.58	5.35	
05/11/81	62	87.59	5.36	
05/15/81	66	87.62	5.39	
05/18/81	69	87.73	5.50	

TABLE 9 WATER LEVELS IN ADDITIONAL FIRST SANDSTONE OBSERVATION WELLS DURING PUMPING OF WELLS 1A, 8, and 10.

DATE	TIME SINCE PUMPING STARTED (DAYS)	WATER LEVEL (ft, below MP)					
		1A	2A	3A	4A	14	15
10/10/80		93.87	--	27.41	28.26	27.15	19.51
11/21/80		--	--	26.12	27.61	27.77	20.37
12/12/80		--	--	25.57	27.33	27.43	19.87
1/28/81		--	--	24.96	26.93	28.42	20.26
2/25/81		94.25	--	24.39	26.94	27.22	20.35
3/10/81		--	46.58	Pumps Started In Wells 1A, 8 & 10			
3/13/81	3	--	46.94	--	--	--	--
3/16/81	6	--	46.42	--	--	--	--
3/20/81	10	--	46.38	--	--	--	--
3/23/81	13	--	46.49	--	--	--	--
3/27/81	17	--	46.47	--	--	--	--
3/30/81	20	--	--	23.68	26.68	28.23	20.06
3/31/81	21	--	46.52	--	--	--	--
4/06/81	27	--	46.30	--	--	--	--
4/09/81	30	--	46.37	--	--	--	--
4/13/81	34	--	46.45	--	--	--	--
4/16/81	37	--	46.38	--	--	--	--
4/20/81	41	--	46.34	--	--	--	--
4/24/81	45	--	46.48	23.48	--	--	20.14
4/27/81	48	--	46.35	24.00	26.45	28.65	20.07
4/28/81	49	--	46.33	--	--	--	--
5/01/81	52	125.83	46.64	24.18	26.56	28.74	20.08
				(Well 1A Turned Off)			
5/04/81	55	100.73	--	--	--	--	--
5/05/81	56	100.83	--	24.03	26.44	28.69	20.16
5/08/81	59	100.63	--	23.70	26.18	28.51	19.94
5/11/81	62	100.69	--	23.69	26.34	28.45	19.92
5/15/81	66	100.53	--	23.71	26.18	28.44	19.90
5/18/81	69	100.72	46.34	23.78	26.50	28.59	20.09
5/19/81	70	--	--	--	26.52	--	--

TABLE 10 WATER LEVELS IN ALLUVIAL WELLS 1B, 2B, 3B, and 4B DURING PUMPING OF WELLS 1A, 8, and 10.

DATE	Water Level (ft, below MP) WELLS 1B	2B	3B	4B
10/10/80	36.08	36.27	17.36	17.07
11/21/80	DAMP	36.10	17.13	17.07
12/12/80	36.12	35.95	17.09	16.79
1/28/81	36.10	35.98	16.87	16.78
2/25/81	DAMP	36.79	16.73	16.72
3/10/81	36.27	DAMP	--	--
Pumps Started in Wells 1A, 8, and 10.				
3/13/81	35.78	36.78	--	--
3/16/81	DAMP	36.50	--	--
3/20/81	--	36.63	--	--
3/23/81	36.35	36.65	--	--
3/24/81	36.21	--	--	--
3/27/81	36.06	--	--	--
3/30/81	36.23	36.52	16.96	16.70
4/06/81	36.38	36.65	--	--
4/09/81	36.37	36.53	--	--
4/13/81	--	36.81	--	--
4/16/81	36.60	36.25	--	--
4/20/81	36.00	36.49	--	--
4/24/81	36.22	36.53	--	--
4/27/81	36.28	36.50	16.38	15.84
4/28/81	36.28	36.49	--	--
5/01/81	36.33	36.48	--	--
5/05/81	36.32	36.59	--	--
5/08/81	36.22	36.51	--	--
5/11/81	36.32	36.57	--	--
5/15/81	36.32	36.63	--	--
5/18/81	36.20	36.79	--	--

TABLE 11 RECOVERY DATA FROM PUMPING WELLS 1A, 8 & 10.

DATE	t	$t'_{8\&10}$	t'_{1A}	$(t/t'_{8\&10})^{Q_8 + Q_{10}}_{Q_{1A}}$	WELL 1A		WELL 2A		WELL 3A		WELL 4A		WELL 5		WELL 6		WELL 7	
					W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.
					93.3e		46.58		24.1e		26.8e		40.85		53.85		66.98	
3/10/81		Pumps On in Wells 1A, 8, & 10																
5/01/81	52	Well 1A Off																
5/18/81	69	Well 10 & 8 Off																
5/19/81	70	1	18	6430	97.92	4.62	46.42	-.16	23.86	-.24	26.52	-.28	43.53	2.68	56.20	2.35	69.30	2.32
5/20/81	71	2	19	1640	95.78	2.48	46.24	-.34	23.58	-.52	26.14	-.66	42.90	2.05	--	--	68.35	1.37
5/21/81	72	3	20	744	95.99	2.69	46.22	-.36	23.46	-.64	26.17	-.63	42.63	1.78	55.35	1.50	68.00	1.02
5/22/81	73	4	21	427	95.98	2.68	46.21	-.37	23.54	-.56	26.16	-.64	42.35	1.50	55.02	1.17	67.75	0.77
5/26/81	77	8	25	116	94.82	1.52	46.12	-.46	23.52	-.58	26.14	-.66	41.77	0.92	--	--	66.95	-.03
5/27/81	78	9	26	93.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--
6/01/81	83	14	31	42.8	94.32	1.02	46.32	-.26	23.39	-.71	26.1e	-.66	41.00	0.15	53.62	-0.23	66.18	-.80

DATE	WELL 8		WELL 9		WELL 10		WELL 12		WELL 14		WELL 15	
	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.
	74.1e		145.13		104.1e		82.23		27.2e		20.1e	
5/19/81	80.39	6.29	148.89	3.76	110.13	6.03	84.30	2.07	28.48	1.28	20.08	-.02
5/20/81	78.49	4.39	148.43	3.30	109.30	5.20	83.17	.94	27.95	.75	19.78	-.32
5/21/81	77.46	3.36	147.62	2.49	108.71	4.61	82.77	.54	27.80	.60	19.70	-.40
5/22/81	76.74	2.64	147.34	2.21	108.46	4.36	82.46	.23	27.57	.37	19.77	-.33
5/26/81	75.50	1.40	146.54	1.41	107.71	3.61	81.70	-.53	27.22	.02	19.94	-.16
5/27/81	--	--	--	--	--	--	--	--	27.16	-.04	19.92	-.18
6/01/81	74.61	0.51	146.00	0.87	--	--	81.29	-.94	26.92	-.28	19.94	-.16

NOTE: t = Time Since Wells 1A, 8, & 10 Were Started, in days.
$t'_{8\&10}$ = Time Since Wells 8 & 10 Were Stopped, in days.
t'_{1A} = Time Since Well 1A Has Stopped, in days.
W.L. = Water Level Depth below Measuring point (MP), in ft.
R.D. = Residual Drawdown, in ft.

Q_8 = Discharge of Well 8, in gpm.
Q_{10} = Discharge of Well 10, in gpm.
Q_{1A} = Discharge of Well 1A, in gpm.

TABLE 12 DRAWDOWN AND RECOVERY DATA FOR WELL 2A

DATE	TIME	t_1	t_2	t_3	t'	Q_1 (t_1/t_2)	Q_2 (t_2/t_3)	Q_3 (t_3/t')	WATER LEVEL (FT-MP)	DRAWDOWN (FT)	DISCHARGE (GPM)
6/09/81	1315								46.12		
				Trial Test, Installed measuring tube and Dole Valve							3.0
6/10/81	0620								46.18		
	0638								46.28		
	0640								46.28		
	0645	0		Pump On							
	0646	1							49.31	3.03	
	0647	2							49.74	3.46	
	0649	4							50.64	4.36	
	0651	6							51.08	4.80	
	0654	9							51.53	5.25	
	0657	12							51.75	5.47	
	0700	15							51.81	5.53	
	0705	20							51.98	5.70	
	0710	25							52.16	5.88	
	0714	29		pH = 6.71, T = 17.8°C, COND = 17000 µmhos/cm @ 25°C							
	0718	33							52.30	6.02	
	0720	35									
	0729	44							52.32	6.04	
	0741	56							52.33	6.05	
	0750	65							52.61	6.33	
	0801	76							52.72	6.44	
	0817	92		pH = 6.74, T = 17.8°C, COND = 17100					52.82	6.54	
	0855	130							52.92	6.64	
	0859	134							52.88	6.60	
	0900	135		pH = 6.71, T = 17.8°C, COND = 17400							

TABLE #12 DRAWDOWN AND RECOVERY DATA FOR WELL 2A (CONT.)

DATE	TIME	t_1	t_2	t_3	t'	Q_1 (t_1/t_2)	Q_2 (t_2/t_3)	Q_3 (t_3/t')	WATER LEVEL (FT-MP)	DRAWDOWN (FT)	DISCHARGE (GPM)
	0910	145									3.0
	0911	146							52.97	6.69	
	0925	160							53.01	6.73	
	0927	162		pH = 6.70, T = 17.8°C, COND = 17300							
	0945	180							53.03	6.75	
	0950	185		pH = 6.69, T = 17.7°C, COND = 17300							
	0957	192							53.06	6.78	
	1000	195		pH = 6.69, pH = 6.43 and HCO_3 = 1140 mg/l lab @ 1007.							
				pH = 6.60 and HCO_3 = 1140 lab @ 10:45 on 6/11/81.							
				pH = 6.58 and HCO_3 = 1160 lab @ 1500 on 6/11/81.							
	1015	210							53.26	6.98	
	1020	215		pH = 6.69, T = 17.8°C, COND = 17300							
	1030	225		pH = 6.66, T = 18.0°C, COND = 17200					53.07	6.79	
	1050	245							53.14	6.86	
	1105	260	0	Increased Discharge							
	1112	267	7	Sample Taken, pH = 6.64					63.78	17.50	5.5
	1129	284	24								
	1144	299	39	0	Pumping Some Air, Flow Dropping Off						
	1147	302	42	3							3.4
	1150	305	45	pH =6.73	T = 18.0°C COND = 17500						
	1152	307	47	8							
	1159	314	54	15	pH = 6.71, T = 17.8°C, COND = 17300						
	1210	325	65	26	0	Pump Off					
	1218	333	73	34	8			869000	64.29	18.01	
	1221	336	76	37	11			280000	60.41	14.13	Cascading Stopped
	1225	340	80	41	15			92600	54.72	8.44	

TABLE 12 DRAWDOWN AND RECOVERY DATA FOR WELL 2A (CONT.)

DATE	TIME	t_1	t_2	t_3	t'	Q_1 Q_2 Q_3 (t_1/t_2) (t_2/t_3) (t_3/t')	WATER LEVEL (FT-MP)	DRAWDOWN (FT)	DISCHARGE (GPM)
	1232	347	87	48	22	23700	52.19	5.91	
	1234	349	89	50	24	17400			
	1236	351	91	52	26	13200	51.58	5.30	
	1240	355	95	56	30	7970	50.91	4.63	
	1247	362	102	63	37	3860	49.97	3.69	
	1252	367	107	68	42	2510	49.40	3.12	Pump Pulled
	1322	397	137	98	72	438	46.87	0.59	
	1336	411	151	112	86	256	46.82	0.54	
	1438	473	213	174	148	57.7	46.69	0.41	
	1538	533	273	234	208	25.9	46.55	0.27	
6/11/81	0903	1578	1318	1279	1253	2.17	46.37	0.09	
	1303	1818	1558	1519	1493	1.94	46.23	-0.05	

*NOTE: t_1 = Time Since Pumping Started at Discharge Rate 1, in min.

t_2 = Time Since Pumping Started at Discharge Rate 2, in min.

t_3 = Time Since Pumping Started at Discharge Rate 3, in min.

t' = Time Since Pumping Stopped, in min.

TABLE 13 WATER LEVELS IN ADJACENT WELLS DURING THE 2A TEST.

DATE	TIME	WATER LEVEL, (FT-MP) FOR WELLS					
		2B	3A	5	6	7	8
6/09/81	1255				53.15		
	1300					65.79	
	1304						73.95
	1308				53.13		
	1309				53.12		
	1315		22.90	40.48	53.15		
	1322	36.48					
	1348				53.14		
	1350					65.78	
	1352			40.50			
	1353						73.94
	1354		22.89				
	1356					65.78	
	1408				53.10		
	1411				53.10		
	1441				53.10		
	1508	36.48					
	1528				53.10		
	1531					65.77	
6/10/81	0625	36.48					
	0631				53.12		
	0635					65.76	
	0710				53.11		
	0715					65.75	
	0718					65.75	
	0810				53.11		
	0814					65.78	
	0936				53.10		
	0942					65.77	
	1040				53.10		
	1047					65.79	
	1205	36.49					
	1248				53.11		
	1251					65.75	

TABLE 14 PUMPING AND RECOVERY DATA FOR WELL 3A

DATE	TIME	TIME SINCE PUMPING STARTED (t, IN MIN.)	TIME SINCE PUMPING STOPPED (t, IN MIN.)	(t/t')	WATER LEVEL (FT-MP)	DRAWDOWN (FT)
6/10/81	1340				22.89	
	1350				21.85	
			With Pump In Hole			
	1354				22.48	
	1358				22.76	
	1401	0	Pump On			
	1403	2			25.58	2.69
	1405	4			26.05	3.16
	1407	6	Discharge = 0.84 GPM			
	1409	8			27.12	4.23
		pH = 7.42, T = 28.0°C, COND = 43800			µmhos/cm @ 25°C	
	1421	20			28.54	5.65
	1425	24	Pump Off			
	1428	27	3	9.00		
		T = 26.5°C , COND = 43300				
	1432	31	7	4.43	28.57	5.68
	1435	34	10	3.40	28.56	5.67
	1443	42	18	2.33	28.56	5.67
	1453	52	28	1.86	28.38	5.49
	1457	56	32	1.75	28.23	5.34
	1501	60	36	1.67	28.13	5.24
	1505	64	40	1.60	28.02	5.13
	1508	67	43	1.56	27.92	5.03
	1512	71	47	1.51	27.88	4.99
	1530	89	65	1.37	27.43	4.54
	1535	84	70	1.34	27.28	4.39
	1542	101	77	1.31	26.99	4.10
	1545	104	80	1.30	26.98	4.09
6/11/81	909	1148	1124	1.02	23.19	0.30
	930	1169	1145	1.02	23.08	0.19
	932	1171	1147	1.02	23.07	0.18
	934		Pump Turned On @ 6.5 GPM Sample Taken			
		pH = 7.64, T = 18.5°C, COND = 37,000				
	937		Pump Off, Filtered and Preserved Sample			

TABLE 15 PUMPING AND RECOVERY DATA FOR WELL 4A

DATE	TIME	TIME SINCE PUMPING STARTED (t, IN MIN.)	TIME SINCE PUMPING STOPPED (t', IN MIN.)	(t/t')	WATER LEVEL (FT-MP)	DRAWDOWN (FT)
6/11/81	1127				25.97	
	1145				25.65	w/Pump Installed
	1319	Pump On				
	1320	1			30.04	4.07
	1322	3			30.77	4.80
			T = 22.5°C COND = 7800 µmhos/cm @ 25°C			
	1323	4	Pumped Dry Q= 4 GPM			
	1326	7	3	2.33	31.55	5.58
	1327	8	4	2.00	31.56	5.59
	1328	9	5	1.80	31.38	5.41
	1329	10	6	1.67	30.98	5.01
	1330	11	7	1.57	30.92	4.95
	1332	13	9	1.44	30.42	4.45
	1336	17	13	1.31	29.82	3.85
	1337	18	14	1.29	29.71	3.74
	1341	22	18	1.22	29.27	3.30
	1349	30	26	1.15	28.53	2.56
	1400	41	37	1.11	28.20	2.23
	1406	47	43	1.09	28.02	2.05
	1411	Pump On				
	1413	Sample Taken	T = 21.0 COND = 7800		pH = 7.20	

TABLE 16 PUMPING AND RECOVERY DATA FOR WELL 15.

DATE	TIME	TIME SINCE PUMPING STARTED (t, IN MIN.)	TIME SINCE PUMPING STOPPED (t', IN MIN.)	(t/t')	WATER LEVEL (FT-MP)	DRAWDOWN (FT)
6/11/81	1448	--	--		19.96	
			Total Depth - 37.6 FT-MP			
	1520	0	Pump On			
	1523	3			24.9[F]	4.99
	1525	5			26.53	6.57
	1528	8	Temp = 24.1°C	Cond = 8560	µmhos/cm @ 25°C	
	1530	10			26.71	6.75
	1533	13			26.49	6.53
			Discharge = 0.3 GPM			
	1536	16			26.62	6.66
			T = 25.1	Cond = 8880	pH = 7.05	
	1538	18	0	Pump Off		
	1541	21	3	7.00	24.78	4.82
	1543	23	5	4.60	23.24	3.82
	1545	25	7	3.57	22.89	2.93
	1548	28	10	2.80	20.91	0.95
	1550	30	12	2.50	20.70	0.74
	1552	32	14	2.29	20.57	0.61
	1555	35	17	2.06	20.33	0.37
	1600	40	22	1.82	20.21	0.25

TABLE 17 CASING-FILLING DATA FOR WELL 17

DATE	TIME	TIME SINCE BAILING STARTED (MIN)	WATER LEVEL (FT-MP)	DRAWDOWN (s, FT)	RATE FILLED (Q, GPM)	s/Q (FT/GPM)
6/11/81	1705		75.65			
	1708	0	STARTED BAILING			
	1710		TEMP = 20.0°C COND = 5600 µmhos/cm @ 25°C pH = 6.93			
	1716	8	STOPPED BAILING 2 GAL.			
	1722	14	77.51	1.86	--	--
	1724	16	77.47	1.82	0.013	140
	1730	22	77.41	1.76	.0065	271
	1736	28	77.35	1.70	.0065	262
	1740	32	77.32	1.67	.0049	341

TABLE 18 SUMMARY OF AQUIFER PROPERTIES

WELL NO. @	AQUIFER THICKNESS *	SEMI-LOG T	SEMI-LOG K	SEMI-LOG S	LOG-LOG T	LOG-LOG K	LOG-LOG S	RECOVERY T	RECOVERY K
1A	10	--	--	--	--	--	--	250	3.3
2A	10	660	8.8	--	--	--	--	1200	16
3A	7	62	1.2	--	--	--	--	6.3	0.12
4A	8	--	--	--	--	--	--	39	0.65
5	20	280	1.9	$4.0X10^{-5}$	--	--	--	260	1.7
6	20	310	2.1	$4.0X10^{-5}$	300	2.0	$4.1X10^{-5}$	210	1.4
7	40	330	1.1	$2.0X10^{-5}$	320	1.1	$2.1X10^{-5}$	200	0.67
8	40	--	--	--	--	--	--	250	0.84
9	21	190	1.2	$3.8X10^{-5}$	190	1.2	$3.9X10^{-5}$	200	1.3
10	17	--	--	--	--	--	--	160	1.3
12	22	310	1.9	$1.3X10^{-5}$	310	1.9	$1.1X10^{-5}$	210	1.3
14	21	--	--	--	--	--	--	380	2.4
15	17	--	--	--	--	--	--	21	0.17
17	5	--	--	--	--	--	--	0.4	0.01

NOTE: Aquifer Thickness In Ft.,

T = Transmissivity In Gal/Day/Ft.,

K = Permeability = Ft/Day,

and S = Storage Coefficient

@ All of these wells are completed in the first Tres Hermanos aquifer.

* Aquifer thickness was assumed to be equal to the saturated portion of the perforated interval.

TABLE 19 FIELD DATA FOR THE FIRST TRES HERMANOS WELLS.

WELL NO.	DATE	TIME	TEMPERATURE (°C)	CONDUCTIVITY (µmhos/cm @ 25°C)	pH	WATER LEVEL (FT-MP)
1A	6/17/81	--	19.5	5330	7.52	93.64
		Sample Bailed and Filtered				
2A	6/09/81	1315				46.12
		1340	Pump On			
		1342	Q = 5.9 GPM			
		1344	17.9	16700	--	--
		1346	17.1	17400	Q = 5.4	57.35
		1402	--	--		61.07
		1420	17.7	16800	--	62.41
		1428	Q = 5.6			
		1432	17.1	17200	Q = 5.6	
		1447	Pump Off			
2A	6/10/81	0645	Pump On @ 3 GPM			46.18
		1112	18.0	17200	6.64	
3A	6/10/81	1340	--	--	--	22.89
		1401	Pump On Q = 0.84 GPM			
		1425	26.5	43300	7.42	Pump Off
	6/11/81	0934	18.5	37000	7.64	
				(Sample Pumped and Filtered)		
4A	6/11/81	1319	Pump On Q=4 GPM			25.97
		1323	Pumped Dry			
			22.5	7800	--	--
		1413	21.0	7800	7.20	
				(Sample Pumped and Filtered)		
5	6/15/81	1330				40.50
		1332	Started Bailing			
		1339	Stopped Bailing (11 Gallons, Sample Taken and Filtered)			
			14.8	6930	7.51	

TABLE 19 FIELD DATA FOR THE FIRST TRES HERMANOS WELLS. (CONT'D)

WELL NO.	DATE	TIME	TEMPERATURE (°C)	CONDUCTIVITY (μmhos/cm @°25 C)	pH	WATER LEVEL (FT-MP)
5	6/15/81	1342				48.00
		1351				45.55
		1355				44.19
		1359				43.60
		1402				42.98
		1405				41.96
		1419				41.43
		1425				41.15
		1432				40.97
6	6/15/81	1441				53.06
		1444	Started Bailing			
		1453	Stopped Bailing (10.5 Gallons, Sample Taken and Filtered)			
			15.6	5220	7.79	--
		1455				60.03
		1458				59.29
		1500				58.43
		1506				57.59
		1512				56.69
		1518				56.02
		1524				55.54
		1528				54.79
		1531				55.08
		1537				54.69
		1539				54.64
8	6/17/81		18.5 After Pumping 10 MIN.	18500	7.10	
9	6/12/81	1035	Start of Bailing, Pulled Water From 20 FT. Above Bottom			
		1059	Stopped Bailing (11 Gallons, Sample Taken and Filtered)			
			19.7	3860	7.83	-
		1103				157.69
		1110				156.76
		1114				156.14
		1120				155.43

TABLE 19 FIELD DATA FOR THE FIRST TRES HERMANOS WELLS. (CONT'D)

WELL NO.	DATE	TIME	TEMPERATURE (°C)	CONDUCTIVITY (µmhos/cm @ 25°C)	pH	WATER LEVEL (FT-MP)
10	6/17/81		22.0	12300	7.25	104.6
12	6/15/81	1050				80.44
		1052	Started Bailing			
		1101	Stopped Bailing (11 Gallons, Sample Taken and Filtered)			
		1102	15.1	2800	7.28	
		1104				81.59
		1107				81.06
		1112				81.04
		1115				80.96
		1119				80.93
		1126				80.84
		1135				80.75
		1141				80.74
		1150				80.65
		1154				80.65
14	6/15/81	915				26.30
		943	Started Bailing			
		948	Stopped Bailing (11 Gallons, Sample Taken and Filtered)			
		950				34.95
		952	13.8	4060	7.83	--
		958				33.27
		1000				32.87
		1004				32.18
		1009				31.66
		1013				31.02
		1017				30.39
		1023				29.72
		1031				29.03
		1034				28.09

TABLE 19 FIELD DATA FOR THE FIRST TRES HERMANOS WELLS, (CONT'D)

WELL NO.	DATE	TIME	TEMPERATURE (°C)	CONDUCTIVITY (µmhos/cm @ 25°C)	pH	WATER LEVEL (FT-MP)
15	6/11/81	1448				19.96
		1520	Pump On	Q= 0.3 GPM		
		1528	24.1	8560	--	--
		1536	25.1	8880	7.05	26.62
		1538	Pump Off			
	6/18/81	1100	15.2	9070	7.11	20.15
			Sample Bailed and Filtered			
17	6/11/81	1705				75.65
		1708	Started Bailing			
		1710	20.0	5600	6.93	
		1716	Stopped Bailing (2 Gallons)			
		1722				77.51
		1724				77.47
		1730				77.41
		1736				77.35
		1740				77.32
	6/17/81	1410				75.78
		1415	Started Bailing			
		1418	Stopped Bailing (5 Gallons, Sample Taken and Filtered)			
			18.1	5960	7.05	--

TABLE 20 FIELD DATA FOR THE ALLUVIAL WELLS.

WELL NO.	DATE	TIME	TEMPERATURE (°C)	CONDUCTIVITY (μmhos/cm @ 25°C)	WATER LEVEL (FT-MP)
1B	6/12/81	940	13.5	2020	--
			Not Sufficient Water To Bail		
2B	6/12/81	934	14.8	2220	--
			Not Sufficient Water To Bail		
3B	6/12/81	740			16.11
		750	Started Bailing		
			14.9	34,000 @ 5 gal.	
			13.9	34,100 @ 7 gal.	
			pH = 7.94		
		802	Stopped Bailing - Sample Filtered and Preserved		
		814			19.46
		835			19.42
4B	6/12/81	910	14.8	1160	16.59
			pH = 7.49		
			Not Sufficient Water To Bail		
18	6/12/81	857	15.0	7760	7.76
			pH = 7.63		
			Not Sufficient Water To Bail		
20	6/29/81	-	18.1	2980	12.44
			pH = 7.08		

TABLE 2? CHEMICAL ANALYSIS OF WATER FROM MONITOR WELLS AT L-BAR SITE

DATE	LAB	Ca	Mg	Na	K	Fe	Cl	SO_4	HCO_3	CO_3	F	NO_3	Hard-ness	pH	Conduc-tivity	TDS Cal.	TDS Meas.	Cation Anion Ratio	Ag	As	Ba	Be
WELL MW-1A (FIRST TRES HERMANOS SANDSTONE AQUIFER)																						
4/09/76	3	28.1	7.77	1000	8.2	.02	76.5	1670	431	*.1	--	--	111	8.2	3780	3908	3922	1.04	*.001	*.01	.33	--
7/07/76	3	36	12	1000	11	.65	41	1440	854	0	--	--	--	7.75	3500	2967	2988	1.03	*.05	*.1	*.01	--
10/06/76	3	360	18	24	10.5	1.1	71	2410	--	--	--	--	--	8,7	4000	--	3290	--	*.05	*.01	--	--
1/20/77	3	36	12	1000	11	.65	41	1440	854	--	--	.02	--	7.75	3500	2968	2988	1.03	*.05	*.1	*.01	--
4/12/77	3	33	11	960	17	.27	77	1540	1160	--	2.66	--	118	7.40	2080	3218	2980	.84	*.05	*.025	*.01	--
7/13/77	1,2	26	11	780	18	.29	57	1450	911	*.1	--	--	560	8.05	3500	2795	17666	.78	*.05	*.01	--	--
10/19/77	1,2	17	8.4	880	7	.08	46.6	690	--	--	1.22	--	100	7.81	3300	--	17880	--	*.01	*.05	*1.0	--
4/06/78	1,2	18	--	--	--	--	103	312	595	19	1.70	6	60	8.7	1000	--	3004	--	--	*.029	.022	--
7/12/78	6	--	--	965	12	.02	57	1785	--	--	1.18	--	106	8.09	2000	--	3260	--	--	--	--	--
10/23/78	1	15	8	105	5	.03	--	--	--	--	--	--	--	--	--	--	--	--	.011	.068	--	--
2/21/79	6	--	--	--	--	.09	100	2440	--	--	--	--	--	7.65	--	--	6840	--	--	--	--	--
3rd Q 79	5	148	14.8	2325	25.5	.52	1180	2730	602	0	.58	206	--	7.56	7760	6728	6787	1.10	--	--	.0	--
3/25/80	4	89	57	2500	15	1.5	1200	2800	530	0	1.3	.44	--	7.4	9600	6926	--	1.17	--	--	.2	--
6/03/80	4	88	43	1900	16	.78	1200	2700	--	0	1.2	.35	--	8.2	9000	--	7500	--	--	--	*.1	--
6/03/80	6	117	118	2920	14	*.1	1440	3770	816	0	--	--	--	7.5	11000	8787	9158	1.08	--	--	--	--
6/03/80	1	96	69	2600	15	.52	1400	3200	800	24	--	--	--	--	10000	7804	9300	1.03	--	--	--	--
6/03/80	1	110	63	2600	13	.38	1400	3200	--	--	--	--	--	--	11000	--	9000	--	--	--	--	--
8/19/80	6	105	69.3	3000	14	--	1450	4020	824	0	--	--	--	7.6	11000	9070	9232	1.03	--	--	--	--
10/10/80	6	78.4	67.1	2600	14	*.1	1200	3610	732	0	--	--	--	7.54	9240	7935	8056	1.02	--	--	*.1	--
11/25/80	6	56	36	2000	11.4	--	756	2400	761	0	--	--	--	7.69	7000	5640	5700	1.11	--	--	--	--
1/21/81	6	38	13.5	1250	6.3	.100	290	2170	683	0	--	--	--	8.28	5000	4109	3690	.89	--	--	--	--
2/ /81	6	36	13	1240	10	*.001	259	1760	632	0	.78	--	--	8.28	4700	3634	3700	1.05	--	--	--	--
3/31/81	6	32	17.3	1200	10	*.001	266	1760	634	0	.54	--	--	8.0	4700	3602	3750	1.02	--	--	--	--
4/29/81	6	46	11	1280	5.83	*.001	271	1950	622	0	.55	--	--	7.9	4700	3875	4060	1.01	--	--	.01	--
5/29/81	6	40	16.8	1330	8	--	299	2040	625	0	--	--	--	7.33	5400	4046	4120	1.01	--	--		--
6/17/81	6	37	24.5	1270	4.3	--	278	1920	683	0	--	--	--	7.39	5400	4620	4120	1.01	--	--	--	--

TABLE 21 CHEMICAL ANALYSIS OF WATER FROM . .ITOR WELLS AT L-BAR SITE (CONT.)

DATE	LAB	Ca	Mg	Na	K	Fe	Cl	SO_4	HCO_3	CO_3	F	NO_3	Hard-ness	pH	Conduc-tivity	TDS Cal.	TDS Meas.	Cation Anion Ratio	Ag	As	Ba	Be
WELL MW-1B (ALLUVIAL AQUIFER)																						
3/31/78	1,2	206	--	--	--	--	35	172	--	--	.14	5300	--	--	--	--	776	--	--	.010	.10	--
WELL MW-2A (FIRST TRES HERMANOS SANDSTONE AQUIFER)																						
7/07/76	3	115	39	1240	15	.850	84	2370	854	--	--	--	454	7.25	4500	4290	4250	.96	*.05	*1.0	*.01	--
7/13/76	3	119	34.6	1240	10.9	.014	93.3	2150	--	--	.38	--	--	--	--	--	--	--	*.01	--	*.10	.8
10/06/76	3	106	90	25	10.7	.25	71	3110	--	--	--	--	--	7.85	5000	--	4640	--	*.05	*.01	--	--
1/20/77	3	115	39	1240	15	.85	84	2370	854	--	--	.02	--	7.25	4500	4290	4251	.96	*.05	*.10	*.10	--
4/12/77	3	100	39	1210	27	.72	85	2290	1220	--	1.10	--	392	7.43	4200	4363	4260	.88	*.05	*.025	--	--
7/13/77	1,2	86	38	990	15	.21	72	2350	877	*.1	--	--	1720	7.25	6000	3989	18800	.78	*.05	*.01	--	--
10/19/77	1,2	--	--	1200	--	--	65.2	180	--	--	.18	--	386	7.00	5000	--	19180	--	--	--	--	--
4/06/78	1,2	71	--	--	--	--	1005	6020	490	15	--	650	3364	7.53	13000	--	13872	--	--	.12	.028	--
7/19/78	1,2	--	--	3780	--	--	--	7570	--	--	--	--	--	--	--	--	--	--	--	--	--	--
8/07/78	1,2	--	--	3680	--	--	--	4200	--	--	--	--	--	--	--	--	--	--	--	--	--	--
8/15/78	1,2	--	--	3480	--	--	--	7800	--	--	--	--	--	--	--	--	--	--	--	--	--	--
10/17/78	1	200	210	108	40	.054	--	--	--	--	--	--	--	--	--	--	--	--	.006	.032	--	--
3rd Q 79	5	411	387	2440	33.5	4.6	1335	3170	761	0	.30	23.3	--	6.78	9190	8157	7527	1.37	--	--	0.0	--
3/24/80	4	440	460	2200	31	1.7	1700	3300	1200	0	.55	2.4	--	7.1	18000	8731	--	1.15	--	--	1.4	--
6/03/80	4	570	620	2300	41	6.1	2100	4700	--	0	.43	.32	--	7.8	21000	--	14000	--	--	--	.22	--
6/03/80	1	120	500	3000	38	.74	2400	5000	960	0	--	--	--	--	20000	11538	12000	.95	--	--	--	--
6/30/80	1	590	640	3400	33	.72	2500	4900	--	--	--	--	--	--	20000	--	16000	--	--	--	--	--
6/03/80	6	544	790	3000	27.9	2.0	2400	5790	930	0	--	--	--	6.63	15000	13017	13150	1.10	--	--	--	--
8/19/80	6	525	735	3440	41	--	2270	5650	917	0	--	--	--	7.30	16000	13120	15400	1.21	--	--	--	--
10/10/80	6	508	759	3320	38.8	*.1	2260	5270	1000	--	--	--	--	7.2	17600	12655	15925	1.23	--	--	*.1	--
2/ /81	6	568	638	3100	45	*.001	2000	5970	2070	0.0	.15	--	--	7.23	17000	13356	15210	1.01	--	--	--	--
3/31/81	6	500	624	3000	45	.2	2270	5070	2060	0	.56	--	--	6.84	14000	12539	13920	1.02	--	--	--	--
4/29/81	6	480	684	2600	12.5	.01	2050	5480	1120	0	.56	--	---	--	15000	11867	14780	1.02	--	--	.02	--
5/29/81	6	540	792	2550	50.0	--	2160	5900	1010	0	--	--	--	6.90	17000	12497	--	1.02	--	--	*.1	--
6/10/81	6	544	694	2500	51.5	--	2200	5490	1110	0	--	--	--	6.54	15000	12590	15740	1.00	--	--	--	--

TABLE 21 CHEMICAL ANALYSIS OF WATER FROM MONITOR WELLS AT L-BAR SITE (CONT.)

DATE	LAB	Ca	Mg	Na	K	Fe	Cl	SO_4	HCO_3	CO_3	F	NO_3	Hard-ness	pH	Conduc-tivity	TDS Cal.	TDS Meas.	Cation Anion Ratio	Ag	As	Ba	Be
WELL MW-2B (ALLUVIAL AQUIFER)																						
4/06/78	1,2	178	--	--	--	--	14	98	325	28	.20	20	516	8.50	1000	--	724	--	--	.007	.064	--
WELL MW-3A (FIRST TRES HERMANOS SANDSTONE AQUIFER)																						
3/31/78	1,2	91	--	--	--	--	6	103	174	--	.32	18	22	8.25	700	--	400	--	--	*.005	.12	--
8/19/80	6	640	3230	12800	8.7	--	1510	38700	393	0	--	--	--	8.00	34000	56085	58500	1.00	--	--	--	--
10/10/80	6	648	3320	12200	6.9	.25	1380	38200	378	--	--	--	--	7.6	39600	55944	58330	1.00	--	--	*.1	--
2/ /81	6	408	2920	11500	20.0	.20	1270	35100	426	7.2	1.15	--	--	8.42	36000	48808	50890	.98	--	--	--	--
3/31/81	6	380	2890	11500	6.0	.6	1380	35100	440	0	1.25	--	--	7.79	34000	51476	52920	.97	--	--	--	--
4/29/81	6	380	2680	10600	6.3	.16	1270	32100	403	0	1.2	--	--	8.0	34000	47238	45920	.99	--	--	.02	--
5/29/81	6	414	3050	12000	4.0	--	1440	36300	440	0	--	--	--	7.60	40000	53428	56600	.99	--	--	*.1	--
6/11/81	6	388	3030	12800	4.0	--	1480	37200	572	0	--	--	--	7.65	42000	55520	54460	1.00	--	--	--	--
WELL MW-3B (ALLUVIAL AQUIFER)																						
4/06/78	1,2	75	--	--	--	--	5	184	180	--	.24	10	21	8.30	500	--	348	--	--	*.005	.082	--
7/17/78	6	--	--	26	11.7	.02	29	1160	--	--	.29	--	266	7.63	2000	--	--	--	--	--	--	--
10/10/80	6	416	2230	8080	10.9	.17	1110	24900	305	--	--	--	--	7.84	27500	36899	37200	1.00	--	--	*.1	--
2/ /81	6	368	2060	9000	30	.20	1090	26000	332	0	1.30	--	--	7.80	30000	38714	37730	1.00	--	--	--	--
4/29/81	6	380	2170	9500	11.3	.22	1210	27900	334	0	1.10	--	--	7.80	32000	41338	42840	.99	--	--	.02	--
5/29/81	6	388	2190	9250	7.70	--	1240	27300	398	0	--	--	--	7.71	33000	40575	43100	.99	--	--	*.1	--
6/12/81	6	392	2090	9750	5.0	--	1130	27600	370	0	--	--	--	7.80	35000	41380	40460	1.01	--	--	--	--
WELL MW-4A (FIRST TRES HERMANOS SANDSTONE AQUIFER)																						
3/31/78	1,2	123	--	--	--	--	10	92	283	6	.29	*10	31	8.23	500	--	444	--	--	*.005	.11	--
7/17/78	6	410	293	824	20.8	.06	100	9460	--	--	.28	--	2780	7.70	4000	--	5740	--	--	--	--	--
10/17/78	1	175	163	105	23	.066	--	--	--	--	--	--	--	--	--	--	--	--	.006	.067	--	--
2/21/79	6	--	--	--	--	--	158	70	--	--	--	--	--	7.98	--	--	3140	--	--	--	--	--
3rd Q 79	5	398	459	1080	19.5	12.02	95.8	4400	281	0	.18	1.9	--	7.15	6330	6587	6634	1.06	--	--	.8	--
3/24/80	4	480	420	1000	17	6.5	110	4400	290	0	.24	2.7	--	7.1	6400	6572	--	1.03	--	--	.8	--
6/03/80	4	460	410	800	15	4.0	97	4600	--	0	.22	4.6	--	7.8	6200	--	6600	--	--	--	.26	--
6/03/80	1	100	370	830	15	15	100	4200	270	27	--	--	--	--	7200	5777	6900	.75	--	--	--	--

TABLE 21 CHEMICAL ANALYSIS OF WATER FROM MONITOR WELLS AT L-BAR SITE (CONT.)

DATE	LAB	Ca	Mg	Na	K	Fe	Cl	SO_4	HCO_3	CO_3	F	NO_3	Hard-ness	pH	Conduc-tivity	TDS Cal.	TDS Meas.	Cation Anion Ratio	Ag	As	Ba	Be
WELL MW-4A (FIRST TRES HERMANOS SANDSTONE AQUIFER (CONT.))																						
6/03/80	1	490	34	850	14	.52	100	4400	--	--	--	--	--	--	7000	--	7100	.87	--	--	--	--
6/03/80	6	422	436	1600	14.9	2.0	103	4900	330	0	--	--	--	7.61	8700	7639	7670	1.15	--	--	--	--
8/19/80	6	450	405	980	16	--	133	4400	342	0	--	--	--	7.70	7600	6555	6726	.98	--	--	--	--
10/10/80	6	436	416	950	16	*.10	131	4280	397	--	--	--	--	7.34	7600	6428	6800	.99	--	--	*.1	--
2/ /81	6	440	398	1100	16.5	*.001	114	4340	451	0	.15	--	--	7.38	5800	6628	6670	1.02	--	--	--	--
3/31/81	6	430	366	1030	15	.10	104	4240	470	0	.16	--	--	--	5600	6423	6270	.98	--	--	--	--
4/29/81	6	420	410	1000	16.7	*.001	125	4290	460	0	.14	--	--	7.20	6000	6492	7110	.98	--	--	*.01	--
5/29/81	6	440	437	1080	25.0	--	138	4540	473	0	--	--	--	7.10	8600	6897	7090	1.00	--	--	*.10	--
6/11/81	6	440	408	1000	21.5	--	138	4300	469	0	--	--	--	7.55	6700	6770	6780	1.06	--	--	--	--
WELL MW-4B (ALLUVIAL AQUIFER)																						
2/28/79	1,2	34	--	--	--	--	57	7	327	19	.92	*10	14	8.50	2000	--	1220	--	--	.009	.032	--
WELL MW-5 (FIRST TRES HERMANOS SANDSTONE AQUIFER)																						
10/17/78	1	60	62	105	20	.08	--	--	--	--	--	--	--	--	--	--	--	--	.008	.068	--	--
3/24/80	4	23	7.7	340	3.3	3.2	23	410	380	0	1.1	.82	--	7.7	1600	997	--	1.08	--	--	*.1	--
6/03/80	4	180	74	400	7.6	54	53	1100	--	--	.83	3.9	--	8.3	2700	-	2000	--	--	--	.26	--
6/03/80	6	172	215	1420	14.7	*.1	272	3050	576	--	--	--	--	7.64	6000	5432	5380	1.10	--	--	--	--
6/03/80	1	130	160	1100	13	.070	240	2900	510	22	--	--	--	--	7100	4820	5500	.89	--	--	--	--
6/03/80	1	200	200	1200	13	.072	240	2900	--	--	--	--	--	--	6600	--	6000	--	--	--	--	--
8/19/80	6	180	214	1380	14	--	272	3370	486	20.4	--	--	--	8.40	6600	5693	5640	1.01	--	--	--	--
10/10/80	6	172	222	1300	14.4	*.1	261	3200	533	0	--	--	--	7.77	6600	5436	5544	1.01	--	--	*.1	--
11/25/80	6	442	348	1860	19.8	--	757	4360	615	0.0	--	--	--	7.66	9400	8094	9210	1.08	--	--	--	--
1/21/81	6	480	550	2000	24.8	.4	970	5860	678	0	--	--	--	8.01	13000	10224	10070	.98	--	--	--	--
2/ /81	6	440	576	1875	32	*.001	900	5360	660	0.0	.22	--	--	7.92	10500	9513	10180	1.03	--	--	--	--
3/31/81	6	432	540	1870	50	.20	871	5310	570	0	.25	--	--	7.30	11000	9408	9700	1.02	--	--	--	--
4/29/81	6	292	314	1630	20	*.001	530	4110	530	0	.19	--	--	7.06	7400	7161	7300	1.02	--	--	*.01	--
6/15/81	6	176	195	1300	18.3	--	327	2990	595	0	--	--	--	7.48	6600	5600	5550	1.01	--	--	--	--

TABLE 21 CHEMICAL ANALYSIS OF WATER FROM MONITOR WELLS AT L-BAR SITE (CONT.)

DATE	LAB	Ca	Mg	Na	K	Fe	Cl	SO_4	HCO_3	CO_3	F	NO_3	Hard-ness	pH	Conduc-tivity	TDS Cal.	TDS Meas.	Cation Anion Ratio	Ag	As	Ba	Be
WELL MW-6 (FIRST TRES HERMANOS SANDSTONE AQUIFER)																						
10/17/78	1	50	22	108	2[illegible]	.045	--	--	--	--	--	--	--	--	--	--	--	--	.012	.056	--	--
2/22/79	1	--	--	--	--	.03	86	60	--	--	--	--	--	8.02	--	--	3570	--	--	--	--	--
3/24/80	4	14	2.9	330	2.6	1.4	18	390	360	0	1.1	.89	--	7.7	1400	936	--	1.06	--	--	*.1	--
6/03/80	4	24	310	440	13	49	47	800	--	--	1.2	9.7	--	8.4	2300	--	1700	--	--	--	1.9	--
6/03/80	1	130	160	1300	14	8.6	190	2700	160	22	--	--	--	--	7000	4596	5100	1.18	--	--	--	--
6/03/80	1	200	55	1400	14	.075	190	2900	--	--	--	--	--	--	6500	--	2800	--	--	--	--	--
6/03/80	6	123	75	1660	16.4	2.0	212	2940	470	0	--	--	--	7.67	5800	5261	5300	1.23	--	--	--	--
8/19/80	6	127	61.5	1420	13.3	--	188	2810	501	24	--	--	--	8.35	5500	4894	4720	1.01	--	--	--	--
10/10/80	6	63.2	34.5	1280	9.4	*.1	115	2310	512	--	--	--	--	7.72	6600	4068	4035	1.04	--	--	*.1	--
11/25/80	6	74.0	34.0	1320	10.6	--	121	2550	265	1.00	--	--	--	8.06	4800	4243	3580	1.05	--	--	--	--
1/21/81	6	64.0	47.0	1300	8	*.001	120	2680	549	0	--	--	--	8.23	5000	4495	4020	.94	--	--	--	--
2/ /81	6	33.6	44.0	1200	9	*.001	99	2320	520	0.0	.88	--	--	7.91	4800	3966	3810	.97	--	--	--	--
3/31/81	6	48	28.8	1225	7.5	*.001	99.2	2170	537	0	.86	--	--	7.80	4700	3847	3830	1.02	--	--	--	--
4/29/81	6	54	24.5	1240	10	*.01	113	2350	493	0.0	.55	--	--	7.80	4400	4038	3930	.98	--	--	*.01	--
4/29/81	6	48	26	1200	10	*.001	100	2240	500	0	.84	--	--	7.80	4200	3874	3710	.99	--	--	.01	--
5/29/81	6	54	31.7	1170	10.3	--	114	2120	525	0	--	--	--	7.80	5200	3763	4060	1.01	--	--	.01	--
6/15/81	6	52	30.2	1230	11.3	--	110	2280	577	0	--	--	--	7.7	5000	4220	3990	.98	--	--	--	--
WELL MW-7 (FIRST TRES HERMANOS SANDSTONE AQUIFER)																						
10/25/78	1	20	8	107	5	.04	--	--	--	--	--	--	--	--	--	--	--	--	.008	.041	--	--
3rd Q 79	5	17.5	2.6	357	20	1.66	31.5	504	460	0	.51	.88	--	7.56	2030	1163	1426	.91	--	--	0.0	--
3/24/80	4	17	3.1	310	2.9	1.4	20	390	380	0	1.1	.71	--	7.6	1500	933	--	.98	--	--	*.1	--
6/03/80	4	29	4.6	360	3.7	1.2	37	670	--	--	1.2	.63	--	7.7	1400	934	1500	--	--	--	*.1	--
6/03/80	1	19	11	870	5.2	.091	81	1700	480	24	--	--	--	--	5000	2950	3200	.86	--	--	--	--
6/03/80	1	30	9.8	550	5.4	.066	83	1800	--	--	--	--	--	--	4600	--	3100	--	--	--	--	--
6/03/80	6	17.2	11	1300	7.4	2.0	84.7	2100	521	0	--	--	--	7.95	4300	3783	3520	1.07	--	--	--	--
8/19/80	6	28	10.9	1150	6.0	--	84	2040	510	9.6	--	--	--	8.40	4300	3584	3450	.[illegible]	--	--	--	--
10/10/80	6	25.6	11.2	1040	5	*.1	86.2	1810	526	--	--	--	--	8.00	5500	3241	3360	.98	--	--	*.1	--

TABLE 21 CHEMICAL ANALYSIS OF WATER FROM MONITOR WELLS AT L-BAR SITE (CONT.)

DATE	LAB	Ca	Mg	Na	K	Fe	Cl	SO_4	HCO_3	CO_3	F	NO_3	Hard-ness	pH	Conduc-tivity	TDS Cal.	TDS Meas.	Cation Anion Ratio	Ag	As	Ba	Be
								WELL MW-7 (FIRST TRES HERMANOS SANDSTONE AQUIFER (CONT.))														
11/25/80	6	30	12	1220	5.6	--	88	1760	520	7	--	--	--	8.12	4000	3383	2280	1.17	--	--	--	--
1/21/81	6	24	18	1110	5.7	*.001	97	2180	570	0	--	--	--	8.27	4300	3718	3210	.89	--	--	--	--
2/ /81	6	22.4	30	1140	4	*.001	94	2060	540	0.0	.39	--	--	8.07	4400	3620	3460	.98	--	--	--	--
3/31/81	6	24.8	12	1120	5	*.001	90	1910	553	0	.30	--	--	7.82	3800	3438	3140	.99	--	--	--	--
4/29/81	6	29	13	1100	5.8	*.001	98	1870	532	0	.55	--	--	8.00	3700	3382	3240	1.00	--	--	*.01	--
5/29/81	6	24	13.9	935	5.7	--	83.3	1530	542	0	--	--	--	7.85	4200	2863	3250	1.00	--	--	*.1	--
6/15/81	6	48	19.2	1130	7.83	--	96.8	1880	656	0	--	--	--	7.8	4200	3850	3380	1.01	--	--	--	--
								WELL MW-8 (FIRST TRES HERMANOS SANDSTONE AQUIFER)														
10/25/78	1	10	5	107	6.5	.035	--	--	--	--	--	--	--	--	--	--	--	--	.0067	.068	--	--
2/21/79	1	--	--	--	--	.05	272	80	--	--	--	--	--	8.18	--	--	3060	--	--	--	--	--
3rd Q 79	5	8.8	3.5	358	9	.22	21.9	347	440	0	.54	--	--	8.23	1570	969	1150	1.10	--	--	0.0	--
3/24/80	4	23	2.9	330	2.8	1.9	22	360	380	0	1.2	--	--	7.7	1400	931	--	1.10	--	--	*.1	--
6/03/80	4	26	3.2	350	3.5	.08	41	510	--	--	1.3	--	--	7.14	--	--	1300	--	--	--	*.1	--
6/03/80	1	82	86	230	18	.37	1000	4100	940	0	--	--	--	--	15000	5986	11000	.17	--	--	--	--
6/03/80	1	250	81	2800	16	.20	1100	4400	--	--	--	--	--	--	15000	--	11000	--	--	--	--	--
6/03/80	6	235	111	3220	17.8	1.0	1190	4760	866	0	--	--	--	7.14	12000	9967	11000	1.10	--	--	--	--
8/19/80	6	300	119	3700	21.5	--	1090	4100	878	0	--	--	--	7.20	14000	9770	12700	1.43	--	--	--	--
8/19/80	4	860	210	3100	16	1.8	860	4000	770	0	.41	4.5	--	7.5	22000	9768	12000	1.63	--	--	--	--
10/10/80	6	340	148	3460	18.6	.1	972	4230	998	--	--	--	--	7.02	16500	9668	13020	1.37	--	--	*.1	--
11/21/80	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11/25/80	6	424	330	4050	19.4	--	914	4620	993	0	--	--	--	7.04	16000	10854	15100	1.63	--	--	--	--
1/21/81	6	35	30	1040	6.5	*.001	177	1710	734	0	--	--	--	7.76	4500	3366	3260	.95	--	--	--	--
2/ /81	6	112	125	2000	12	*.001	510	3410	800	0.0	.52	--	--	7.93	8500	6569	8250	1.05	--	--	--	--
2/ /81	1	110	78	1900	13	.15	460	2900	--	--	.91	--	--	--	--	--	--	--	--	*.006	.2	--
3/31/81	6	37.3	44.8	1030	5.8	*.001	133	1710	734	0	.30	--	--	7.12	3800	3328	2930	.98	--	--	--	--
4/29/81	6	36	17.8	880	5.8	*.001	117	1320	678	0	.26	--	--	7.20	3400	3060	2916	1.00	--	--	*.01	--
5/29/81	6	440	257	4000	32.5	--	852	8310	992	0	--	--	--	7.42	16500	14388	15000	1.02	--	--	.10	--
6/18/81	6	112	77	1330	14.3	--	302	2240	881	0	--	--	--	7.74	7000	4950	5820	1.01	--	--	--	--

TABLE 21 CHEMICAL ANALYSIS OF WATER FROM MONITOR WELLS AT L-BAR SITE (CONT.)

DATE	LAB	Ca	Mg	Na	K	Fe	Cl	SO_4	HCO_3	CO_3	F	NO_3	Hard-ness	pH	Conduc-tivity	TDS Cal.	TDS Meas.	Cation Anion Ratio	Ag	As	Ba	Be
WELL MW-9 (FIRST TRES HERMANOS SANDSTONE AQUIFER)																						
10/10/80	6	30	9.2	890	8.3	*.1	82.5	1430	547	--	--	--	--	8.19	4510	2724	2862	1.00	--	--	*.1	--
11/25/80	6	34	10	875	6.4	--	82	1180	537	7	--	--	--	8.26	3400	2463	2680	1.14	--	--	--	--
1/21/81	6	27	12	900	7	*.001	91	1720	545	12	--	--	--	8.52	3700	3042	2700	.87	--	--	--	--
2/ /81	6	28.8	9.6	820	6	*.001	85	1510	540	1.2	1.05	--	--	8.31	3700	2831	2740	.99	--	--	--	--
2/ /81	1	20	4.3	900	5.2	.14	79	1700	--	--	1.6	--	--	--	--	--	--	--	--	*.006	*.1	--
3/31/81	6	28.8	9.6	900	2.0	*.001	77	1430	581	0	1.0	--	--	--	3400	2738	2600	1.00	--	--	--	--
4/29/81	6	30	8	940	7.5	*.001	91	1500	532	14.4	1.0	--	--	[illegible]	3300	2857	2790	1.01	--	--	*.01	--
5/29/81	6	28	7.7	920	9.0	--	87.1	1490	571	0	--	--	--	7.89	[illegible]	2828	2720	.99	--	--	*.1	--
5/29/81	6	30.4	8.2	860	8.5	--	88	1350	570	0	--	--	--	7.96	3700	2628	2750	1.00	--	--	--	--
6/12/81	6	25.6	8.64	950	2.0	--	88.3	1520	581	0	--	--	--	7.87	3800	3180	2860	.99	--	--	--	--
WELL MW-10 (FIRST TRES HERMANOS SANDSTONE AQUIFER)																						
10/10/80	6	40.8	17.9	1540	9.6	*.1	615	2070	431	--	--	--	--	8.30	5720	4509	4788	1.05	--	--	*.1	--
11/21/80	1	56	24	1300	9.8	2.5	650	2600	390	0	1.8	.89	--	8.1	7900	4835	5000	.78	--	*.02	*.1	--
11/25/80	1	59	18	1620	11.6	--	673	2160	464	7.0	--	--	--	8.2	6200	4774	3490	1.05	--	--	--	--
1/21/81	1	74	48	1830	11	*.001	800	2950	564	0	--	--	--	7.97	7000	5995	5990	.94	--	--	--	--
2/ /81	1	120	38	2420	12	*.001	930	3780	590	7.2	.78	--	--	--	8400	7602	7560	1.00	--	--	--	--
3/31/81	6	88	38.4	2130	10.8	*.001	653	3380	765	0	.58	--	--	7.4	8200	6683	6370	.99	--	--	--	--
4/29/81	6	66	26	1630	10.7	*.01	294	2760	708	0	.55	--	--	7.60	5700	5141	5040	.99	--	--	*.01	--
5/29/81	6	200	101	2600	32.5	--	1080	4150	793	0	--	--	--	7.60	12000	8560	10200	1.02	--	--	*.1	--
6/15/81	6	192	91.2	2800	15.0	--	1140	4560	778	0	--	--	--	7.27	13000	9580	10400	1.00	--	--	--	--
WELL MW-11 (SECOND TRES HERMANOS SANDSTONE AQUIFER)																						
11/25/80	6	70	13	540	6.4	--	64	1070	360	0	--	--	--	7.94	2300	1943	1870	.94	--	--	--	--
1/21/81	6	54	34	2040	9.5	*.001	2010	1380	586	20.4	--	--	--	8.47	8200	5820	5870	.99	--	--	--	--
2/ /81	6	66.4	15.8	1680	10	*.001	1560	1180	[illegible]	[illegible]	.82	--	--	8.7	7000	4756	5020	1.02	--	--	--	--
3/31/81	6	56	15.6	1440	8.8	*.001	1230	1070	561	[illegible]	.58	--	--	8.38	5600	4111	4210	1.00	--	--	--	--
5/29/81	6	48	14.4	1000	15.5	--	728	810	593	0	--	--	--	7.76	4500	2912	3210	1.01	--	--	*.1	--
6/18/81	6	45	12.5	975	8.5	--	682	790	603	0	--	--	--	7.82	4300	3120	2990	1.01	--	--	--	--

TABLE 21 CHEMICAL ANALYSIS OF WATER FROM MONITOR WELLS AT L-BAR SITE (CONT.)

DATE	LAB	Ca	Mg	Na	K	Fe	Cl	SO_4	HCO_3	CO_3	F	NO_3	Hard-ness	pH	Conduc-tivity	TDS Cal.	TDS Meas.	Cation Anion Ratio	Ag	As	Ba	Be
WELL MW-12 (FIRST TRES HERMANOS SANDSTONE AQUIFER)																						
10/10/80	6	136	4.5	618	5.2	*.1	53.5	668	752	--	--	--	--	8.28	2640	1861	1760	1.23	--	--	*.1	--
11/25/80	6	22	3.7	650	5.7	--	54	651	730	0	--	--	--	8.30	2400	1751	1710	1.10	--	--	--	--
1/21/81	6	10	20.5	690	4.6	*.001	87	786	766	9.6	--	--	--	8.41	2500	1991	1840	1.02	--	--	--	--
2/ /81	6	13.6	6.2	675	4.5	*.001	57	820	760	0.0	1.10	--	--	8.30	2400	1956	1710	.98	--	--	--	--
3/31/81	6	9.6	2.9	650	4.5	*.001	50.8	700	798	0	1.05	--	--	--	--	--	--	--	--	--	--	--
4/29/81	6	12	4.8	660	6	*.001	57	696	830	0.0	1.03	--	--	8.00	2200	1851	1670	1.01	--	--	*.01	--
5/29/81	6	6.4	4.32	620	11	--	61.4	662	769	0	--	--	--	7.85	2500	1750	1740	.99	--	--	*.1	--
6/15/81	6	10.4	4.3	640	4.8	--	58.1	730	761	0	--	--	--	7.98	2600	2210	1800	.98	--	--	--	--
WELL MW-13 (SECOND TRES HERMANOS SANDSTONE AQUIFER)																						
11/25/80	6	8	.2	500	25.2	--	52	674	296[1/]	135	--	--	--	11.65	2600	1542	1340	.92	--	--	--	--
1/21/81	6	4	1.4	570	17	*.001	17	664	105[1/]	300	--	--	--	11.22	2300	1626	1640	.98	--	--	--	--
2/ /81	6	3.2	1.0	420	21	*.001	21	320	17[1/]	312	1.8	--	--	--	1300	1107	1360	1.06	--	--	--	--
3/31/81	6	2.4	1.0	460	15	*.001	14.5	360	83.64[1/]	226	1.16	--	--	10.74	1900	1121	1340	1.23	--	--	--	--
4/29/81	6	5	1	500	15	*.01	29	466	440	144	1.10	--	--	10.55	1800	1380	1482	1.00	--	--	*.01	--
5/29/81	6	5.6	1.44	620	25.1	--	31.5	553	352	312	--	--	--	10.0	2300	1725	1760	.98	--	--	*.01	--
6/18/81	6	3.2	1.9	680	18.3	--	50.8	580	74.8	384	--	--	--	10.64	1800	1790	1590	1.10	--	--	--	--
WELL MW-14 (FIRST TRES HERMANOS SANDSTONE AQUIFER)																						
10/10/80	6	88.8	25.8	913	8.5	*.1	85.6	1680	578	--	--	--	--	7.91	4180	3091	3134	--	--	*.1	--	
11/25/80	6	75	23	905	7.1	--	91	1710	578	0	--	--	--	7.94	3700	3100	3050	.95	--	--	--	--
1/21/81	6	62	40	933	7	*.001	93	1960	630	0	--	--	--	8.10	4100	3410	3060	.88	--	--	--	--
2/ /81	6	56	32	1040	9	*.001	93	1680	590	84	.89	--	--	8.76	3800	3205	3180	1.08	--	--	--	--
3/31/81	6	51.2	22.1	940	6	*.001	14.5	1610	652	0	.88	--	--	7.88	3600	2970	2870	1.02	--	--	--	--
4/29/81	6	48	21.6	1000	10	*.001	88	1660	593	0	.60	--	--	7.80	3500	3114	3040	1.02	--	--	*.01	--
5/29/81	6	48	23	1030	21.7	--	90.8	1770	627	0	--	--	--	7.60	4000	3297	3050	1.00	--	--	*.1	--
6/15/81	6	42.4		1000	7.5	--	88.3	1730	615	0	--	--	--	7.77	4100	3510	3160	.99	--	--	--	--

TABLE 21 CHEMICAL ANALYSIS OF WATER FROM MONITOR WELLS AT L-BAR SITE (CONT.)

DATE	LAB	Ca	Mg	Na	K	Fe	Cl	SO_4	HCO_3	CO_3	F	NO_3	Hard-ness	pH	Conduc-tivity	TDS Cal.	TDS Meas.	Cation Anion Ratio	Ag	As	Ba	Be
WELL MW-15 (FIRST TRES HERMANOS SANDSTONE AQUIFER)																						
10/10/80	6	436	640	1660	19.5	.10	563	5980	630	--	--	--	--	7.43	9900	9614	9790	.98	--	--	*.1	--
11/25/80	6	430	715	1590	16.8	--	473	5620	603	0	--	--	--	7.50	8400	9146	8740	1.07	--	--	--	--
1/21/81	6	620	620	1550	16.5	.10	460	6140	760	0	--	--	--	7.38	9400	9787	9750	.97	--	--	--	--
2/ /81	6	420	550	1620	18	*.001	420	5350	850	0.0	.17	--	--	7.95	8400	8803	8640	1.00	--	--	--	--
3/31/81	6	352	557	1550	17.5	.2	460	5050	854	0	.18	--	--	--	8400	8414	9090	.99	--	--	--	--
4/29/81	6	400	547	1570	23	*.001	448	5220	795	0	.12	--	--	7.20	8000	8306	8270	.90	--	--	*.01	--
5/29/81	6	448	547	1300	60	--	454	4880	850	0	--	--	--	7.10	9000	8114	8550	.98	--	--	*.01	--
5/29/81	6	412	545	1500	15	--	450	4960	844	0	--	--	--	7.10	8600	8304	8580	1.01	--	--	--	--
6/18/81	6	416	552	1500	21.3	--	430	5130	859	0	--	--	--	7.12	8400	8910	8510	.99	--	--	--	--
WELL MW-17 (FIRST TRES HERMANOS SANDSTONE AQUIFER)																						
10/10/80	6	267	97.7	1300	13.6	*.1	130	2650	826	--	--	--	--	7.65	5610	4671	5244	1.08	--	--	*.1	--
11/25/80	6	692	97	1200	13.5	--	40	3070	803	0	--	--	--	7.81	5400	5514	4830	1.21	--	--	--	--
1/21/81	6	260	150	1250	12.8	*.001	130	3350	860	0	--	--	--	7.81	6000	5583	5190	.92	--	--	--	--
2/ /81	6	240	106	1280	12	*.001	128	2930	860	0	.29	--	--	7.19	5600	5126	4970	.97	--	--	--	--
4/29/81	6	218	109	1450	16.7	*.001	125	3100	864	0	.12	--	--	7.23	5200	5451	5140	1.01	--	--	*.01	--
4/29/81	6	216	105	1420	16.7	*.001	127	3130	738	0	.12	--	--	--	5200	5384	5050	1.01	--	--	*.01	--
5/29/81	6	136	110	1350	37.5	--	127	2830	871	0	--	--	--	7.06	6000	5026	5120	.98	--	--	*.1	--
6/17/81	6	197	114	1433	17	--	131	3120	866	0	--	--	--	7.82	6000	5880	5250	.99	--	--	--	--
WELL MW-18 (ALLUVIAL AQUIFER)																						
4/28/81	6	400	456	2000	8	--	744	4580	1700	0	--	--	--	7.27	9600	9658	8980	1.00	--	--	--	--
WELL MW-20 (ALLUVIAL AQUIFER)																						
4/28/81	6	122	24.5	250	4	.01	30.3	607	340	0	.6	--	--	7.30	1200	1208	1450	1.00	--	--	.02	--

TABLE 21 CHEMICAL ANALYSIS OF WATER FROM MONITOR WELLS AT L-BAR SITE (CONT.)

DATE	LAB	Ca	Mg	Na	K	Fe	Cl	SO_4	HCO_3	CO_3	F	NO_3	Hard-ness	pH	Conduc-tivity	TDS Cal.	TDS Meas.	Cation Anion Ratio	Ag	As	Ba	Be
TOWN OF SEBOYETA																						
4th Q 79	5	24	3.8	73	3.1	*.1	3	30	218	0	.37	.02	--	8.5	350	246	--	1.11	--	--	--	--
1/21/81	6	.25	2.5	100	1.75	1.20	8.47	30.7	263.5	0	--	--	--	7.99	340	275	240	.89	--	--	--	--
2/04/81	1	--	--	--	--	--	--	--	--	--	1.0	*.1	--	--	--	--	--	--	--	--	*.1	--
TOWN OF MOQUINO																						
4th Q 79	5	8.9	6.5	140	1.6	*.1	2.0	26.7	360	0	.66	*.01	--	8.4	630	367	--	1.10	--	--	--	--
1/21/81	6	.35	6.1	148	1.9	1.2	9.68	57.5	370.9	7.2	--	--	--	7.79	580	416	460	.90	--	--	--	--
2/04/81	1	--	--	--	--	--	--	--	--	--	1.4	.71	--	--	--	--	--	--	--	--	*.1	--
TOWN OF BIBO																						
4th Q 79	5	26	3.7	180	2.1	*.1	8.4	107	481	0	.70	.17	--	8.4	750	568	--	.92	--	--	.2	--
7/15/80	4	10	4.6	190	2.7	.06	12	140	290	0	.60	.14	--	7.8	790	504	600	1.15	--	--	*.1	--
1/21/81	6	.75	4.8	164	1.55	.80	16.9	34	361	0	--	--	--	8.07	670	403	530	1.07	--	--	--	--
2/04/81	1	--	--	--	--	--	--	--	--	--	1.4	.25	--	--	--	--	--	--	--	--	*.1	--

NOTES: * Actual value less than reported value
1/ Value reported is in the form, OH^-

Labs - 1 Eberline Lab (EAL), Albuquerque, NM, for radionuclide analyses
2 Wilson Lab, Kansas City, MO, for stable element analyses
3 CEP Lab, Santa Fe, New Mexico
4 LFE Laboratory, California
5 CORE lab, Albuquerque, New Mexico
6 SOHIO Lab, New Mexico

TABLE 21 CHEMICAL ANALYSIS OF WATER FROM MONITOR WELLS AT L-BAR SITE (CONT.)

DATE	LAB	Cd	Cr	Pb	Mn	Hg	Mo	Ni	Se	Sr	V	Zn	Gross-Alpha	Gross-Beta	Gross-Gamma	Pb210	Ra226	Th230	U
WELL MW-1A (FIRST TRES HERMANOS SANDSTONE AQUIFER)																			
4/09/76	3	*.001	*.001	.001	.017	.0015	.002	.04	*.01	--	.01	.01	--	--	--	--	--	--	--
7/07/76	3	*.01	*.04	*.10	.040	*.005	*.030	.08	*.10	--	*1.0	.10	--	--	--	--	--	--	.0170
10/06/76	3	.01	*.04	.40	--	--	*.300	.08	*.10	--	*.1	.04	--	5.4±2.3	0±20	--	4.11±.32	.98±.99	.0106
1/20/77	3	*.01	*.04	*.10	.04	*.005	*.300	.08	*.10	--	*1.0	.10	--	--	--	--	--	--	.0254
4/12/77	3	*.01	*1.0	*.10	.05	*.10	*.300	*.05	*.025	--	*3.5	.03	--	10.0±3.0	3430±480	--	2.4±1.0	4.6±2.8	.0203
7/13/77	1,2	*.01	*.04	*.10	.03	*.001	*.300	*.05	*.01	--	*1.8	*.02	--	15.0±2.0	400±157	--	3.7±2.0	2.5±1.8	.0359
10/19/77	1,2	*.01	*.1	*.01	.03	*.005	*.01	.03	*.05	--	*.1	.07	--	0.0±2.0	ND	--	0.0±.05	1.8±.80	.0130
4/06/78	1,2	.0023	*.0005	.0029	--	*.0005	.0008	.06	.024	--	*.002	--	*79	27±8	ND	--	*.09	3.9±0.8	.056
7/12/78	1	--	--	--	--	--	--	--	--	--	--	--	*24	16±12	--	--	3.3±0.1	1.1±0.8	.049
10/23/78	1	.002	.041	.012	*.003	*.01	.143	.36	.021	--	*.003	*.015	*22	9.7±8.3	--	--	.52±.08	.20±.14	.006
2/21/79	1	--	--	--	--	--	--	--	--	--	--	--	*34	*9.5	--	--	2.8±0.1	*.08	.0001
1st Q 79	6	--	--	--	.05	--	*.5	.31	--	--	*.1	--	--	--	--	--	--	--	--
3rd Q 79	5	.01	.02	.107	.05	*.0003	.015	.23	.132	--	--	.36	47±27	72±27	--	0±1	.27±.31	0.0±1.0	.073
3/25/80	4	.009	.02	.09	.05	*.0003	.1	.29	.03	--	*.1	.28	0±11	60±8	--	0±.3	2.0±0.1	1.3±0.2	.003
6/03/80	4	.011	*.01	.08	.04	*.5	.1	.24	*.5	--	*.1	.49	25±2	70±10	--	0±2	1.4±0.3	0.7±0.2	.031
6/03/80	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	.034
8/19/80	4	--	--	--	--	--	--	--	--	--	--	--	0±20	30±20	--	0±1	.11±.05	0±0.2	.006
10/10/80	6	*.01	*.1	*.5	*.01	--	*.5	*.1	--	--	*.1	*.01	--	--	--	--	--	--	.150
1/21/81	6	*.001	.050	--	.040	--	--	.100	--	--	--	*.001	--	--	--	--	--	--	*.001
1/21/81	1	--	--	--	--	--	--	--	--	--	--	--	0±30	0±30	--	0±1	.64±.06	1.0±0.2	.035
2/ /81	6	*.001	*.010	--	*.010	--	--	*.010	--	--	--	*.001	--	--	--	--	--	--	.003
2/ /81	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6±1	.64±.07	0±0.2	.016
3/31/81	6	*.01	*.001	--	*.001	--	--	*.001	--	--	--	*.001	--	--	--	--	--	--	.010
4/29/81	6	*.01	*.01	--	*.01	--	--	.01	--	--	--	*.01	--	--	--	--	--	--	.001
5/29/81	6					--			--	--			--	--	--	--	--	--	
WELL MW-1B (ALLUVIAL AQUIFER)																			
3/31/78	1,2	.0096	.0088	.0082	--	.0175	.0082	*.01	.025	--	.014	.14	*40	*34.0	ND	--	9.5±.8	*.57	.053

TABLE 21 CHEMICAL ANALYSIS OF WATER FROM MONITOR WELLS AT L-BAR SITE (CONT.)

DATE	B	Cd	Cr	Pb	Mn	Hg	Mo	Ni	Se	Sr	V	Zn	Gross-Alpha	Gross-Beta	Gross-Gamma	Pb210	Ra226	Th230	U
WELL MW-2A (FIRST TRES HERMANOS SANDSTONE AQUIFER)																			
7/07/76	3	*.01	*.04	*.1	.17	*.005	*.30	.06	*.1	4.22	*1.0	.10	--	--	--	--	--	--	.0170
7/13/76	3	*.001	.001	.015	2.1	*.0004	*.00	*.01	*.01	--	*.1	.18	--	11.2±3.6	44±27	--	3.12±.26	.00±.03	.0177
10/06/76	3	.03	*.04	.60	--	--	*.300	.08	*.1	--	*.1	.14	--	--	--	--	--	--	.0254
1/20/77	3	*.01	*.04	*.10	.17	*.005	*.300	.06	*.1	--	*1.0	.35	--	14±4	630±300	--	6.1±1.9	4.5±2.7	.0223
4/12/77	3	.01	.10	*.10	.15	*.10	*.300	.09	*.025	--	*3.5	.15	--	15±2	1060±100	--	5.4±2.5	4.6±3.8	.0306
7/13/77	1,2	*.01	*.04	*.10	.12	*.001	*.300	*.05	*.01	--	*1.8	.08	--	24±7	ND	--	0.0±.05	1.4±.70	.0220
10/19/77	1,2	--	--	*.01	--	--	--	.06	*.05	--	*.1	.03	--	--	--	--	--	--	--
4/06/78	1,2	.00059	.0008	.0036	--	*.001	.0032	--	.52	--	*.002	--	*79	11±5	ND	--	1.8±.1	.43±.25	.041
7/17/78	1	--	--	--	--	--	--	--	--	--	--	--	*24	48±13	--	--	3.1±0.2	.95±.58	.037
10/17/78	1	.009	.024	.002	*.003	*.01	.095	.40	.15	--	*.003	*.015	*21	*5.3	--	--	.62±.10	.39±.19	.014
1st Q 79	6	--	--	--	.01	--	*.5	.04	--	--	*.1	--	--	--	--	--	--	--	--
3rd Q 79	5	.01	.03	.093	.24	*.0003	.104	.16	.379	--	--	.34	83±32	168±38	--	--	4.08±.71	3.1±2.1	.28
3/24/80	4	.014	.04	.10	.04	*.0003	*.1	.31	*.03	--	*.1	.22	0±35	80±14	--	5±3.5	8±0.2	1.3±0.2	.024
6/03/80	4	.016	.03	.15	.12	*.5	.1	.57	*.5	--	*.1	.82	0±80	100±60	--	4.4±0.4	3.3±0.3	1.5±0.3	.10
6/03/80	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	.042
8/19/80	4	--	--	--	--	--	--	--	--	--	--	--	0±90	0±90	--	0±1	.25±.05	0±0.2	.035
10/10/80	6	*.01	*.1	--	*.01	--	*.5	*.1	--	--	*.1	*.01	--	--	--	--	--	--	.013
2/ /81	6	*.03	*.010	--	.03	--		.20	--	--	--	*.001	--	--	--	--	--	--	.005
2/ /81	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0±1	4.1±0.3	2.1±0.2	.030
3/31/81	6	.02	*.001	--	*.001	--	--	*.01	--	--	--	*.001	--	--	--	--	--	--	.010
4/29/81	6	.02	.01	--	*.01	--	--	.02	--	--	--	.02	--	--	--	--	--	--	.007
5/29/81	6					--			--	--			--	--	--	--	--	--	
WELL MW-2B (ALLUVIAL AQUIFER)																			
4/06/78	1,2	.00074	.0003	--	--	.001	.0013	--	*.0006	--	*.002	--	25±17	30±7	ND	--	1.5±.1	.18±.16	.047
2/21/79	1	--	--	--	--	--	--	--	--	--	--	--	62±15	59±9	--	--	21±1	.10±.09	--

TABLE 21 CHEMICAL ANALYSIS OF WATER FROM MONITOR WELLS AT L-BAR SITE (CONT.)

DATE	LAB	Cd	Cr	Pb	Mn	Hg	Mo	Ni	Se	Sr	V	Zn	Gross-Alpha	Gross-Beta	Gross-Gamma	Pb210	Ra226	Th230	U
WELL MW-3A (FIRST TRES HERMANOS SANDSTONE AQUIFER)																			
3/31/78	1,2	.012	.0004	*.0002	--	*.0025	.0023	--	.008	--	*.005	--	290±70	1300±100	ND	--	5.1±.7	17±5	.68
1st Q 79	6	--	--	--	.04	--	*.5	.81	--	--	*.1	--	--	--	--	--	--	--	--
2/21/79	1	--	--	--	--	--	--	--	--	--	--	--	*34	*9.5	--	--	1.3±.1	.43±.27	--
10/10/80	6	*.01	*.1	*.1	.03	--	*.5	*.1	--	--	*.1	.20	--	--	--	--	--	--	.011
2/ /81	6	.09	.10	--	.05	--	--	.30	--	--	--	.30	--	--	--	--	--	--	.005
2/ /81	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0±1	.6±.07	.4±.2	.072
4/29/81	6	.08	.02	--	*.01	--	--	.02	--	--	--	.22	--	--	--	--	--	--	.006
5/29/81	6					--			--	--			--	--	--	--	--	--	
WELL MW-3B (ALLUVIAL AQUIFER)																			
4/06/78	1,2	.0021	.0007	*.0002	--	*.0025	.0023	--	.007	--	*.005	--	80±71	280±40	ND	--	*1.0	3±1.2	1.2
7/17/78	1	--	--	--	--	--	--	--	--	--	--	--	140±20	130±10	--	--	3.6±.3	8.1±1.6	.78
10/17/78	1	.002	.01	.0051	*.003	*.01	.065	.042	.042	-	*.003	*.015	110±20	51±10	--	--	.77±.25	2.1±.8	.38
10/10/80	6	*.01	*.1	*.1	*.01	--	*.5	*.1	--	--	*.1	.06	--	--	--	--	--	--	.012
2/ /81	6	.08	.10	--	.05	--	--	.30	--	--	--	.30	--	--	--	--	--	--	.002
2/ /81	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0±1	.4±.1	.7±.2	.071
4/29/81	6	.08	.02	--	*.01	--	--	.02	--	--	--	.120	--	--	--	--	--	--	.004
5/29/81	6					--			--	--			--	--	--	--	--	--	
WELL MW-4A (FIRST TRES HERMANOS SANDSTONE AQUIFER)																			
3/31/78	1,2	.0019	.0024	*.00022	--	.025	.0054	--	*.0015	--	*.002	--	--	19.9±3.8	120±86	--	2.05±.22	0.0±.05	.0079
3/31/78	1	--	--	--	--	--	--	--	--	--	--	--	120±70	*69	ND	--	17±1	5.9±1.6	.055
7/17/78	1	--	--	--	--	--	--	--	--	--	--	--	*24	14±12	--	--	1.3±.1	.61±.33	.046
10/17/78	1	.003	.023	.0026	*.003	*.01	.08	.145	.029	--	*.003	.02	*21	20±7	--	--	.95±.10	.58±.33	.031
2/21/79	1	--	--	--	.01	--	ND	.18	--	--	--	--	*34	*9.5	--	--	*.09	.28±.15	--
1st Q 79	6	.01	.04	.152	.30	.0003	.085	.31	--	--	*.1	--	--	--	--	--	--	--	.001
3rd Q 79	5	.007	.06	.23	.08	*.3	*.1	.21	*.005	--	--	.23	54±28	138±37	--	--	2.7±.64	4.1±1.8	.029
3/24/80	4	.007	.06	.23	.08	*.3	*.1	.21	*.03	--	*.1	.13	0±10	124±15	--	24±3	2.6±.1	3.5±.2	.004
6/03/80	4	.008	.06	.18	.04	*.5	*.1	.25	*.5	--	*.1	.19	0±30	80±20	--	8.4±.4	2.2±.3	5.6±.4	.031

TABLE 21 CHEMICAL ANALYSIS OF WATER FROM MONITOR WELLS AT L-BAR SITE (CONT.)

DATE	LAB	Cd	Cr	Pb	Mn	Hg	Mo	Ni	Se	Sr	V	Zn	Gross-Alpha	Gross-Beta	Gross-Gamma	Pb210	Ra226	Th230	U
WELL MW-4A (FIRST TRES HERMANOS SANDSTONE AQUIFER (CONT.))																			
6/03/81	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	.016
8/19/80	4	--	--	--	--	--	--	--	--	--	--	--	0±50	100±50	--	0±1	.57±.05	2.8±.3	.040
10/10/80	6	*.01	*.1	*.1	*.01	--	*.5	*.1	--	--	*.1	*.01	--	--	--	--	--	--	.005
2/ /81	6	*.01	*.01	--	*.01	--	--	*.01	--	--	--	*.001	--	--	--	--	--	--	.001
2/ /81	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9±1	2.5±.1	.6±.2	.046
3/31/81	6	*.01	*.001	--	*.001	--	--	*.01	--	--	--	.1	--	--	--	--	--	--	.006
4/29/81	6	*.01	*.01	--	*.01	--	--	.01	--	--	--	*.01	--	--	--	--	--	--	.002
5/29/81	6					--			--	--			--	--	--	--	--	--	
WELL MW-4B (ALLUVIAL AQUIFER)																			
2/28/79	1,2	.00031	.0003	.0015	--	.003	.0008	--	.006	--	*.002	--	*20	*8.1	ND	--	1.7±.1	.19±.10	.016
WELL MW-5 (FIRST TRES HERMANOS SANDSTONE AQUIFER)																			
10/17/78	1	.002	.041	.002	*.003	*.01	.125	.05	.022	--	*.003	.015	*21	15±6	--	--	3.1±.1	.43±.27	.035
2/22/79	1	--	--	--	--	--	--	--	--	--	--	--	*34	16±10	--	--	2±.1	.41±.77	--
1st Q 79	6	-	--	--	.03	--	--	.60	--	--	*.1	--	--	--	--	--	--	--	.0001
3/24/80	4	*.004	.05	*.03	.03	*.3	*.1	.15	*.03	--	*.1	.083	33±6	42±3	--	8.5±1.7	2.4±.1	5.4±.11	.025
6/03/80	4	.006	.04	.16	.4	*.5	*.1	.34	*.5	--	*.1	.63	30±2	67±6	--	4.22±2.2	2.5±.4	11.4±.6	.004
6/03/80	6		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	.170
8/19/80	4	--	--	--	--	--	--	--	--	--	--	--	0±20	60±20	--	0±1	.12±.05	0±.3	.015
10/10/80	6	*.01	*.1	*.1	*.01	--	*.5	*.1	--	--	*.1	*.01	--	--	--	--	--	--	.007
11/25/80	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1/21/81	6	.060	.100	--	.070	--	--	.200	--	--	--	*.001	--	--	--	--	--	--	.008
2/ /81	6	*.01	*.01	--	.02	--	--	*.10	--	--	--	*.001	--	--	--	--	--	--	.002
2/ /81	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0±1	2.3±.2	.8±.2	.046
3/31/81	4	.02	*.001	--	.05	--	--	*.01	--	--	--	.01	--	--	--	--	--	--	.009
4/29/81	4	*.01	*.01	--	*.01	--	--	.01	--	--	--	*.01	--	--	--	--	--	--	.001

TABLE 21 CHEMICAL ANALYSIS OF WATER FROM MONITOR WELLS AT L-BAR SITE (CONT.)

DATE	LAB	Cd	Cr	Pb	Mn	Hg	Mo	Ni	Se	Sr	V	Zn	Gross-Alpha	Gross-Beta	Gross-Gamma	Pb210	Ra226	Th230	U
WELL MW-6 (FIRST TRES HERMANOS SANDSTONE AQUIFER)																			
10/17/78	1	.002	.046	.001	*.003	*.01	.162	.05	.001	--	*.003	*.015	*21	*5.3	--	--	.45±.15	*.12	.012
2/22/79	1	--	--	--	--	--	--	--	--	--	--	--	*34	13±10	--	--	3±.2	.81±.31	--
1st Q 79	6	--	--	--	.02	--	*.5	.26	--	--	*.1	--	--	--	--	--	--	--	.0001
3/24/80	4	*.004	.07	*.03	.01	*.3	*.1	.13	*.03	--	*.1	.10	10±1	16±2	--	2.5±.5	.77±.07	2.4±.2	.01
6/03/80	4	.017	.01	.12	3.2	*.5	*.1	.48	*.5	--	*.1	1.6	0±20	54±40	--	0±1	2±.4	0±.2	.018
2/22/79	1	--	--	--	--	--	--	--	--	--	--	--	*34	13±10	--	--	3±.2	.87±.31	--
6/03/80	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	.034
8/19/80	4	--	--	--	--	--	--	--	--	--	--	--	0±30	80±40	--	0±1	.11±.05	.9±.2	.021
10/10/80	6	*.01	*.1	*.1	*.01	--	*.5	*.1	--	--	*.1	*.01	--	--	--	--	--	--	.007
11/25/80	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1/21/81	6	.020	.030	--	.030	--	--	.100	--	--	--	.070	--	--	--	--	--	--	.002
2/ /81	6	*.01	*.01	--	.02	--	--	*.10	--	--	--	*.001	--	--	--	--	--	--	.020
2/ /81	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0±1	2.1±.1	.7±.3	.027
3/31/81	6	*.01	*.001	--	.02	--	--	*.01	--	--	--	.05	--	--	--	--	--	--	.002
4/29/81	6	*.01	*.01	--	*.01	--	--	.01	--	--	--	*.01	--	--	--	--	--	--	.012
4/29/81	6	*.01	*.01	--	*.01	--	--	*.01	--	--	--	.01	--	--	--	--	--	--	.058
5/29/81	6					--			--	--			--	--	--	--	--	--	
WELL MW-7 (FIRST TRES HERMANOS SANDSTONE AQUIFER)																			
10/25/78	1	.002	.023	.005	*.003	*.01	.109	.105	.018	--	*.003	*.015	*21	6.8±5.5	--	--	1.4±.2	.85±.4	.007
2/26/79	1	--	--	--	--	--	--	--	--	--	--	--	*34	*9.5	--	--	.16±.10	.71±.29	--
1st Q 79	6	--	--	--	.03	--	*.5	.19	--	--	*.1	--	--	--	--	--	--	--	.0001
3rd Q 79	5	.01	*.02	.017	.02	*.0003	.0005	.23	.013	--	--	.18	205±19	267±16	--	--	1.21±.44	1.8±1.5	.025
3/24/80	4	*.004	.04	*.03	.02	*.3	*.1	.14	*.03	--	*.1	.11	20±1	28±3	--	4.8±.6	1.7±.1	2.3±.2	.018
6/03/80	4	*.004	.02	.04	.03	*.5	*.1	.32	*.5	--	*.1	.31	16±2	28±4	--	2.7±.7	2.5±.4	2±.2	.018
2/26/79	1	--	--	--	--	--	--	--	--	--	--	--	*34	*9.5	--	--	.16±.1	.71±29	--
6/03/80	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	.102
6/19/80	4	--	--	--	--	--	--	--	--	--	--	--	0±20	0±20	--	0±1	.47±.05	1.6±.2	.006

TABLE 21 CHEMICAL ANALYSIS OF WATER FROM MONITOR WELLS AT L-BAR SITE (CONT.)

DATE	LAB	Cd	Cr	Pb	Mn	Hg	Mo	Ni	Se	Sr	V	Zn	Gross-Alpha	Gross-Beta	Gross-Gamma	Pb210	Ra226	Th230	U
WELL MW-7 (FIRST TRES HERMANOS SANDSTONE AQUIFER (CONT.))																			
10/10/80	6	*.01	*.1	*.1	*.01	--	*.5	*.1	--	--	*.1	.02	--	--	--	--	--	--	.007
11/25/80	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1/21/81	6	.020	*.001	--	.020	--	--	.100	--	--	--	.040	--	--	--	--	--	--	.002
2/ /81	6	*.01	.02	--	.03	--	--	*.10	--	--	--	*.001	--	--	--	--	--	--	.008
2/ /81	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0±1	2.1±.1	0±.2	.019
3/31/81	6	*.01	*.001	--	.01	--	--	*.001	--	--	--	.01	--	--	--	--	--	--	.001
4/29/81	6	*.01	*.01	--	*.01	--	--	*.01	--	--	--	.06	--	--	--	--	--	--	.001
5/29/81	6					--			--	--			--	--	--	--	--	--	
WELL MW-8 (FIRST TRES HERMANOS SANDSTONE AQUIFER)																			
10/25/78	1	.0024	.03	.0044	*.015	*.01	.11	.085	*.001	--	*.003	*.015	*21	*5.3	--	--	.18±.08	.32±.23	.032
2/21/79	1	--	--	--	--	--	--	--	--	--	--	--	*34	10±9	--	--	.44±.12	1.2±.3	--
3rd Q 79	5	.01	*.02	.017	*.02	*.0003	.004	.01	.014	--	--	.10	69 12	92 10	--	--	2.11 .63	3.9 2.7	.005
1st Q 80	6	--	--	--	.01	--	*.5	.26	--	--	*.1	--	--	--	--	--	--	--	.0001
3/25/80	4	*.004	.03	*.03	.02	*.3	*.1	.26	.03	--	*.1	.25	16±1	30±3	--	2±.5	.30±.04	.9±.1	.015
6/03/80	4	*.004	*.01	*.03	*.01	*.5	*.1	*.03	*.5	--	*.1	.22	23±2	36±4	--	0±3	.8±.3	1.6±.2	.019
6/03/80	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	.017
6/19/80	4	.02	*.1	.1	.04	*.0005	*.1	.24	.30	--	*.1	.2	0±50	0±40	--	12±1	.5±.05	0±.3	.081
10/10/80	6	*.01	*.1	*.1	*.01	--	*.5	*.1	--	--	*.1	*.01	--	--	--	--	--	--	.007
11/21/80	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3±1	.5±.2	2.1±.4	.056
11/25/80	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1/21/81	6	.020	*.001	--	.010	--	--	.060	--	--	--	*.001	--	--	--	--	--	--	.006
1/21/81	1	--	--	--	--	--	--	--	--	--	--	--	0±30	40±20	--	0±1	.21±.04	7.6±.4	.035
2/ /81	6	*.01	.02	--	.03	--	--	*.01	--	--	--	*.001	--	--	--	--	--	--	.004
2/ /81	1	.03	.10	.07	*.01	*.0005	*.1	.072	.32	--	*.1	.05	--	--	--	0±1	3±.3	3.2±.3	.059
3/31/81	8	.01	*.001	--	.01	--	--	*.001	--	--	--	*.001	--	--	--	--	--	--	*.001
4/29/81	6	*.01	*.01	--	*.01	--	--	*.01	--	--	--	*.01	--	--	--	--	--	--	.003
5/29/81	6					--			--	--			--	--	--	--	--	--	

TABLE 21 CHEMICAL ANALYSIS OF WATER [illegible] MONITOR WELLS AT L-BAR SITE (CONT.)

DATE	LAB	Cd	Cr	Pb	Mn	Hg	Mo	Ni	Se	Sr	V	Zn	Gross-Alpha	Gross-Beta	Gross-Gamma	Pb210	Ra226	Th230	U
WELL MW-9 (FIRST TRES HERMANOS SANDSTONE AQUIFER)																			
10/10/80	6	*.01	*.1	*.1	*.01	--	*.5	*.1	--	--	*.1	.06	--	--	--	--	--		.009
11/25/80	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1/21/81	6	.010	*.001	--	.080	--	--	.030	--	--	--	*.001	--	--	--	--	--	--	.008
2/ /81	6	.01	*.01	--	.06	--	--	*.1	--	--	--	*.001	--	--	--	--	--	--	.004
2/ /81	1	.007	*.01	*.03	*.01	*.0005	*.1	*.03	*.1	--	*.1	.026	--	--	--	0±1	3.6±.4	1±.2	.038
3/31/81	6	.01	*.001	--	.07	--	--	*.01	--	--	--	.06	--	--	--	--	--	--	.005
4/29/81	6	*.01	*.01	--	*.01	--	--	*.01	--	--	--	.02	--	--	--	--	--	--	.001
5/29/81	6					--			--	--			--	--	--	--	--	--	
WELL MW-10 (FIRST TRES HERMANOS SANDSTONE AQUIFER)																			
10/10/80	6	*.01	*.1	*.1	*.01	--	*.5	*.1	--	--	*.1	.05	--	--	--	--	--	--	.006
11/21/81	1	*.004	*.01	.05	.06	17	*.05	.12	*.09	--	*.1	.69	--	--	--	--	3.5±.5	2.8±.2	.024
1/21/81	1	--	--	--	--	--	--	--	--	--	--	--	0±60	0±60	--	0±1	2.4±.1	.4±.2	.044
1/21/81	6	.030	*.001	--	.040	--	--	.070	--	--	--	1.91	--	--	--	--	--	--	.006
2/ /81	6	.02	*.01	--	.02	--	--	*.10	--	--	--	*.01	--	--	--	--	--	--	.001
2/ /81	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2±1	3.5±.2	0±.2	.062
3/31/81	6	.01	*.001	--	*.001	--	--	*.001	--	--	--	*.001	--	--	--	--	--	--	.001
4/29/81	6	.03	*.01	--	*.01	--	--	*.01	--	--	--	*.01	--	--	--	--	--	--	.004
5/29/81	6					--			--	--			--	--	--	--	--	--	
WELL MW-11 (SECOND TRES HERMANOS SANDSTONE AQUIFER)																			
11/25/80	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1/21/81	6	.030	.080	--	.020	--	--	.040	--	--	--	*.001	--	--	--	--	--	--	.005
2/ /81	6	.01	*.01	--	*.01	--	--	*.10	--	--	--	*.001	--	--	--	--	--	--	.005
2/ /81	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0±1	1.8±.1	.9±.2	.022
3/31/81	6	.03	*.001	--	*.001	--	--	*.001	--	--	--	*.001	--	--	--	--	--	--	.003
5/29/81	6					--			--	--			--	--	--	--	--	--	

TABLE 21 CHEMICAL ANALYSIS OF WATER FROM MONITOR WELLS AT L-BAR SITE (CONT.)

DATE	LAB	Cd	Cr	Pb	Mn	Hg	Mo	Ni	Se	Sr	V	Zn	Gross-Alpha	Gross-Beta	Gross-Gamma	Pb210	Ra226	Th230	U
WELL MW-12 (FIRST TRES HERMANOS SANDSTONE AQUIFER)																			
10/10/80	6	*.01	*.1	*.1	*.01	--	*.5	*.1	--	--	*.1	*.01	--	--	--	--	--	--	.006
11/25/80	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1/21/81	6	.010	.030	--	.020	--	--	.030	--	--	--	.130	--	--	--	--	--	--	.004
2/ /81	6	*.01	*.01	--	*.01	--	--	*.10	--	--	--	*.001	--	--	--	--	--	--	.009
2/ /81	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0±1	.88±.07	.7±.2	.021
3/31/81	6	.02	*.001	--	.03	--	--	*.01	--	--	--	.01	--	--	--	--	--	--	.001
4/29/81	6	.03	*.01	--	*.01	--	--	*.01	--	--	--	.02	--	--	--	--	--	--	.002
5/29/81	6					--			--	--			--	--	--	--	--	--	.001
WELL MW-13 (SECOND TRES HERMANOS SANDSTONE AQUIFER)																			
11/25/80	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1/21/81	6	.010	*.001	--	.010	--	--	.040	--	--	--	*.001	--	--	--	--	--	--	.007
2/ /81	6	.020	.05	--	*.01	--	--	*.10	--	--	--	*.001	--	--	--	--	--	--	.001
2/ /81	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0±1	3.3±.3	1.2±.2	.012
3/31/81	6	*.001	*.001	--	*.001	--	--	*.001	--	--	--	*.001	--	--	--	--	--	--	.009
4/29/81	6	.02	*.01	--	*.01	--	--	*.01	--	--	--	.02	--	--	--	--	--	--	.003
5/29/81	6					--			--	--			--	--	--	--	--	--	
WELL MW-14 (FIRST TRES HERMANOS SANDSTONE AQUIFER)																			
10/10/80	6	*.01	*.1	*.1	*.01	--	*.5	*.1	--	--	*.1	*.01	--	--	--	--	--	--	.003
11/25/80	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1/21/81	6	.020	.030	--	.3	--	--	.030	--	--	--	.033	--	--	--	--	--	--	.003
2/ /81	6	*.01	.02	--	*.01	--	--	*.1	--	--	--	*.001	--	--	--	--	--	--	.001
2/ /81	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0±1	1.02±.07	0±.2	.010
3/31/81	6	.02	*.001	--	.2	--	--	*.01	--	--	--	.070	--	--	--	--	--	--	.003
4/29/81	6	.01	.02	--	*.01	--	--	*.01	--	--	--	*.01	--	--	--	--	--	--	.001
5/29/81	6					--			--	--			--	--	--	--	--	--	

TABLE 21 CHEMICAL ANALYSIS OF WATER FROM MONITOR WELLS AT L-BAR SITE (CONT.)

DATE	LAB	Cd	Cr	Pb	Mn	Hg	Mo	Ni	Se	Sr	V	Zn	Gross-Alpha	Gross-Beta	Gross-Gamma	Pb210	Ra226	Th230	U
WELL MW-15 (FIRST TRES HERMANOS SANDSTONE AQUIFER)																			
10/10/80	6	*.01	*.1	*.1	*.01	--	*.5	*.1	--	--	*.1	.02	--	--	--	--	--	--	.011
11/25/80	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1/21/81	6	.060	.030	--	.060	--	--	.110	--	--	--	.270	--	--	--	--	--	--	.006
2/ /81	6	.01	.03	--	.01	--	--	*.01	--	--	--	.1	--	--	--	--	--	--	.017
2/ /81	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0±1	2.3±.1	0±.2	.009
3/31/81	6	.02	*.001	--	*.001	--	--	*.001	--	--	--	--	--	--	--	--	--	--	.004
4/29/81	6	.02	.02	--	*.01	--	--	*.01	--	--	--	.03	--	--	--	--	--	--	.011
5/29/81	6					--			--	--			--	--	--	--	--	--	
WELL MW-17 (FIRST TRES HERMANOS SANDSTONE AQUIFER)																			
10/10/80	6	*.01	*.1	*.1	*.01	--	*.5	*.1	--	--	*.1	*.01	--	--	--	--	--	--	.008
11/25/80	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1/21/81	6	.030	.040	--	1.47	--	--	.080	--	--	--	.040	--	--	--	--	--	--	.007
2/ /81	6	*.01	*.01	--	*.01	--	--	*.1	--	--	--	*.001	--	--	--	--	--	--	.003
2/ /81	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2±1	3.6±.2	.0±.2	0
4/29/81	6	*.01	.01	--	*.01	--	--	.01	--	--	--	.01	--	--	--	--	--	--	.001
4/29/81	6	*.01	.01	--	*.01	--	--	.02	--	--	--	.01	--	--	--	--	--	--	.001
5/29/81	6					--			--	--			--	--	--	--	--	--	
WELL MW-20 (ALLUVIAL AQUIFER)																			
4/ /81	6	*.01	*.01	--	*.01	--	--	.01	--	--	--	.02	--	--	--	--	--	--	.001
TOWN OF SEBOYETA																			
7/11/80	4	--	--	--	--	--	--	--	--	--	--	--	0±6	10±2	--	2±1	1.28±.08	.7±.2	0.0
2/04/81	1	--	--	*.04	--	*.001	*.1	--	*.007	--	*.1	--	0±5	8±5	--	0±1	.42±.05	.5±.2	.007
2/04/81	6	--	--	--	*.001	--	--	.03	--	--	--	.04	--	--	--	--	--	--	.012

TABLE 21 CHEMICAL ANALYSIS OF WATER FROM MONITOR WELLS AT L-BAR SITE (CONT.)

DATE	LAB	Cd	Cr	Pb	Mn	Hg	Mo	Ni	Se	Sr	V	Zn	Gross-Alpha	Gross-Beta	Gross-Gamma	Pb210	Ra226	Th230	U
										TOWN OF MOQUINO									
7/ /80	4	--	--	--	--	--	--	--	--	--	--	--	0±6	7±2	--	0±1	.37±.05	.4±.2	0.0
2/04/81	1	--	--	*.03	--	*.001	*.1	--	*.007	--	*.1	--	2±1	6±3	--	0±1	0±.04	.3±.2	0.0
2/04/81	6	--	--	--	*.001	--	--	--	--	--	--	.04	--	--	--	--	--	--	.009
										TOWN OF BIBO									
4th Q 79	5	*.01	*.01	*.1	.02	*.001	*.01	*.1	*.01	--	*.01	.08	5±4	3±4	--	13.1±26.3	.3±.2	.8±3.6	*.001
7/15/80	4	*.004	*.01	*.03	*.01	*.0005	*.1	*.03	*.005	--	*.1	.09	0±6	8±2	--	0±1	.25±.04	.5±.2	0.0
1/ /81	6	--	--	--	*.001	--	--	.010	--	--	--	.040	--	--	--	--	--	--	.005
2/04/81	1	--	--	*.03	--	*.001	*.1	--	*.007	--	*.1	--	0±3	9±4	--	0±1	.54±.06	.6±.2	0.0

TABLE 22 COMPOSITE SAMPLES OF TAILINGS WATER

MONTH/ YEAR	Cl	SO_4	Na	Ca	Fe	TDS	U_3O_8	Mo	V_2O_5	Ra -226
	IN mg/ℓ									IN pci/ℓ
10/80	792	65,600	-	3.8	5000	74,300	48.9	1.0	133	--
11/80	645	60,500	-	2.5	4600	72,400	55.5	1.0	<1.0	--
12/80	611	58,300	-	2.0	4400	67,800	40.3	1.2	<1.0	--
2/81	567	74,300	1550	2.4	4200	77,000	46.7	1.0	<1.0	--
3/81	559	60,400	-	-	4300	66,600	43.1	1.0	187	--
4/81	588	56,300	-	-	4480	67,100	69.4	--	--	153±8
5/81	711	64,900	-	11.4	3600	76,800	49.5	2.0	110	--

TABLE 23 PROPOSED GROUND - WATER MONITORING

WELL NO.	SAMPLING FREQUENCY	PARAMETERS TO BE MEASURED
ALL WELLS (1A-20)	MONTHLY	WATER LEVEL AND FIELD CONDUCTIVITY
ALL WELLS (1A-20)	QUARTERLY	WATER LEVEL, Cl, SO_4, FIELD pH, HCO_3, CO_3, AND FIELD CONDUCTIVITY (ALL YEARLY PARAMETERS ARE TO BE ANALYZED IF THE pH DECREASES BY 1.0)
1A, 2A, 3A, 3B, 5, 8, 9, 10, 12, 13, 14, 15, 17, and 20	YEARLY	WATER LEVEL, Ca, Mg, Na, K, Fe, Cl, SO_4, HCO_3, CO_3, FIELD pH, pH, FIELD CONDUCTIVITY TDS, F, NO_3, Ba, Cd, Cr, Pb, Mn, Mo, Ni, Se, V, Zn, U AND Ra - 226

APPENDIX A

CONDUCTIVITY AND TEMPERATURE

PROFILES

OF THE TAILINGS WELLS

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WELL 1A

DEPTH (ft-MP)	TEMPERATURE (°C)	CONDUCTIVITY (μmhos/cm @ 25°C)
94.8	17.0	5640
98.8	17.0	5640
103.8	17.0	5640
108.8	17.0	5640
113.8	17.1	5630
118.8	18.5	5560
119.8	18.5	5560
120.8	18.3	5590
121.8	18.5	5560
122.8	18.5	5560
123.8	18.5	5560
124.8	18.9	5510
125.8	19.1	5490
126.8	18.5	5560
127.8	18.9	5510
128.8	19.1	5600
129.8	19.1	5600
130.8	19.1	5600
131.8	19.2	5700
132.8	19.2	6150
133.8	19.3	6130
134.8	19.3	6240
135.8	19.6	6200
136.8	19.5	6220
137.8	19.5	6220
138.8	19.5	5330
139.8	19.3	4460

NOTE: MP = Measuring point, which is top of casing.
Static Water Level: 93.78 ft-MP on 06/05/81.
Total Depth: 140 ft-MP.

WELL 1B

DEPTH (ft-MP)	TEMPERATURE (C)	CONDUCTIVITY (mhos/cm @ 25 C)
36.3	15.1	1720

NOTE: MP = Measuring point, which is top of casing.
Static Water Level: 36.07 ft-MP on 04/27/81.
Total Depth: 36.30 ft-MP.

WELL 2A

DEPTH (ft-MP)	TEMPERATURE (°C)	CONDUCTIVITY (μmhos/cm @ 25°C)
47.3	14.9	17400
51.3	14.9	17400
56.3	14.9	17500
61.3	14.9	17500
66.3	14.9	17500
71.3	20.1	15900
72.3	19.9	16000
73.3	19.1	16200
74.3	19.9	16000
75.3	19.5	16100
76.3	19.1	16200
77.3	19.0	16300
78.3	19.0	16300
79.3	19.9	12000

NOTE: MP = Measuring point, which is top of casing.
Static Water Level: 46.33 ft-MP on 04/27/81.
Total Depth: 79.72 ft-MP.

WELL 2B

DEPTH (ft-MP)	TEMPERATURE (°C)	CONDUCTIVITY (μmhos/cm @ 25°C)
37.C	15.1	1700

NOTE: MP = Measuring point, which is top of casing.
Static Water Level: 36.49 ft-MP on 04/27/81.
Total Depth: 37.0 ft-MP.

WELL 3A

DEPTH (ft-MP)	TEMPERATURE (°C)	CONDUCTIVITY (μmhos/cm @ 25°C)
24.5	15.1	41200
25.5	14.9	40900
26.5	14.6	41000
27.5	14.5	41100
28.5	14.2	41400
29.5	14.2	41400
30.0	14.2	41400

NOTE: MP = Measuring point, which is top of casing.
Static Water Level: 23.48 ft-MP on 04/24/81.
Total Depth: 30.2 ft-MP.

WELL 3B

DEPTH (ft-MP)	TEMPERATURE (°C)	CONDUCTIVITY (μmhos/cm @ 25°C)
17.4	13.9	34000
18.4	13.8	34100
19.4	13.8	34100
20.2	13.8	34100

NOTE: MP = Measuring point, which is top of casing.
Static Water Level: 16.38 ft-MP on 04/27/81.
Total Depth: 20.28 ft-MP.

WELL 4A

DEPTH (ft-MP)	TEMPERATURE (°C)	CONDUCTIVITY (μmhos/cm @ 25°C)
27.5	14.1	7550
28.5	13.8	7350
29.5	13.7	7370
30.5	13.7	7370
31.5	13.8	7350
32.5	13.7	7370
33.5	13.7	7370

NOTE: MP = Measuring point, which is top of casing.
Static Water Level: 26.52 ft-MP on 05/19/81.
Total Depth: 34.2 ft-MP.

WELL 4B

DEPTH (ft-MP)	TEMPERATURE (°C)	CONDUCTIVITY (μmhos/cm @ 25°C)
16.98	13.9	949

NOTE: MP = Measuring point, which is top of casing.
Static Water Level: 15.84 ft-MP on 04/27/81.
Total Depth: 16.98 ft-MP.

WELL 5

DEPTH (ft-MP)	TEMPERATURE (°C)	CONDUCTIVITY (μmhos/cm @ 25°C)
44.5	16.2	9700
49.5	14.8	10000
54.5	14.7	10000
59.5	14.7	9900
64.5	14.7	10000
69.5	16.5	9600
74.5	16.5	9600
79.5	16.0	9700
84.5	16.0	9700
85.5	15.8	9800
86.5	15.5	9900
87.5	15.5	9900
[illegible]	15.5	9900
89.5	15.3	9900
90.5	15.3	9900
91.5	15.4	9900
92.5	15.3	9900
93.5	15.3	9900
94.5	15.3	9900
95.5	15.6	10000
96.5	15.8	10800
97.5	15.8	10800
98.5	16.0	10700
99.5	16.0	11100
100.5	15.3	11600
101.5	15.1	11700
102.5	15.1	11700
103.5	15.1	11700
104.5	15.1	10400
105.5	15.1	8800
106.5	15.1	8800

NOTE: MP = Measuring point, which is top of casing.
Static Water Level: 44.48 ft-MP on 04/24/81.
Total Depth: 107.2 ft-MP.

WELL 6

DEPTH (ft-MP)	TEMPERATURE (°C)	CONDUCTIVITY (μmhos/cm @ 25°C)
58.4	15.0	5380
62.4	14.9	5370
67.4	14.8	5380
72.4	14.8	5380
77.4	14.8	5400
82.4	17.0	5180
83.4	16.5	5240
84.4	16.0	5290
85.4	16.0	5290
86.4	16.0	5290
87.4	16.0	5290
88.4	16.0	5290
89.4	15.8	5320
90.4	15.8	5320
91.4	18.0	5110
92.4	17.5	5190
93.4	16.9	5240
94.4	17.0	5190
95.4	17.0	5190
96.4	16.9	5200
97.4	16.9	5200
98.4	17.0	5230
99.4	17.0	5230
100.4	16.9	5190
101.4	17.0	4880
102.4	16.9	4360

NOTE: MP = Measuring point, which is top of casing.
Static Water Level: 57.42 ft-MP on 04/27/81.
Total Depth: 102.73 ft-MP.

WELL 7

DEPTH (ft-MP)	TEMPERATURE (°C)	CONDUCTIVITY (µmhos/cm @ 25°C)
73.6	16.0	4550
77.6	15.6	4520
82.6	15.5	4520
87.6	15.5	4560
92.6	16.5	4490
97.6	17.0	4460
102.6	17.0	4460
107.6	17.5	4470
112.6	17.9	4430
117.6	17.5	4470
118.6	17.5	4470
119.6	17.2	4500
120.6	17.2	4480
121.6	17.2	4480
122.6	17.2	4480
123.6	17.1	4490
124.6	17.1	4490
125.6	17.1	4490
126.6	17.1	4490
127.6	17.1	4510
128.6	17.1	4510
129.6	17.1	4510
130.6	17.1	4510
131.6	17.1	4510
132.6	17.1	4490
133.6	17.1	4510
134.6	17.1	4510
135.6	17.1	4510
136.6	17.1	4510
137.6	17.1	4510
138.6	17.1	4510
139.6	17.1	4470
140.6	17.1	4340
141.6	17.1	4100

NOTE: MP = Measuring point, which is top of casing.
Static Water Level: 72.64 ft-MP on 04/27/81.
Total Depth: 142.16 ft-MP.

WELL 8

DEPTH (ft-MP)	TEMPERATURE (°C)	CONDUCTIVITY (μmhos/cm @ 25°C)
75.3	15.5	17200
79.3	15.5	17200
84.3	15.5	17500
89.3	15.5	19400
94.3	15.9	19400
99.3	19.0	18200
104.3	19.6	17900
109.3	20.0	17900
114.3	20.2	17700
119.3	20.0	17800
124.3	20.0	18100
129.3	20.0	18300
134.3	20.0	18300
139.3	19.9	18500
140.3	19.5	18800
141.3	19.2	18800
142.3	19.2	18800
143.3	19.0	18900
144.3	19.0	18900
145.3	19.0	18900
146.3	19.0	18900
147.3	19.0	18900
148.3	19.0	18900
149.3	18.9	18900
150.3	18.9	18900
151.3	18.9	18900
152.3	18.9	18900
153.3	18.9	12300
154.3	19.0	11800
155.3	18.9	11700
156.3	18.9	11700
157.3	18.5	11800
158.3	18.5	11700

NOTE: MP = Measuring point, which is top of casing.
Static Water Level: 74.29 ft-MP on 06/05/81.
Total Depth: 160 ft-MP.

WELL 9

DEPTH (ft-MP)	TEMPERATURE (°C)	CONDUCTIVITY (µmhos/cm @ 25°C)
151.1	18.0	3900
155.1	18.0	3960
160.1	18.0	4000
165.1	18.0	4010
170.1	18.1	4000
175.1	19.5	3900
180.1	19.8	3910
185.1	21.2	3860
190.1	21.5	3940
195.1	21.0	3880
196.1	20.9	3870
197.1	20.4	3930
198.1	20.1	3940

NOTE: MP = Measuring point, which is top of casing.
Static Water Level: 150.1 ft-MP on 04/27/81.
Total Depth: 216.0 ft-MP.

WELL 10

DEPTH (ft-MP)	TEMPERATURE (°C)	CONDUCTIVITY (μmhos/cm @ 25°C)
105.6	16.0	14200
109.6	16.0	13200
114.6	16.0	13400
119.6	16.1	13300
124.6	16.1	13400
125.6	17.1	13500
126.6	17.2	13500
127.6	21.5	12500
128.6	22.5	12300
129.6	22.5	12400
130.6	20.3	13000
131.6	20.3	13000
132.6	20.3	13000
133.6	20.3	13000
134.6	22.0	12300
135.6	22.0	12300
136.6	22.1	12400
137.6	25.5	11600
138.6	25.5	11500
139.6	25.7	11400
140.6	25.0	11800
141.6	25.0	11800
142.6	22.0	12500
143.6	22.5	12400
144.6	22.5	12400
145.6	22.5	12400
146.6	22.5	12400
147.6	23.0	12100
148.6	23.0	12100
149.6	24.0	11900
150.6	24.0	11800
151.6	24.0	11900
152.6	24.0	11900
153.6	24.5	9090

NOTE: MP = Measuring point, which is top of casing.
Static Water Level: 104.6 ft-MP on 6/17/81
Total Depth: 156 ft-MP.

WELL 12

DEPTH (ft-MP)	TEMPERATURE (°C)	CONDUCTIVITY (μmhos/cm @ 25°C)
88.0	16.5	2730
92.0	16.3	2740
97.0	16.3	2740
98.0	16.3	2740
99.0	16.3	2740
100.0	16.3	2740
101.0	16.5	2720
102.0	16.8	2700
103.0	16.8	2700
104.0	16.8	2700
105.0	16.8	2700
106.0	16.8	2700
107.0	17.2	2690
108.0	17.5	2680
109.0	17.3	2700
110.0	17.2	2700
111.0	17.2	2700
112.0	17.2	2700
113.0	17.2	2700
114.0	17.3	2700
115.0	17.3	2700
116.0	17.3	2700
117.0	17.2	2700
118.0	17.2	2700
119.0	18.0	2710
120.0	18.0	2310
121.0	18.0	2300

NOTE: MP = Measuring point, which is top of casing.
Static Water Level: 87.01 ft-MP on 04/27/81.
Total Depth: 121.61 ft-MP.

WELL 14

DEPTH (ft-MP)	TEMPERATURE (°C)	CONDUCTIVITY (μmhos/cm @ 25°C)
29.6	15.1	4080
30.6	14.5	4300
31.6	14.2	4230
32.6	14.2	4260
33.6	14.2	4270
34.6	14.2	4270
35.6	14.2	4270
36.6	14.2	4280
37.6	14.2	4280
38.6	14.2	4290
39.6	14.2	4290
40.6	14.2	4300
41.6	14.3	4320
42.6	14.3	4320
43.6	14.5	4300
44.6	14.5	4300
45.6	14.5	4300
46.6	14.5	4300
47.6	14.5	4300
48.6	14.5	4300
49.6	15.5	4250
50.6	15.1	4200

NOTE: MP = Measuring point, which is top of casing.
Static Water Level: 28.63 ft-MP on 04/27/81.
Total Depth: 51.30 ft-MP.

WELL 15

DEPTH (ft-MP)	TEMPERATURE (°C)	CONDUCTIVITY (μmhos/cm @ 25°C)
21.1	13.1	10200
22.2	13.0	10200
23.1	13.0	9800
24.1	13.0	9700
25.1	13.0	9700
26.1	13.0	9700
27.1	13.0	9700
28.1	13.0	9700
29.1	13.1	9800
30.1	13.1	9900
31.1	13.1	9900
32.1	13.1	10100
33.1	13.1	10100
34.1	13.1	10100
35.1	13.3	10000
36.1	13.3	7100
37.1	13.3	6500
37.5	13.3	6500

NOTE: MP = Measuring point, which is top of casing.
Static Water Level: 20.14 ft-MP on 04/24/81.
Total Depth: 37.5 ft-MP.

WELL 17

DEPTH (ft-MP)	TEMPERATURE (°C)	CONDUCTIVITY (μmhos/cm @ 25°C)
76.8	15.5	6210
77.8	15.5	6210
78.8	15.2	6250
79.8	15.2	6250

NOTE: MP = Measuring point, which is top of casing.
Static Water Level: 75.84 ft-MP on .
Total Depth: 80.63 ft-MP.

APPENDIX B

STATIC WATER-LEVEL HYDROGRAPHS AND TABLES

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WATER LEVEL MEASUREMENTS IN MONITOR WELL 1A

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
14 December 1975	108.10	6116.34	3
23 March 1976	95.36	6129.08	2
19 April 1976	95.40	6129.04	2
02 May 1976	95.10	6129.34	3
07 July 1976	95.08	6129.36	2
06 October 1976	95.29	6129.15	2
20 January 1977	95.50	6128.94	2
12 April 1977	95.27	6129.17	2
13 July 1977	95.99	6128.45	2
19 October 1977	95.88	6128.56	2
15 March 1978	95.50	6128.94	3
31 March 1978	95.82	6128.62	2
19 May 1978	95.20	6129.24	2
26 June 1978	95.30	6129.14	3
01 September 1978	95.27	6129.17	3
13 September 1978	95.55	6128.89	3
23 October 1978	96.04	6128.40	2

1 B.M. 6224.44
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL 1A

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
11 January 1979	95.21	6129.23	2
15 February 1979	95.08	6129.36	2
06 March 1979	95.45	6128.99	2
18 April 1979	95.35	6129.09	2
22 May 1979	95.61	6128.83	2
04 June 1979	95.47	6128.97	3
13 June 1979	95.50	6128.94	2
09 July 1979	95.23	6129.21	2
21 August 1979	93.99	6130.45	2
12 September 1979	95.45	6128.99	3
25 September 1979	95.55	6130.89	2
15 October 1979	94.23	6130.21	2
21 November 1979	94.25	6130.19	2
15 December 1979	95.26	6129.18	3
27 December 1979	95.02	6129.42	2
28 January 1980	95.02	6129.42	2
22 February 1980	95.33	6129.11	2
24 March 1980	95.08	6129.36	2
15 April 1980	94.95	6129.49	2
27 May 1980	94.84	6129.60	2

1 B.M. 6224.44
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL 1A

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
25 June 1980	94.73	6129.71	2
29 July 1980	94.71	6129.73	2
26 August 1980	94.31	6130.13	2
30 September 1980	93.84	6130.60	2
10 October 1980	93.87	6130.57	2
November 1980	----	-------	-
December 1980	----	-------	-
January 1981	----	-------	-
25 February 1981	94.35	6130.09	2
27 May 1981	94.78	6129.66	2
05 June 1981	93.78	6130.66	2
08 June 1981	93.65	6130.79	2
17 June 1981	93.64	6130.80	2

1 B.M. 6224.44
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL 1B

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
14 December 1975	>36.25[5]	>6189.22	3
23 March 1976	36.10	6189.37	2
19 April 1976	36.10	6189.37	2
02 May 1976	36.30	6189.17	3
07 July 1976	36.15	6189.32	2
06 October 1976	36.00	6189.47	2
20 January 1977	35.83	6189.64	2
12 April 1977	35.85	6189.62	2
13 July 1977	36.21	6189.26	2
19 October 1977	35.75	6189.72	2
15 March 1978	35.80	6189.67	3
31 March 1978	36.21	6189.26	2
19 May 1978	36.00	6189.47	2
26 June 1978	35.92	6189.55	3
01 September 1978	36.98	6188.49	3
13 September 1978	36.98	6188.49	3
23 October 1978	35.42	6190.05	2

1 B.M. 6225.47
2 SOHIO
3 AGW
4 HYDRO
5 Discrepancy in total depth data

WATER LEVEL MEASUREMENTS IN MONITOR WELL IB

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
11 January 1979	35.38	6190.09	2
15 February 1979	35.32	6190.15	2
06 March 1979	35.61	6189.86	2
18 April 1979	35.68	6189.79	2
22 May 1979	35.65	6189.82	2
04 June 1979	38.57	6189.90	3
13 June 1979	35.55	6189.92	2
09 July 1979	35.65	6189.82	2
21 August 1979	35.69	6189.78	2
12 September 1979	35.83	6189.64	3
25 September 1979	35.69	6189.78	2
15 October 1979	35.65	6189.82	2
21 November 1979	35.92	6189.55	2
15 December 1979	35.80	6189.67	3
27 December 1979	36.08	6189.39	2
29 January 1980	36.04	6189.43	2
22 February 1980	36.12	6189.35	2
24 March 1980	36.07	6189.40	2
15 April 1980	36.02	6189.45	2
27 May 1980	36.05	6189.42	2

1 B.M. 6225.47
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL 1B

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
25 June 1980	36.02	6189.45	2
29 July 1980	36.17	6189.30	2
26 August 1980	36.20	6189.27	2
30 September 1980	35.96	6189.51	2
10 October 1980	36.08	6189.39	2
21 November 1980	DAMP	-------	2
12 December 1980	36.12	6189.35	2
28 January 1981	36.10	6189.37	2
25 February 1981	DAMP	-------	2
30 March 1981	36.23	6189.24	2
06 April 1981	36.38	6189.09	2
09 April 1981	36.37	6189.10	2
16 April 1981	36.60	6188.87	2
20 April 1981	36.00	6189.47	
24 April 1981	36.22	6189.25	2
27 April 1981	36.28	6189.19	2
28 April 1981	36.28	6189.19	2
01 May 1981	36.33	6189.14	2
05 May 1981	36.32	6189.15	2
08 May 1981	36.32	6189.15	2
11 May 1981	36.32	6189.15	2
15 May 1981	36.32	6189.15	2
18 May 1981	36.20	6189.27	2

1 B.M. 6225.47
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL 1B

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
19 May 1981	36.25	6189.22	2
21 May 1981	36.24	6189.23	2
26 May 1981	36.25	6189.22	2
27 May 1981	36.25	6189.22	2
01 June 1981	36.29	6189.18	2
17 June 1981	36.25	6189.22	2

1 B.M. 6225.47
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL 2A

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
14 December	> 80.50	> 6109.4	3
23 March 1976	> 80.50	> 6109.4	2
19 April 1976	> 80.50	> 6109.4	2
02 May 1976	62.70	6127.2	3
07 July 1976	62.88	6127.02	2
06 October 1976	62.83	6127.07	2
20 January 1977	63.24	6126.66	2
12 April 1977	62.95	6126.95	2
13 July 1977	63.41	6126.49	2
19 October 1977	63.24	6126.66	2
15 March 1978	53.75	6136.15	3
31 March 1978	52.69	6137.21	2
19 May 1978	52.30	6137.60	2
26 June 1978	51.90	6138.00	3
01 September 1978	51.37	6138.53	3
13 September 1978	51.30	6138.60	3
23 October 1978	50.04	6139.86	2

1 B.M. 6189.9
2 SOHIO
3 AGW
4 HYDRO
5 Discrepancy in total depth data

WATER LEVEL MEASUREMENTS IN MONITOR WELL 2A

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
12 December 1978	49.51	6140.39	3
11 January 1979	49.90	6140.0	2
15 February 1979	49.60	6140.30	2
05 March 1979	47.82	6142.08	3
06 March 1979	49.60	6140.3	2
18 April 1979	49.52	6140.38	2
22 May 1979	49.35	6140.55	2
04 June 1979	49.15	6140.75	2
13 June 1979	49.36	6140.54	3
09 July 1979	48.91	6140.99	2
21 August 1979	48.83	6141.07	2
12 September 1979	48.58	6141.32	3
25 September 1979	48.03	6141.87	2
15 October 1979	48.50	6141.40	2
21 November 1979	48.50	6141.40	2
15 December 1979	48.18	6141.72	3
27 December 1979	48.65	6141.25	2
28 January 1980	48.18	6141.72	2
22 February 1980	48.11	6141.79	2
24 March 1980	48.00	6141.9	2
15 April 1980	47.70	6142.20	2
27 May 1980	47.39	6142.51	2

1 B.M. 6189.9
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL 2A

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
25 June 1980	47.26	6142.64	2
29 July 1980	47.11	6142.79	2
26 August 1980	47.01	6142.89	2
30 September 1980	46.03	6143.87	2
10 October 1980	46.84	6143.06	2
21 November 1980	46.78	6143.12	2
12 December 1980	46.82	6143.08	2
28 January 1981	46.63	6143.27	2
25 February 1981	46.56	6143.34	2
10 March 1981	46.58	6143.32	2
13 March 1981	46.94	6142.96	2
16 March 1981	46.42	6143.48	2
20 March 1981	46.38	6143.52	2
23 March 1981	46.49	6143.41	2
27 March 1981	46.47	6143.43	2
31 March 1981	46.52	6143.38	2
06 April 1981	46.30	6143.60	2
09 April 1981	46.37	6143.53	2
13 April 1981	46.45	6143.45	2
16 April 1981	46.38	6143.52	2
20 April 1981	46.34	6143.56	2
24 April 1981	46.48	6143.42	2
27 April 1981	46.35	6143.55	2
28 April 1981	46.33	6143.57	2

1 B.M. 6189.9
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL 2A

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
01 May 1981	46.64	6143.26	2
18 May 1981	46.34	6143.56	2
18 May 1981	46.32	6143.58	2
19 May 1981	46.42	6143.48	2
20 May 1981	46.24	6143.66	2
21 May 1981	46.22	6143.68	2
22 May 1981	46.21	6143.69	2
26 May 1981	46.12	6143.78	2
01 June 1981	46.32	6143.58	2
09 June 1981	46.12	6143.78	4
17 June 1981	46.41	6143.49	2

1 B.M. 6189.9
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL 2B

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
14 December 1975	37.40	6150.10[1]	3
23 March 1976	34.92	6152.68	2
19 April 1976	34.82	6152.68	2
02 May 1976	37.20	6150.30	3
07 July 1976	36.58	6150.92	2
06 Ocrober 1976	36.54	6150.96	2
20 January 1977	36.63	6150.87	2
12 April 1977	36.13	6151.37	2
13 July 1977	36.61	6150.89	2
19 October 1977	36.34	6151.16	2
15 March 1978	36.34	6151.16	3
31 March 1978	36.48	6151.02	2
19 May 1978	36.60	6150.90	2
26 June 1978	36.51	6150.99	3
01 September 1978	36.42	6151.08	3
13 September 1978	36.97	6150.53	3
23 October 1978	36.38	6151.12	2

1 B.M. 6187.50
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL 2B

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
12 December 1978	35.25	6152.25	3
11 January 1979	35.82	6151.68	2
15 February 1979	35.86	6151.64	2
05 March 1979	35.16	6152.34	3
06 March 1979	35.88	6151.62	2
18 April 1979	36.13	6151.37	2
22 May 1979	36.12	6151.38	2
04 June 1979	36.41	6151.09	3
13 June 1979	35.98	6151.52	2
09 July 1979	35.92	6151.58	2
21 August 1979	36.06	6151.44	2
12 September 1979	36.19	6151.31	3
25 September 1979	35.40	6152.10	2
16 October 1979	35.35	6152.15	2
21 November 1979	35.34	6152.16	2
15 December 1979	35.91	6151.59	3
27 December 1979	35.93	6151.57	2
28 January 1980	36.13	6151.37	2
22 February 1980	36.24	6151.26	2
24 March 1980	36.26	6151.24	2
15 April 1980	36.08	6151.42	2
27 May 1980	36.12	6151.38	2

1 B.M. 6187.50
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL 2B

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
25 June 1980	36.09	6151.41	2
29 July 1980	36.41	6151.09	2
26 August 1980	36.08	6151.42	2
30 September 1980	36.30	6151.20	2
10 October 1980	36.27	6151.23	2
21 November 1980	36.10	6151.50	2
12 December 1980	35.95	6151.63	2
28 January 1981	35.98	6151.60	2
25 February 1981	36.79	6150.79	2
30 March 1981	36.52	6151.06	2
06 April 1981	36.65	6150.93	2
09 April 1981	36.53	6151.05	2
13 April 1981	36.81	6150.77	2
16 April 1981	36.26	6151.32	2
20 April 1981	36.49	6151.09	2
24 April 1981	36.53	6151.05	2
27 April 1981	36.50	6151.08	2
28 April 1981	36.48	6151.10	2
05 May 1981	36.59	6150.99	2
08 May 1981	36.51	6151.07	2

1 B.M. 6187.50
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL 2B

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
09 June 1981	36.48	6151.10	4
10 June 1981	36.49	6151.09	4
17 June 1981	36.65	6150.93	2

1 B.M. 6187.50
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL 3A

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
14 December 1975	32.10	6125.41	3
23 March 1976	29.78	6127.73	2
19 April 1976	29.78	6127.73	2
02 May 1976	32.10	6125.41	2
07 July 1976	31.75	6125.76	2
06 October 1976	31.67	6125.84	2
20 January 1977	31.65	6125.86	2
12 April 1977	31.33	6126.18	2
13 July 1977	31.79	6125.72	2
19 October 1977	31.43	6126.08	2
15 March 1978	30.36	6127.15	3
31 March 1978	31.90	6125.61	2
19 May 1978	31.75	6125.76	2
26 June 1978	33.33	6124.18	3
01 September 1978	31.75	6125.76	3
13 September 1978	33.18	6124.33	3
23 October 1978	31.46	6126.05	2

1 B.M. 6157.51
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL 3A

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
12 December 1978	30.60	6126.91	3
11 January 1979	30.56	6126.95	2
15 February 1979	31.08	6126.43	2
05 March 1979	32.26	6125.25	3
06 March 1979	31.48	6126.03	2
18 April 1979	31.58	6125.93	2
22 May 1979	31.60	6125.91	2
13 June 1979	31.49	6126.02	2
09 July 1979	31.45	6126.06	2
21 August 1979	31.58	6125.93	2
12 September 1979	31.68	6125.83	3
25 September 1979	31.58	6125.93	2
15 October 1979	31.58	6125.93	2
21 November 1979	31.57	6124.94	2
15 December 1979	31.16	6126.34	3
27 December 1979	31.04	6126.47	2
28 January 1980	30.77	6126.74	2
22 February 1980	30.91	6126.60	2
24 March 1980	30.76	6126.75	2
15 April 1980	30.27	6127.24	2
27 May 1980	29.74	6127.77	2

1 B.M. 6157.51
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL 3A

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
25 June 1980	29.36	612815	2
29 July 1980	28.77	6128.74	2
26 August 1980	28.31	6129.20	2
30 September 1980	27.51	6130.00	2
10 October 1980	27.41	6130.10	2
21 November 1980	26.12	6131.39	2
12 December 1980	25.57	6131.94	2
28 January 1981	24.96	6132.55	2
25 February 1981	24.39	6133.12	2
30 March 1981	23.68	6133.83	2
27 April 1981	24.00	6133.51	2
27 May 1981	23.48	6134.03	2
09 June 1981	22.89	6134.62	4
10 June 1981	22.89	6134.62	4
16 June 1981	23.20	6134.31	2

1 B.M. 6157.51
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL 3B

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
14 December 1975	20.10	6138.90	3
23 March 1976	17.50	6141.50	2
19 April 1976	17.50	6141.50	2
02 May 1976	20.10	6138.90	3
07 July 1976	20.00	6139.00	2
06 October 1976	20.00	6139.00	2
20 January 1977	19.90	6139.10	2
12 April 1977	19.71	6139.29	2
13 July 1977	20.07	6138.93	2
19 October 1977	19.80	6139.20	2
15 March 1978	29.60	6139.40	3
31 March 1978	20.00	6139.00	2
19 May 1978	19.95	6139.05	2
26 June 1978	19.50	6139.50	3
01 September 1978	20.00	6139.00	3
13 September 1978	19.19	6139.81	3
23 October 1978	20.21	6138.79	2

1 B.M. 6159.00
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL 3B

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
12 December 1978	21.17	6137.83	3
11 January 1979	14.75	6144.25	2
15 February 1979	19.28	6139.72	2
05 March 1979	20.17	6138.83	3
06 March 1979	19.69	6139.31	2
18 April 1979	19.81	6139.19	2
22 May 1979	19.87	6139.13	2
04 June 1979	20.16	6138.84	3
13 June 1979	19.69	6139.31	2
09 July 1979	19.67	6139.33	2
21 August 1979	19.77	6139.23	2
12 September 1979	19.46	6139.54	3
25 September 1979	19.03	6139.97	2
15 October 1979	19.02	6139.98	2
21 November 1979	19.03	6139.54	2
15 December 1979	19.59	6139.41	3
27 December 1979	19.78	6139.22	2
28 January 1980	16.52	6142.48	2
22 February 1980	16.82	6142.18	2
24 March 1980	16.93	6142.07	2
15 April 1980	16.83	6142.17	2
27 May 1980	17.00	6142.00	2

1 B.M. 6159.00
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL 3B

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
25 June 1980	18.25	6140.75	2
29 July 1980	17.96	6141.04	2
26 August 1980	17.93	6141.07	2
30 September 1980	17.44	6141.56	2
10 October 1980	17.36	6141.64	2
21 November 1980	17.13	6141.87	2
12 December 1980	17.09	6141.91	2
28 January 1981	16.87	6142.13	2
25 February 1981	16.73	6142.27	2
30 March 1981	16.96	6142.04	2
27 April 1981	16.51	6142.49	2
27 May 1981	16.15	6142.85	2
12 June 1981	16.11	6142.89	2

1 B.M. 6159.00
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL 4A

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
14 December 1975	34.10	6126.65	3
23 March 1976	32.27	6128.48	2
19 April 1976	32.27	6128.48	2
02 May 1976	34.30	6126.45	3
07 July 1976	34.08	6126.67	2
06 October 1976	34.00	6126.75	2
20 January 1977	33.94	6126.81	2
12 April 1977	33.43	6127.32	2
13 July 1977	33.93	6126.82	2
19 October 1977	33.83	6126.92	2
15 March 1978	33.65	6127.10	3
31 March 1978	33.68	6127.07	2
19 May 1978	33.70	6127.05	2
26 June 1978	34.97	6125.78	3
01 September 1978	32.50	6128.25	3
13 September 1978	33.42	6127.33	3
23 October 1978	31.32	6129.43	2

1 B.M. 6160.75
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL 4A

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
12 December 1978	32.25	6128.50	3
11 January 1979	30.90	6129.85	2
15 February 1979	31.30	6129.45	2
05 March 1979	31.78	6128.97	3
06 March 1979	31.58	6129.17	2
18 April 1979	31.09	6129.66	2
22 May 1979	30.85	6129.90	2
04 June 1979	30.84	6129.91	3
13 June 1979	30.75	6130.00	2
09 July 1979	30.48	6130.27	2
21 August 1979	30.48	6130.27	2
12 September 1979	30.34	6130.41	3
25 September 1979	30.17	6130.58	2
15 October 1979	30.20	6130.55	2
21 November 1979	30.19	6130.56	2
15 December 1979	30.02	6130.73	3
27 December 1979	29.93	6130.82	2
28 January 1980	29.76	6130.99	2
22 February 1980	29.68	6131.07	2
24 March 1980	29.63	6131.12	2
15 April 1980	29.31	6131.44	2
27 May 1980	29.03	6131.72	2

1 B.M. 6160.75
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL 4A

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
25 June 1980	29.02	6131.73	2
29 July 1980	28.71	6132.04	2
26 August 1980	28.34	6132.16	2
30 September 1980	27.94	6132.81	2
10 October 1980	28.26	6132.49	2
21 November 1980	27.61	6133.14	2
12 December 1980	27.33	6133.42	2
28 January 1981	26.93	6133.82	2
25 February 1981	26.94	6133.81	2
30 March 1981	26.68	6134.07	2
27 April 1981	20.14	6134.30	2
01 May 1981	26.56	6134.19	2
05 May 1981	26.44	6134.31	2
08 May 1981	26.18	6134.57	2
11 May 1981	26.34	6134.41	2
15 May 1981	26.18	6134.57	2
18 May 1981	26.50	6134.25	2
19 May 1981	26.52	6134.23	2
20 May 1981	26.14	6134.61	2
21 May 1981	26.17	6134.58	2
22 May 1981	26.16	6134.59	2
26 May 1981	26.14	6134.61	2
27 May 1981	26.18	6134.57	2
01 June 1981	26.16	6134.59	2

1 B.M. 6160.75
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENT, IN MONITOR WELL 4A

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
4 June 1981	25.99	6134.76	2
8 June 1981	25.99	6134.76	2
11 June 1981	25.97	6134.78	2
17 June 1981	26.17	6134.58	2

1 B.M. 6160.75
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL 4B

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
14 December 1975	>	> 6022.03	3
23 March 1976	15.91	6146.30	2
19 April 1976	15.91	6146.30	2
02 May 1976	16.90	6145.31	3
07 July 1976	16.94	6145.27	2
06 October 1976	16.75	6145.46	2
20 January 1976	16.55	6145.66	2
12 April 1977	16.64	6145.57	2
13 July 1977	16.99	6145.22	2
19 October 1977	16.82	6145.39	2
15 March 1978	17.05	6145.16	3
31 March 1978	16.50	6145.71	2
19 May 1978	16.10	6146.11	2
26 June 1978	16.88	6145.33	3
01 September 1978	16.54	6145.67	3
13 September 1978	16.88	6145.33	3
23 October 1978	16.29	6145.92	2
12 December 1978	19.96	6142.25	3
11 January 1979	16.05	6146.16	2

1 B.M. 6162.21
2 SOHIO
3 AGW
4 HYDRO
5 Discrepancy in total depth data

WATER LEVEL MEASUREMENTS IN MONITOR WELL 4B

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
15 February 1979	16.10	6146.11	2
05 March 1979	16.69	6145.52	3
06 March 1979	16.32	6145.89	2
18 April 1979	16.38	6145.83	2
22 May 1979	16.37	6145.84	2
04 June 1979	17.47	6144.74	3
13 June 1979	16.32	6145.89	2
09 July 1979	16.57	6145.64	2
21 August 1979	15.56	6145.65	2
12 September 1979	16.72	6145.49	3
25 September 1979	16.56	6145.65	2
15 October 1979	16.57	6145.64	2
21 November 1979	16.57	6145.64	2
15 December 1979	16.58	6145.63	3
27 December 1979	16.54	6145.67	2
28 January 1979	16.52	6145.69	2
22 February 1980	16.82	6145.39	2
24 March 1980	16.93	6145.28	2
15 April 1980	16.83	6145.38	2
27 May 1980	17.00	6145.21	2

1 B.M. 6162.21
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL 4B

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
25 June 1980	16.80	6145.41	2
29 July 1980	16.78	6145.43	2
26 August 1980	16.85	6145.36	2
30 September 1980	17.07 (damp)	6145.14	2
10 October 1980	17.07 (damp)	6145.14	2
21 November 1980	17.07 (damp)	6145.14	2
12 December 1980	16.79	6145.42	2
28 January 1981	16.78	6145.43	2
25 February 1981	16.72	6145.49	2
30 March 1981	16.70	6145.51	2
24 April 1981	15.84	6145.37	2
27 April 1981	16.79	6145.42	2
27 May 1981	16.66	6145.55	2
26 June 1981	16.40	6145.81	2
12 June 1981	16.59	6145.62	4

1 B.M. 6162.21
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL #5

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
11 January 1979	45.28	6125.95	2
15 February 1979	45.25	6125.98	2
06 March 1979	45.56	6125.67	2
18 April 1979	45.62	6125.61	2
22 May 1979	45.40	6125.83	2
04 June 1979	45.45	6125.78	3
21 August 1979	45.24	6125.99	2
12 September 1979	45.09	6126.14	3
15 December 1979	44.32	6126.91	3
28 January 1980	45.08	6126.15	2
22 February 1980	43.86	6127.37	2
24 March 1980	43.80	6127.43	2
15 April 1980	43.38	6127.85	2
27 May 1980	42.99	6128.24	2
25 June 1980	42.90	6128.33	2
29 July 1980	42.49	6128.74	2
26 August 1980	42.14	6129.09	2
30 September 1980	41.59	6129.64	2
10 October 1980	41.46	6129.77	2

1 B.M. 6171.23
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL #5

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
21 November 1980	41.09	6130.14	2
12 December 1980	40.85	6130.38	2
28 January 1981	43.72	(pump test) 6127.51	2
25 February 1981	44.00	6127.23	2
30 March 1981	43.66	6127.57	2
24 April 1981	44.48	6126.75	2
27 April 1981	44.40	6126.83	2
27 May 1981	42.63	6128.60	2
08 June 1981	40.47	6130.76	2
15 June 1981	40.50	6130.73	4
16 June 1981	40.20	6131.03	2

1 B.M. 6171.23
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL #6

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
11 January 1979	57.46	6126.22	2
15 February 1979	57.43	6126.25	2
06 March 1979	57.81	6125.87	2
18 April 1979	57.68	6126.00	2
22 May 1979	57.63	6126.05	2
04 June 1979	57.72	6125.96	3
21 August 1979	57.48	6126.20	2
12 September 1979	57.37	6126.31	3
15 December 1979	56.59	6127.09	3
28 January 1980	56.36	6127.32	2
22 February 1980	56.39	6127.29	2
24 March 1980	56.24	6127.44	2
15 April 1980	55.79	6127.89	2
27 May 1980	55.32	6128.36	2
25 June 1980	55.33	6128.35	2
29 July 1980	54.91	6128.77	2
26 August 1980	54.58	6129.10	2
30 September	54.13	6129.55	2
10 October 1980	54.12	6129.56	2

1 B.M. 6183.68
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL #6

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
21 November 1980	54.02	6129.66	2
12 December 1980	53.51	6130.17	2
28 January 1981	56.83 (pump test)	6126.85	2
25 February 1981	54.00	6129.68	2
10 March 1981	53.85	6129.83	2
30 March 1981	56.88 (pump test)	6126.80	2
27 April 1981	57.42	6126.26	2
27 May 1981	54.25	6129.43	2
09 June 1981	53.14	6130.54	4
10 June 1981	53.11	6130.57	4
15 June 1981	53.06	6130.62	2

1 B.M. 6183.68
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL #7

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
12 December 1978	36.94	6159.25	3
11 January 1979	69.49	6126.70	2
15 February 1979	69.42	6126.77	2
06 March 1979	69.78	6126.41	2
18 April 1979	69.62	6126.57	2
22 May 1979	69.71	6126.48	2
04 June 1979	69.69	6126.50	3
21 August 1979	69.60	6126.59	2
12 September 1979	69.45	6126.74	3
15 December 1979	68.90	6127.29	3
28 January 1980	68.51	6127.68	2
22 February 1980	68.77	6127.42	2
24 March 1980	68.61	6127.58	2
15 April 1980	68.01	6128.18	2
27 May 1980	67.79	6128.40	2
25 June 1980	67.78	6128.41	2
29 July 1980	67.33	6128.86	2
26 August 1980	67.07	6129.12	2
30 September 1980	66.66	6129.30	2
10 October 1980	66.77	6129.42	2

1 B.M. 6196.19
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL #7

Date	Depth (ft)		W.L. Altitude[1] (ft)	Source of Data
21 November 1980	66.46		6129.73	2
12 December 1980	66.12		6130.07	2
28 January 1981	70.77	(pump test)	6125.42	2
25 February 1981	66.79		6129.40	2
10 March 1981	66.98		6129.21	2
30 March 1981	71.26	(pump test)	6124.93	2
27 April 1981	71.64	(pump test)	6123.55	2
27 May 1981	66.26		6129.93	2
09 June 1981	65.79		6130.40	4
10 June 1981	65.76		6130.43	4
17 June 1981	65.75		6130.44	2

1 B.M. 6196.19
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL #8

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
12 December 1978	94.73	6113.46	3
11 January 1979	70.05	6138.14	2
15 February 1979	78.82	6129.37	2
06 March 1979	78.95	6129.24	2
18 April 1979	78.08	6130.11	2
22 May 1979	77.52	6130.67	2
04 June 1979	77.37	6130.82	3
21 August 1979	71.63	6136.56	2
12 September 1979	74.93	6133.26	3
15 December 1979	74.34	6133.85	3
28 January 1980	75.38	6132.81	2
22 February 1980	75.51	6132.68	2
24 March 1980	69.28	6138.91	2
15 April 1980	67.66	6140.53	2
27 May 1980	67.29	6140.90	2
25 June 1980	73.70	6134.49	2
29 July 1980	76.49	6131.70	2
26 August 1980	75.65	6132.54	2
30 September 1980	74.97	6133.22	2
10 October 1980	74.55	6133.64	2

1 B.M. 6208.19
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL #8

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
21 November 1980	----	-------	-
12 December 1980	----	-------	-
January 1981	----	-------	-
25 February 1981	76.26	6131.93	2
March 1981	----	-------	-
27 May 1981	75.58	6132.61	2
05 June 1981	74.29	6133.90	2
09 June 1981	73.95	6134.24	4

1 B.M. 6209.19
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL #9

Date	Depth (ft)		W.L. Altitude[1] (ft)	Source of Data
10 October 1980	144.93		6129.9	2
21 November 1980	146.32		6128.42	2
12 December 1980	145.64		6129.10	2
28 January 1981	147.72		6127.02	2
25 February 1981	145.27		6129.47	2
10 March 1981	145.13		6129.61	2
30 March 1981	149.88		6124.86	2
27 April 1981	150.11	(Pump test)	6124.63	2
27 May 1981	147.34		6127.40	2
25 June 1981	145.63		6129.11	2
29 June 1981	145.61		6129.13	2

1 B.M. 6274.74
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL #10

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
10 October 1980	105.66	6134.97	2
21 November 1980	106.32	6134.31	2
12 December 1980	104.64	6135.99	2
28 January 1981	--(Pump Test)	-------	2
25 February 1981	104.46	6136.17	2
30 March 1981	--(Pump Test)	-------	2
April 1981	--(Pump Test)	-------	2
May 1981	--(Pump Test)	-------	2
08 June 1981	104.82	6135.81	2
17 June 1981	104.60	6136.03	2

1 B.M. 6240.63
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL #11

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
10 October 1980	------	-------	-
21 November 1980	------	-------	-
12 December 1980	184.45	6025.33	2
28 January 1981	156.97	7052.81	2
25 February 1981	183.40	6026.38	2
30 March 1981	156.25	6053.53	2

1 B.M. 6209.78
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL #12

Date	Depth (ft)		W.L. Altitude[1] (ft)	Source of Data
10 October 1980	81.14		6128.81	2
21 November 1980	81.27		6128.68	2
12 December 1980	84.11		6125.84	2
28 January 1981	87.27	(Pump Test)	6122.68	2
25 February 1981	81.46		6128.49	2
10 March 1981	82.23		6127.72	2
30 March 1981	87.49	(Pump Test)	6122.46	2
04 June 1981	80.86		6129.09	2
15 June 1981	80.44		6129.51	2

1 B.M. 6209.95
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL #13

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
10 October 1980	------	-------	-
21 November 1980	209.00	5948.90	2
12 December 1980	204.99	5952.91	2
28 January 1981	198.88	5959.02	2
25 February 1981	193.00	5964.90	2
30 March 1981	193.08	5964.82	2
27 April 1981	199.28	5958.62	2
27 May 1981	198.25	5959.65	2
17 June 1981	198.61	5959.29	2

1 B.M. 6157.90
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL #14

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
10 October 1980	27.15	6128.58	2
21 November 1980	27.77	6127.96	2
12 December 1980	27.43	6128.30	2
28 January 1981	28.42	6127.31	2
25 February 1981	27.22	6128.51	2
30 March 1981	28.23	6127.50	2
April 1981	-- (Pump Test)	-------	2
May 1981	-- (Pump Test)	-------	2
16 June 1981	26.30	6129.43	2
17 June 1981	26.39	6130.34	4
18 June 1981	26.32	6130.41	2

1 B.M. 6156.73
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL #15

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
10 October 1980	19.51	6132.79	2
21 November 1980	20.37	6131.93	2
12 December 1980	19.87	6132.43	2
28 January 1981	20.26	6132.04	2
25 February 1981	20.35	6131.95	2
30 March 1981	20.06	6132.23	2
24 April 1981	20.14	6132.16	2
27 April 1981	20.07	6132.23	2
01 May 1981	20.08	6132.22	2
05 May 1981	20.16	6132.14	2
08 May 1981	19.94	6132.36	2
11 May 1981	19.92	6132.38	2
15 May 1981	19.90	6132.40	2
18 May 1981	20.09	6132.21	2
19 May 1981	20.08	6132.22	2
20 May 1981	19.78	6132.52	2
21 May 1981	19.70	6132.60	2
22 May 1981	19.77	6132.53	2
26 May 1981	19.98	6132.36	2
27 May 1981	19.92	6132.38	2
01 June 1981	19.94	6132.36	2
04 June 1981	19.95	6132.35	2
11 June 1981	19.96	6132.34	4

1 B.M. 6152.3
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL #15

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
15 June 1981	19.96	6132.34	2
17 June 1981	20.15	6132.15	2
18 June 1981	20.15	6132.15	2

1 B.M. 6152.3
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL #16

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
10 October 1980	Dry		2
21 November 1980	Dry		2
12 December 1980	Dry		2
28 January 1981	Dry		2
25 February 1981	Dry		2
30 March 1981	Dry		2
27 April 1981	Dry		2
27 May 1981	Dry		2
17 June 1981	Dry		2

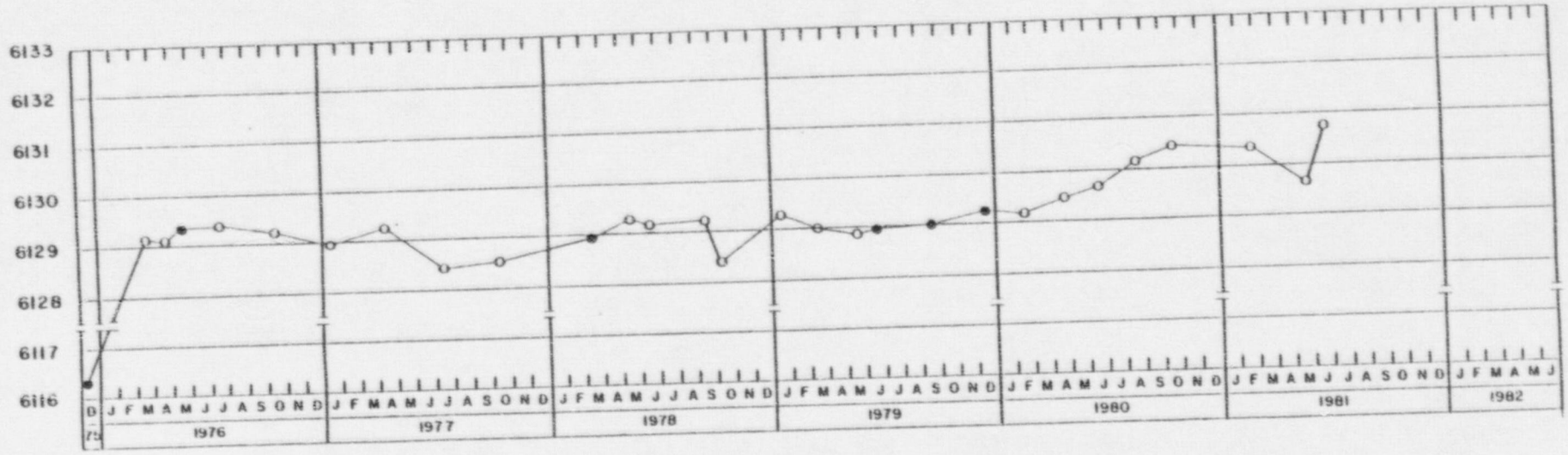
1 B.M. 6208.81
2 SOHIO
3 AGW
4 HYDRO

WATER LEVEL MEASUREMENTS IN MONITOR WELL #17

Date	Depth (ft)	W.L. Altitude[1] (ft)	Source of Data
10 October 1980	76.00	6131.49	2
21 November 1980	76.92	6130.57	2
12 December 1980	76.01	6131.48	2
29 January 1981	75.98	6131.51	2
25 February 1981	75.90	6131.59	2
10 March 1981	76.59	6130.90	2
27 April 1981	75.87	6131.62	2
27 May 1981	75.96	6131.53	2
11 June 1981	75.65	6131.84	4
17 June 1981	75.78	6131.71	2

1 B.M. 6207.49
2 SOHIO
3 AGW
4 HYDRO

MONITOR WELL No. 1A



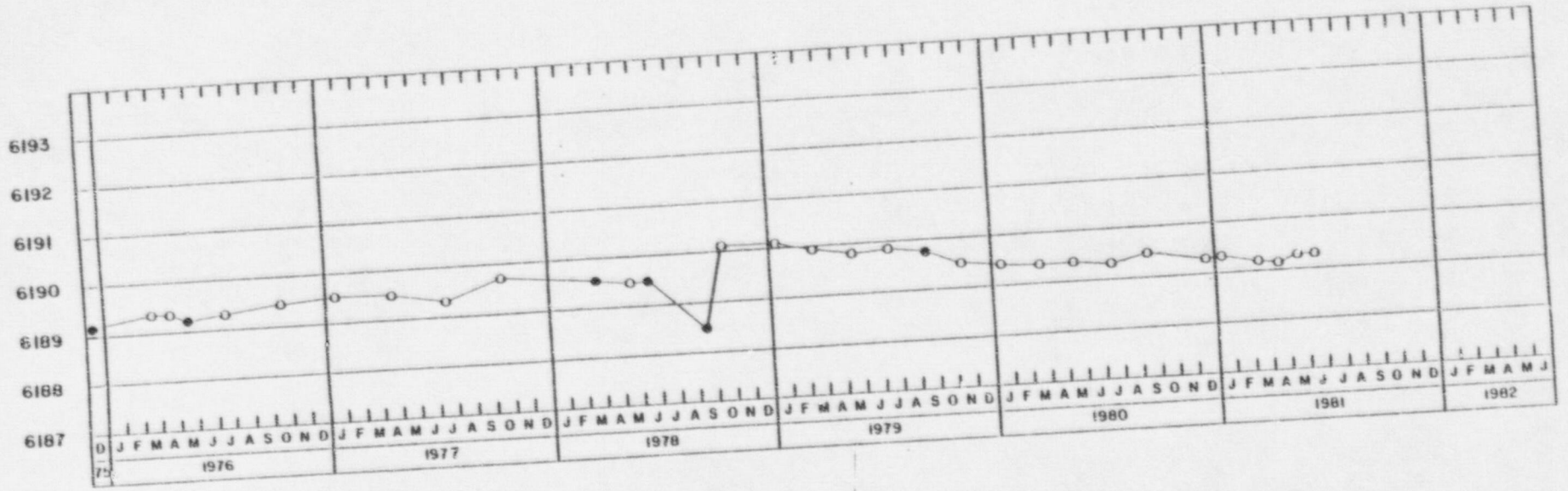
● AGW

○ SOHIO

△ HYDRO

Water level hydrograph for Well 1A

MONITOR WELL No. 1B



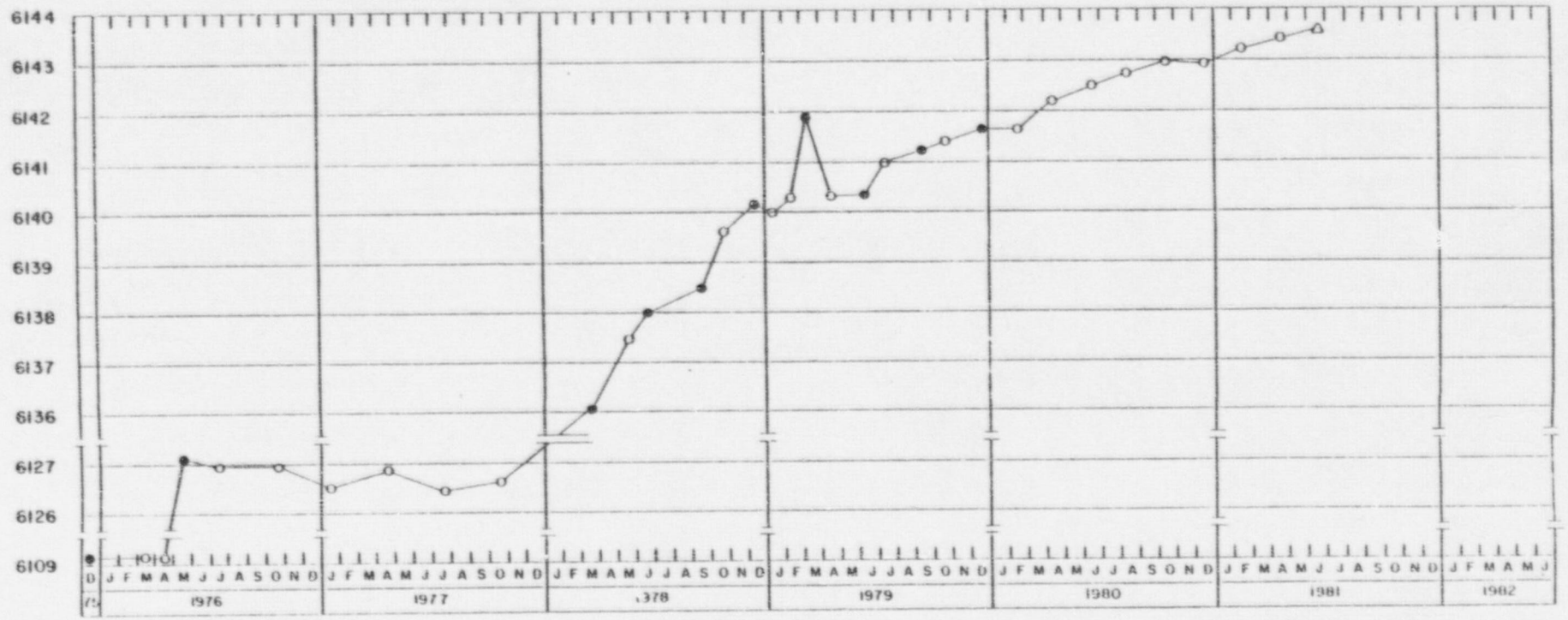
● AGW

O SOHIO

△ HYDRO

Water level hydrograph for Well 1B

MONITOR WELL No. 2A



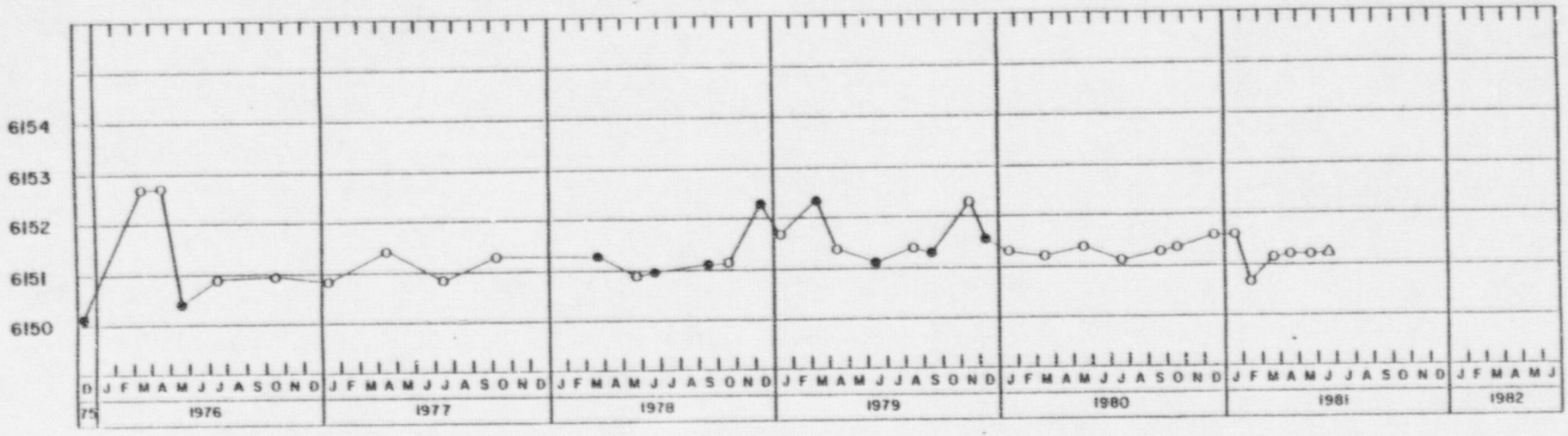
● AGW

○ SOHIO

△ HYDRO

Water level hydrograph for Well 2A

MONITOR WELL No. 2B



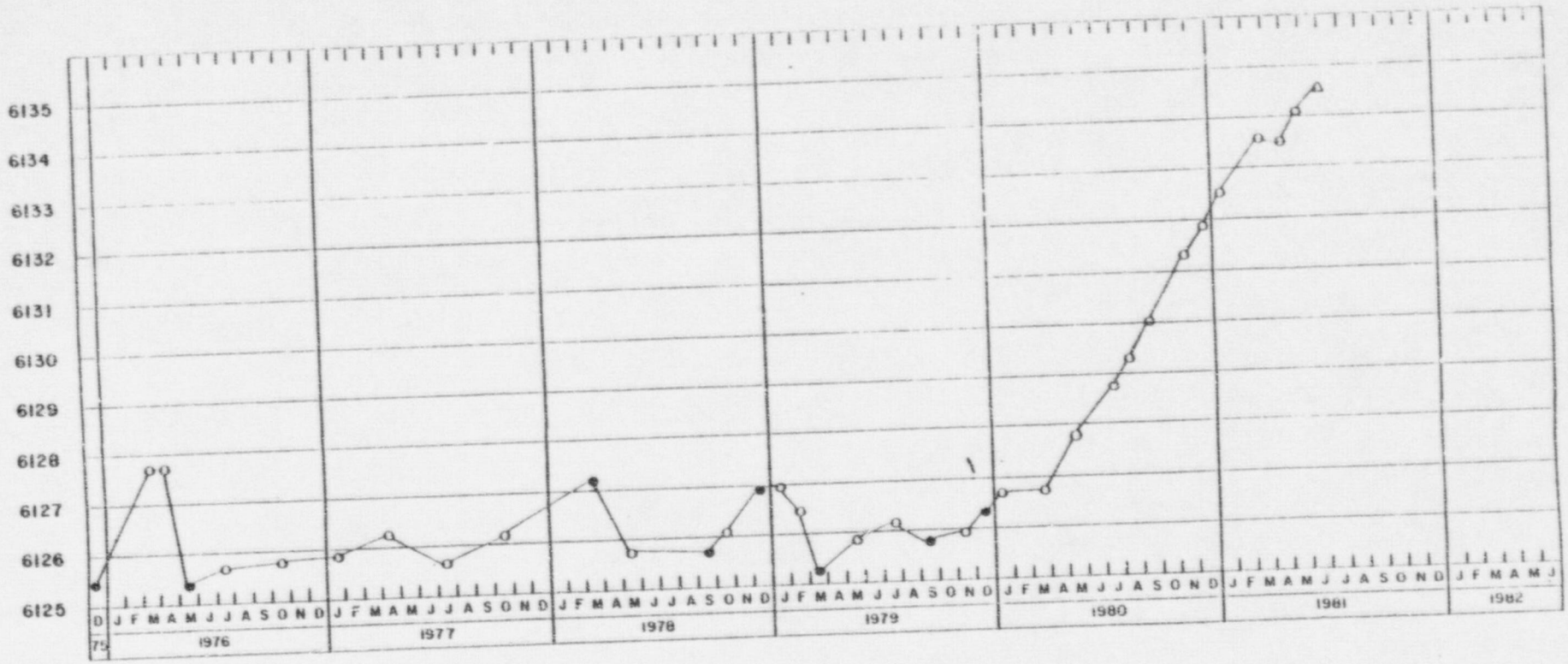
● AGW

O SOHIO

Δ HYDRO

Water level hydrograph for Well 2B

MONITOR WELL No. 3A



● AGW

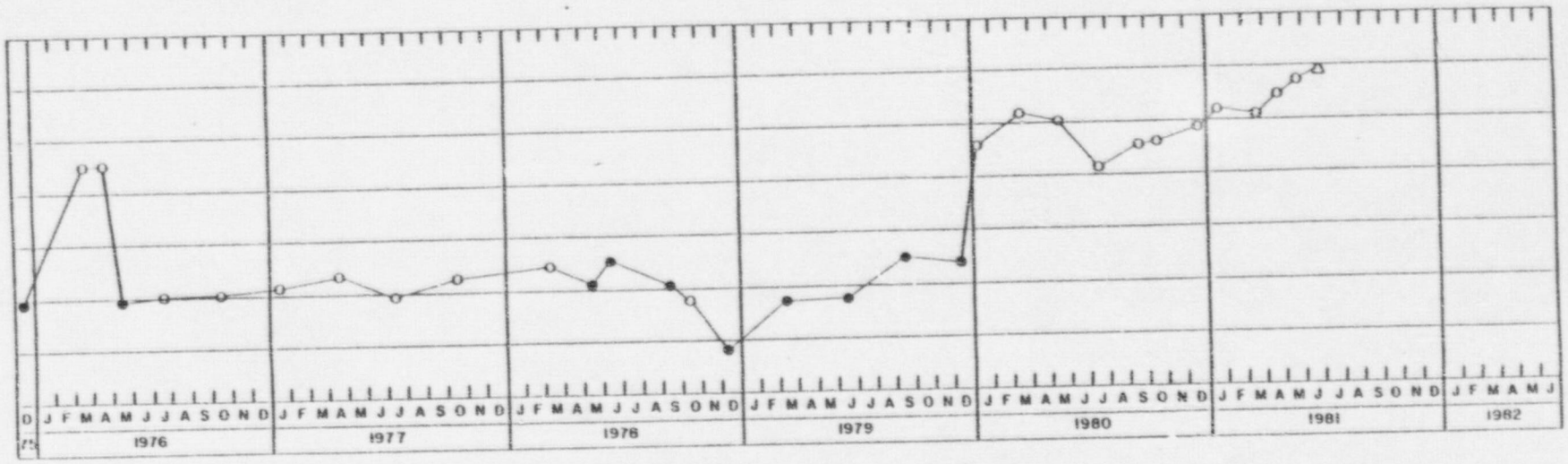
○ SOHIO

△ HYDRO

Water level hydrograph for Well 3A

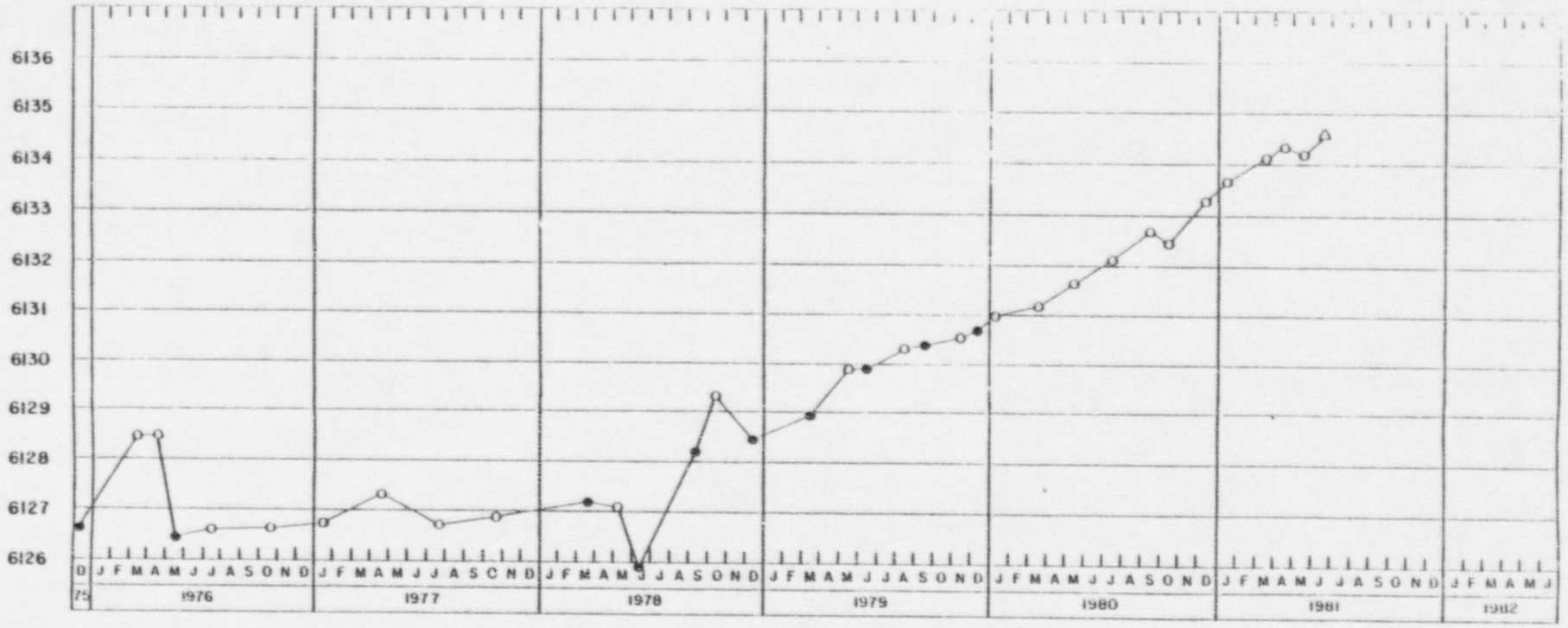
R-51

MONITOR WELL No. 38



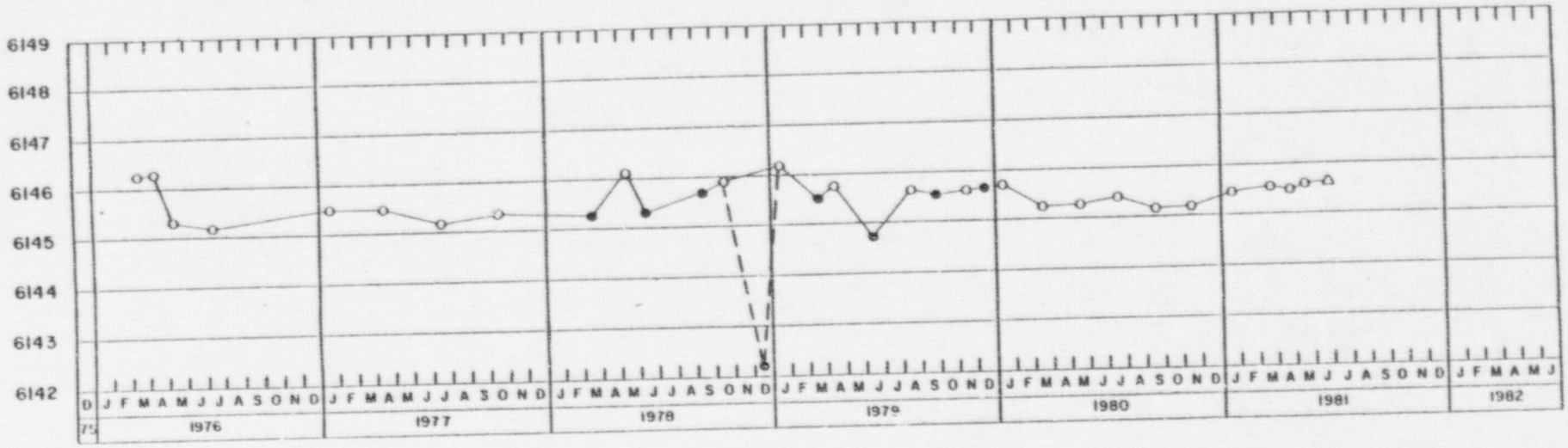
Water level hydrograph for Well 38

MONITOR WELL No. 4A



Water level hydrograph for Well 4A

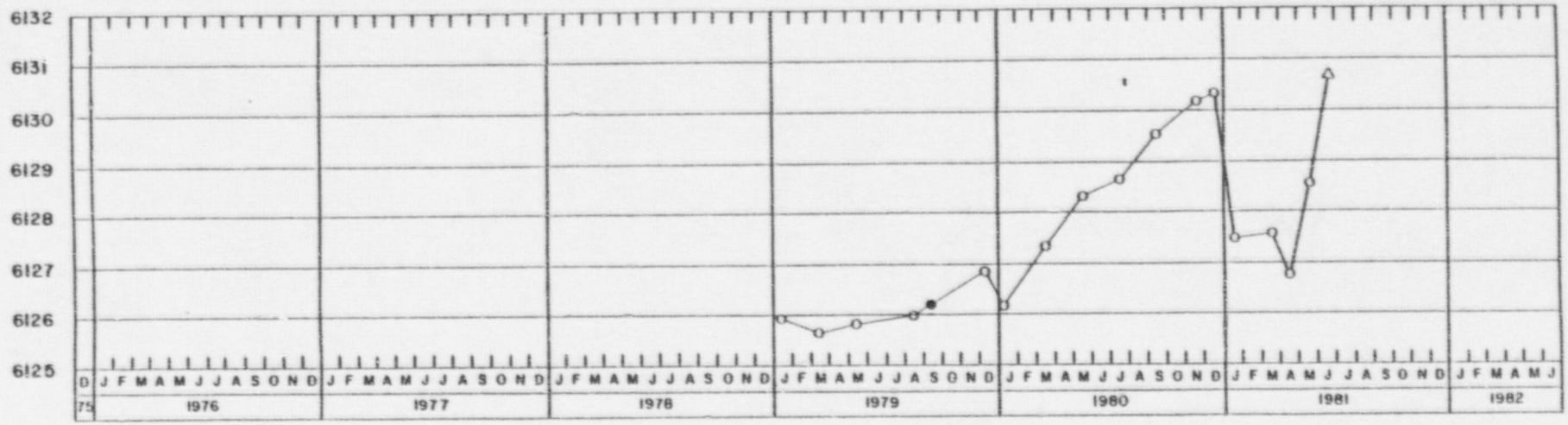
MONITOR WELL No. 48



● AGW
○ SOHIO
△ HYDRO

Water level hydrograph for Well 48

MONITOR WELL No. 5



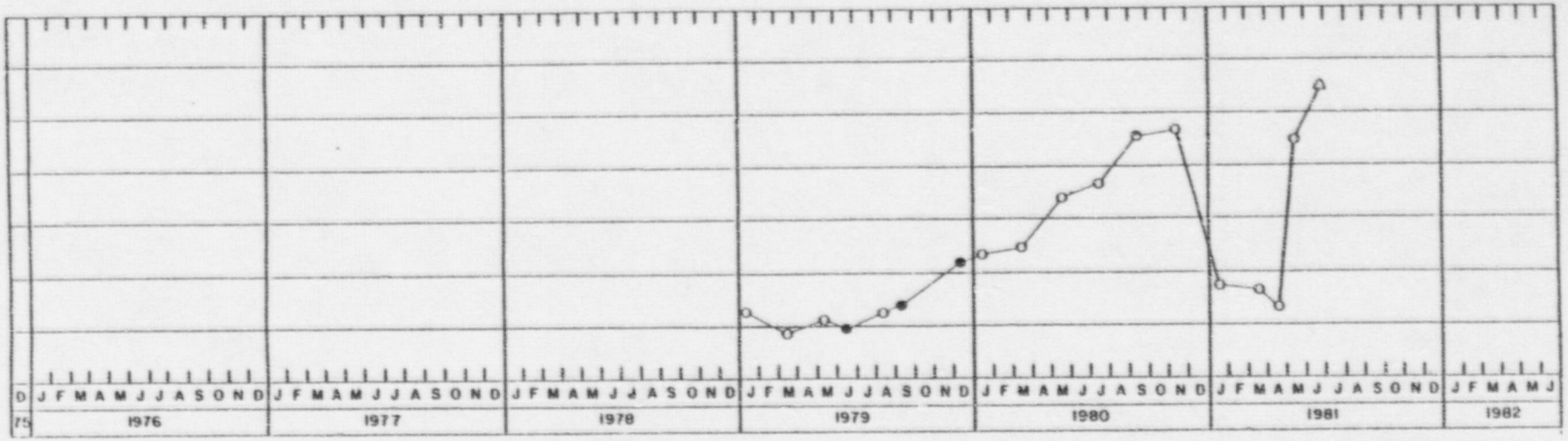
● AGW

○ SOHIO

△ HYDRO

Water level hydrograph for Well 5

MONITOR WELL No. 6



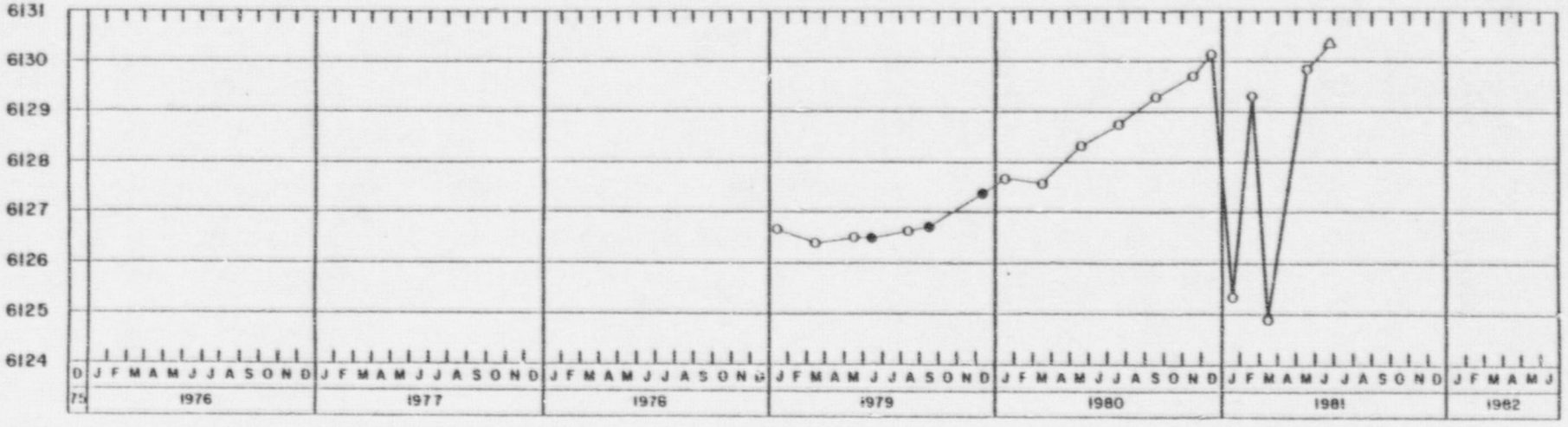
● AGW

○ SOHIO

△ HYDRO

Water level hydrograph for Well 6

MONITOR WELL No. 7



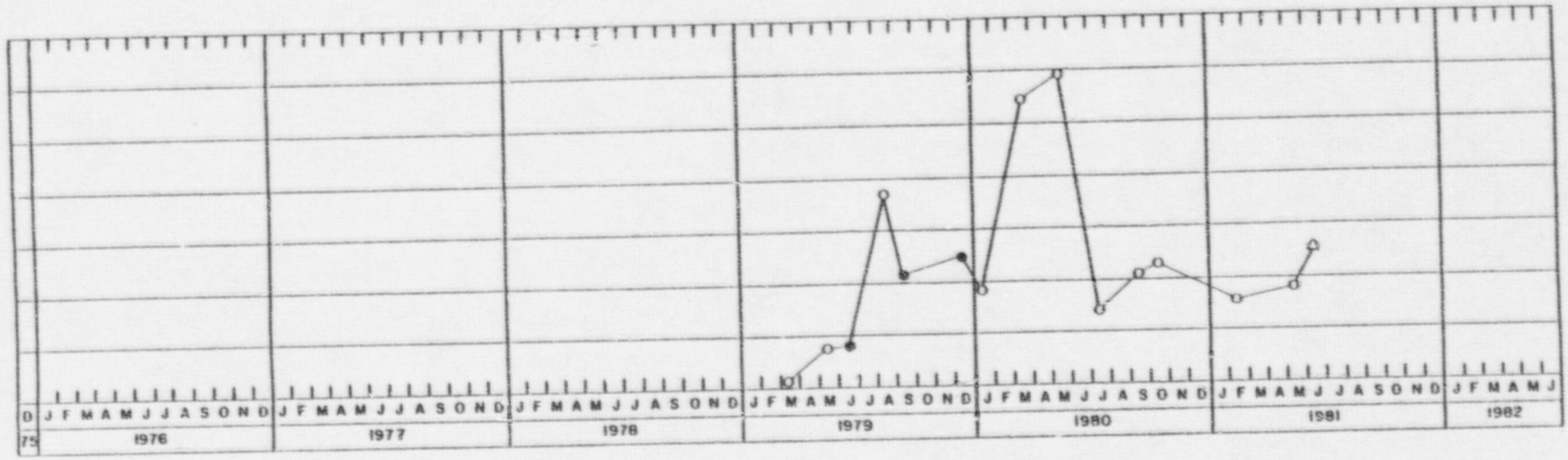
● AGW

○ SOHIO

△ HYDRO

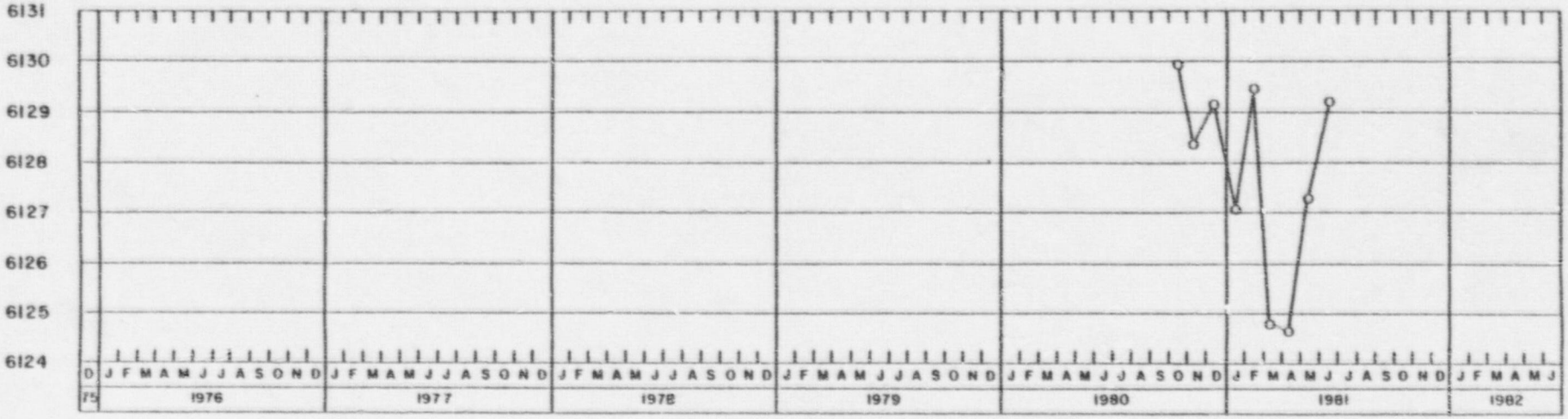
Water level hydrograph for Well 7

MONITOR WELL No. 8



Water level hydrograph for Well 8

MONITOR WELL No. 9



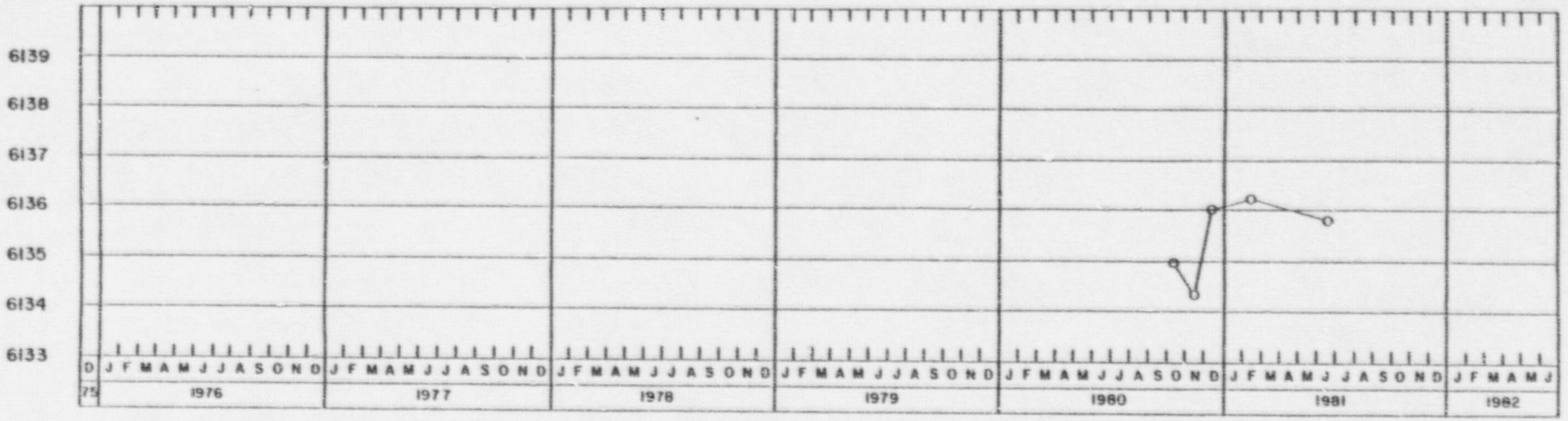
● AGW

○ SOHIO

△ HYDRO

Water level hydrograph for Well 9

MONITOR WELL No. 10



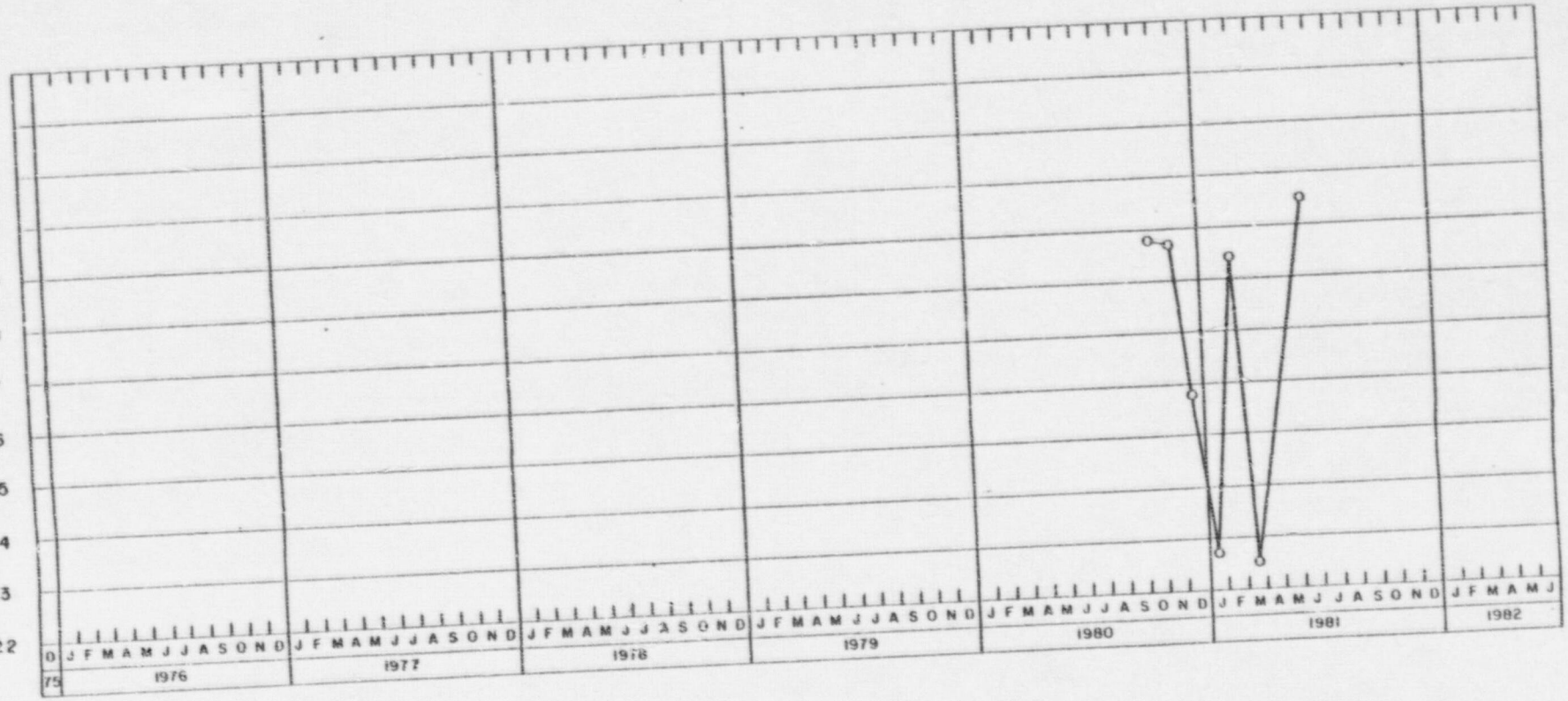
● AGW

○ SOHIO

△ HYDRO

Water level hydrograph for Well 10

MONITOR WELL No. 12



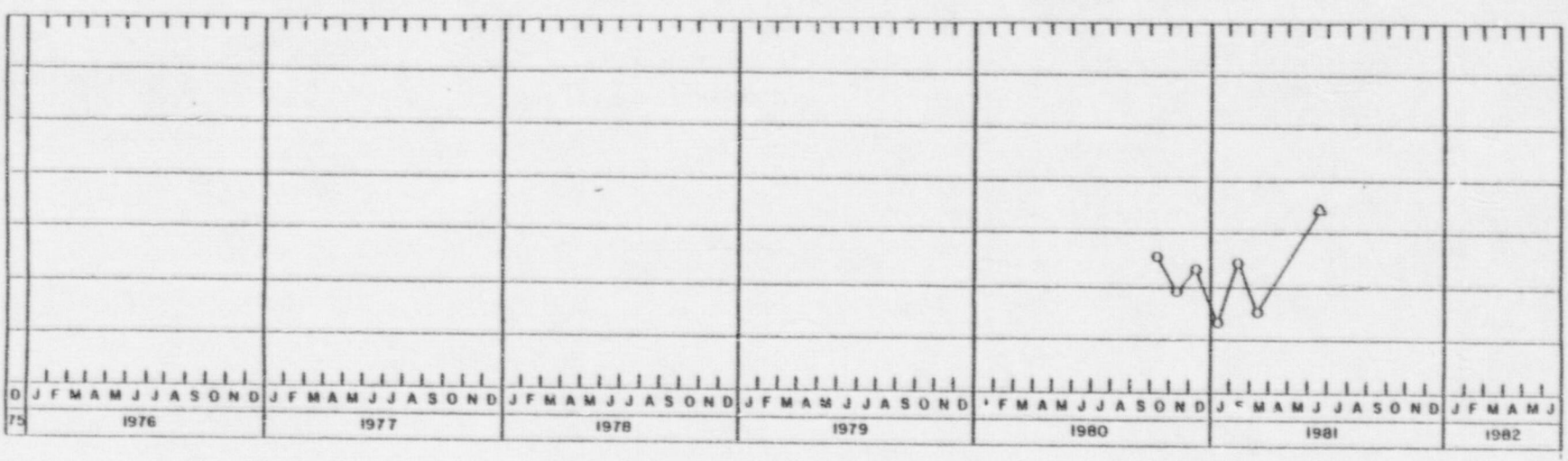
● AGW

○ SOHIO

△ HYDRO

Water level hydrograph for Well 12

MONITOR WELL No. 14



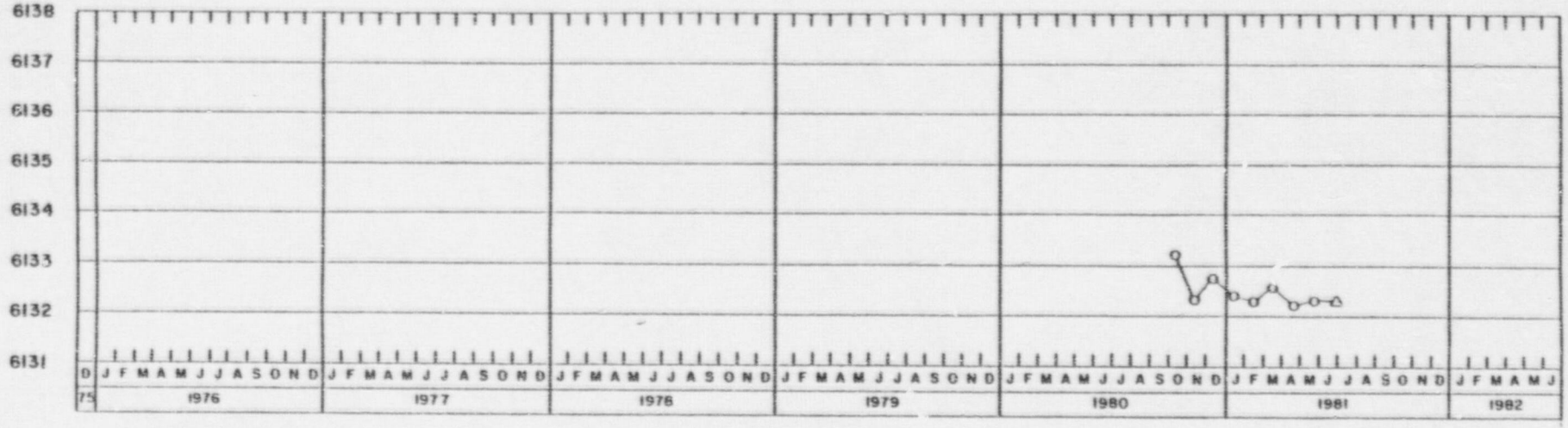
● AGW

○ SOHIO

△ HYDRO

Water level hydrograph for Well 14

MONITOR WELL No. 15



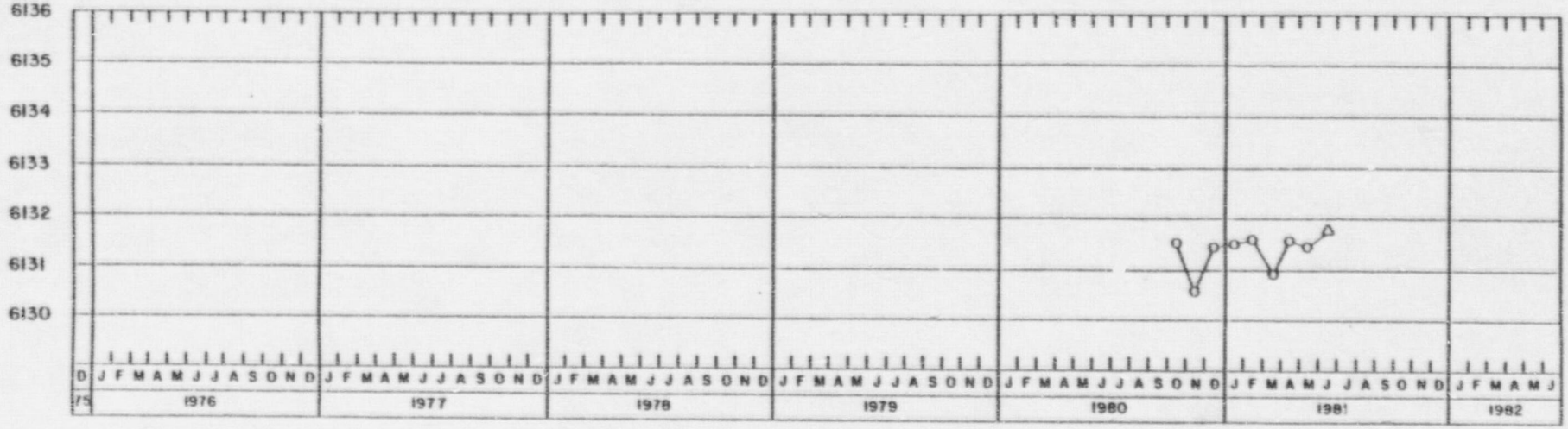
● AGW

○ SOHIO

△ HYDRO

Water level hydrograph for Well 15

MONITOR WELL No. 17



● AGW

○ SOHIO

△ HYDRO

Water level hydrograph for Well 17

APPENDIX C

LABORATORY ANALYTICAL METHODS AND DETECTION LIMITS FOR CHEMICAL CONSTITUENTS

APPENDIX C CONTENTS

PAGE

LABORATORY ANALYTICAL TECHNIQUES AND DETECTION LIMITS, ... C-1
SOHIO LABORATORY

LABORATORY ANALYTICAL TECHNIQUES AND DETECTION LIMITS, ... C-3
EAL LABORATORY

LABORATORY ANALYTICAL TECHNIQUES AND DETECTION LIMITS,
SOHIO LABORATORY

CONSTITUENT	ANALYTICAL TECHNIQUE	DETECTION LIMIT
Sodium	pp. 250-253, SMEWW[1/], 320 A Flame Photometric Method	0.1 mg/l
Potassium	pp. 234-235, SMEWW, 317 A Flame Photometric Method	0.5 mg/l
Calcium	pp. 189-190, SMEWW, 306 C EDTA Titrametric Method	4 mg/l
Magnesium	p. 223, SMEWW, 313 C Calculation Mehtod	--
Sulfate	pp. 493-495, SMEWW, 427 A Gravimetric Method with Ignition of Residue	20 mg/l
Chloride	pp. 303-304, SMEWW, 408 A Argentometric Method	--
Carbonate	pp. 278-282, SMEWW, 403 Alkalinity	--
Bicarbonate	pp. 278-282, SMEWW, 403 Alkalinity	--
Fluoride	pp. 391-393, SMEWW, 414 B Electrode Method	--
Conductivity	pp. 71-75, SMEWW, YSI Model 31 Conductivity Bridge	--
Total Dissolved Solids	pp. 91-93, SMEWW, 208 A	--
Iron	AAMM[2/], Atomic Absorption	0.01 mg/l
Barium	AAMM, Atomic Absorption	0.1 mg/l
Cadmium	AAMM, Atomic Absorption	0.01 mg/l
Chromium	AAMM, Atomic Absorption	0.06 mg/l
Zinc	AAMM, Atomic Absorption	0.008 mg/l
Manganese	AAMM, Atomic Absorption	0.02 mg/l
Nickel	AAMM, Atomic Absorption	0.06 mg/l
Uranium (U_3O_8)	Fluorimetric method suggested by the Raw Materials Development Lab., National Lead Co. Reported in report WIN-34, using a Jarrell Ash 26-000 (short-wave ultra-violet lamp)	0.001 mg/l

LABORATORY ANALYTICAL TECHNIQUES AND DETECTION LIMITS,
SOHIO LABORATORY (CONT.)

NOTES:

1/ Standard methods for the Examination of Water and Waste water (14th edition, 1975, APHA-AWWA-WPCF).

2/ Atomic Absorption Methods Manual, Volume I - Standard conditions for flame operation used in conjunction with Instrumentation Labs. Model 151 A/A Unit.

LABORATORY ANALYTICAL TECHNIQUES AND DETECTION LIMITS,
EAL LABORATORY

CONSTITUENT	ANALYTICAL TECHNIQUE	DETECTION LIMIT[1/]
Arsenic	EPA Method 206.2 - Low temperature acid digestion. Detection by heated graphite furnace AA at 193.4 nm.	0.02 mg/l
Selenium	EPA Method 270.2 - Low temperature acid digestion. Detection by heated graphite furnace AA at 196.0 nm.	0.02 mg/l
Mercury	EPA Method 245.1 - Acid/potassium permanganate digestion. Detection by cold vapor AA at 422.7 nm.	0.001 mg/l
Barium	EPA Method 208.1 - Nitric acid digestion. Matrix modification. Detection by flame AA at 553.6 nm.	0.1 mg/l
Cadmium	DPA Method 213.1 - Nitric acid digestion. Detection by flame AA at 228.8 nm.	0.004 mg/l
Chromium	EPA Method 218.1 - Nitric acid digestion. Detection by flame AA at 357.9 nm.	0.01 mg/l
Iron	EPA Method 236.1 - Nitric acid digestion. Detection by flame AA at 248.3 nm.	0.05 mg/l
Lead	EPA Method 239.1 - Nitric acid digestion. Detection by flame AA at 283.3 nm.	0.03 mg/l
Manganese	EPA Method 243.1 - Nitric acid digestion. Detection by flame AA at 279.5 nm.	0.01 mg/l
Molybdenum	EPA Method 246.1 - Nitric acid digestion. Detection by flame AA at 313.3 nm.	0.1 mg/l
Nickel	EPA Method 249.1 - Nitric acid digestion. Detection by flame AA at 232.0 nm.	0.03 mg/l
Vanadium	EPA Method 286.1 - Nitric acid digestion. Detection by flame AA at 318.4 nm.	0.1 mg/l
Zinc	EPA Method 289.1 - Nitric acid digestion. Detection by flame AA at 213.9 nm.	0.006 mg/l
Alkalinity	EPA Method 310.1 - Titration with Hydrochloric acid to pH 4.5.	2 mg/l
Chloride	EPA Method 325.1 - Titration with mercuric nitrate.	1 mg/l
Fluoride	EPA Method 340.2 - Potentiometric titration using a specific ion electrode.	0.1 mg/l

LABORATORY ANALYTICAL TECHNIQUES AND DETECTION LIMITS,
EAL LABORATORY (CONT.)

CONSTITUENT	ANALYTICAL TECHNIQUE	DETECTION LIMIT[1/]
Nitrate	EPA Method 352.1 - Complexation of nitrate ion using brucine sulfate at 100°C. Colorimetric measurement at 410 nm.	0.1 mg/l
pH	EPA Method 150.1 - Direct measurement with pH meter.	0.1 unit
Total Dissolved Solids	EPA Method 160.1 - Sample filtered through glass fiber filter. Filtrate is evaporated and weighed to constant weight.	5 mg/l
Conductivity	EPA Method 120.1 - Direct measurement with conductivity meter.	1 µmhos/cm @ 25°C
Sulfate	EPA Method 375.4 - Conversion of sulfate ion to barium sulfate and resulting turbidity determined by nephelometer. Calculated by comparison to standard curve obtained by processing sulfate standards.	2.5 mg/l
Calcium	EPA Method 215.1 - Acid digestion. Matrix modification. Detection by flame AA at 422.7 nm.	0.02 mg/l
Magnesium	EPA Method 242.1 - Acid digestion. Matrix modification. Detection by flame AA at 285.2 nm.	0.01 mg/l
Potassium	EPA Method 258.1 - Acid digestion. Matrix modification. Detection by flame AA at 766.5 nm.	0.02 mg/l
Sodium	EPA Method 273.1 - Acid digestion. Matrix modification. Detection by flame AA at 589.0 nm.	0.03 mg/l
Radium-$_{226}$	Outgas aliquot in de-emanation bubbler tube with Helium. After 10-14 day ingrowth period Rn-$_{226}$ daughter is outgassed with Helium into Lucas cell and alpha counted.	0.10 pci/200 ml
Thorium-$_{230}$	Aliquot is traced with Th-$_{230}$ tracer. Thorium is purified by selective precipitations and extractions. Purified Thorium is electro-deposited on a disc for alpha pulse height spcetroscopy.	0.14 pci/.5 l
Uranium	Aliquot is fused with NaF-LiF. Fused pellet is read on Jarrell-Ash Fluorimeter and fluorescence converted to µg using calibrated U standard. An internal spike is run with each sample to determine quenching effects.	--

LABORATORY ANALYTICAL TECHNIQUES AND DETECTION LIMITS,
EAL LABORATORY (CONT.)

NOTES:

1/ Detection limit may be higher for samples with conductivity greater than 5000 µmhos/cm @ 25°C.

APPENDIX D

PUMP TEST THEORY

PUMP TEST THEORY

Theis, in 1935, introduced his equation which described a non-leaky, confined aquifer. The following is a general definition of the Theis equation:

$$T = 114.6Q\ W(u)/s$$

$$u = 2693r^2S/Tt$$

where: s = drawdown, in feet

Q = discharge, in gallons per minute (gpm)

$W(u)$ = well function = $\int_u^\infty \frac{e^{-u}}{u}\ du$

T = transmissivity, in gallons (gal)/day/ft

u = well function variable

r = observation well radius from pumping well, in feet

S = storage coefficient

and t = time since pumping started, in min.

Pump test data are analyzed by matching the log-log plot of drawdown versus time to Theis' type curve (W(u) vs. 1/u) and applying the above equations to the match. Pages 92-98 of Ferris and others (1962) present a more thorough discussion of the Theis equation.

The value of the integral expression for W(u) is given by the following series:

$$W(u) = -0.577216 - \log_e u + u - \frac{u^2}{2\cdot 2!} + \frac{u^3}{3\cdot 3!} - \frac{u^4}{4\cdot 4!} \cdots$$

where all terms are as previously defined. Jacob developed a simplified form of Theis' drawdown equation by truncating the well function series after

the first two terms. Assuming the truncation, the following equation was developed to analyze drawdown versus time data on semi-log plots and is called the straight-line or Jacob equation:

$$T = 264Q \log_{10} (t_2/t_1)/(s_2 - s_1)$$

or $$T = \frac{264Q}{\Delta s}$$

where: s_1 = drawdown, in feet, at time since pumping started, t_1, in minutes

s_2 = drawdown, in feet, at time since pumping started, t_2, in minutes

Δs = change in drawdown over one log cycle of time on a semi-log plot, in feet

A straight line is fitted to the semi-log plot of drawdown versus time (log scale) to obtain transmissivity. Jacob suggested that u values less than 0.01 are needed before his straight-line method is useful. However, a plot of W(u) versus 1/u on semi-log paper indicates that this method should be applicable for values of u as large as 0.1. Pages 98-100 of Ferris and others (1962) should be consulted for additional information on Jacob's method.

The well functions of the residual-drawdown form of Theis' equation can be approximated by using only the first two terms in the well function series. The following equations present the semi-log form of the Theis recovery equation:

$$T = 264Q \log_{10} (t/t')/s'$$

or $$T = 264Q/\Delta s'$$

where: t = time since pumping started, in minutes

t' = time since pumping stopped, in minutes

s' = residual drawdown, in feet

and $\Delta s'$ = change in residual drawdown over one log cycle of time on a semi-log plot, in feet

Therefore, when residual drawdown is plotted on an arithmetic scale versus t/t' on a logarithmic scale, the above equation can be used for the straight line fit. Pages 100-102 of Ferris and others (1962) should be consulted for a discussion of Theis' recovery method. Theis' recovery equation is for a non-leaky confined aquifer also.

The above definition of pump test theory is for a conventional test where one well is pumped at a constant rate for a drawdown period and then shut off for a recovery period. The following modifications to the Theis and Jacob equations will be used in the pump test analyses in this report.

Theis' equation can be modified to predict the observed drawdown from more than one pumping well. The following equations are for three pumping wells:

$$T = \frac{114.6}{s}\left[W(u_1)Q_1 + W(u_2)Q_2 + W(u_3)Q_3\right]$$

$$W(u_1) = -0.577216 - \log_e u_1 + u_1 - \frac{u_1^2}{2\cdot 2!} + \frac{u_1^3}{3\cdot 3!} - \frac{u_1^4}{4\cdot 4!} \cdots$$

$$u_1 = \frac{1.87 r_1^2 S}{Tt}$$

where: parameters are the same as before, plus:

u_1 = well function variable for pumping well 1
u_2 = well function variable for pumping well 2
u_3 = well function variable for pumping well 3
Q_1 = discharge of pumping well 1, in gpm
Q_2 = discharge of pumping well 2, in gpm
Q_3 = discharge of pumping well 3, in gpm
r_1 = observation well radius from pumping well 1, in ft.
r_2 = observation well radius from pumping well 2, in ft.
r_3 = observation well radius from pumping well 3, in ft.

The summation of the well functions times their corresponding discharge

$\left(\sum_{i=1}^{3} \left[W(u_i) Q^i \right] \right)$ are plotted against the inverse of the well function variable for the first pumping well ($1/u_1$). The log-log plot of drawdown versus time for each observation well is then matched to its individual type curve to obtain the aquifer properties.

The above Theis equation for three pumping wells can be modified using Jacob's approximation (see pp. 98-100 of Ferris, 1962) to obtain a straight-line (semi-log plot) for the drawdown data from three pumping wells. The u value of all three wells must meet the straight-line assumptions before the straight-line method is applicable. Jacob recommended that u values be less than 0.01 before the use of the straight-line method. The straight-line method can be used for u values less than 0.1 with the introduction of very little error. The following straight-line equation is equivalent to Jacob's equation for three pumping wells:

$$T = 264 \left(\sum_{i=1}^{3} Q_i \right) \log (t_2/t_1) \,/\, (s_2 - s_1)$$

$$= 264 \left(\sum_{i=1}^{3} Q_i \right) / \Delta s \text{ for } \Delta s \text{ over one log cycle of time}$$

$$S = 0.3 T t_o \left[(1/r_1^{\,2})^{Q_1} (1/r_2^{\,2})^{Q_2} (1/r_3^{\,3})^{Q_3} \right]^{1/\sum_{i=1}^{3} Q}$$

where: parameters are the same as before, plus:

$\sum_{i=1}^{3} Q_i$ = sum of discharges from the three pumping wells

s_2 = drawdown, in feet, at time since pumping started, t_2, in days

s_1 = drawdown, in feet, at time since pumping started, t_1, in days

t_o = time when drawdown equals zero (extension of straight-line fit to s = 0), in days

and S = storage coefficient

The drawdown data for an observation well is plotted on semi-log paper against time since the three wells began pumping. The slope of the straight-line fit is used with the sum of the discharges to compute the transmissivity, and the intercept of the straight line is used with the well radii and discharges to compute the storage coefficient.

The Theis equation for the recovery from three pumping wells with two off times for the pumping wells is as follows:

$$T = \frac{114.6}{s'}\left[W(u_1)Q_1 - W(u_1')Q_1 + W(u_2)Q_2 - W(u_2')Q_2 + W(u_3)Q_3 - W(u_3')Q_3\right]$$

$$u_1' = \frac{1.87r_1^2S}{Tt_1'}\ ,\quad u_2' = \frac{1.87r_2^2S}{Tt_1'}\ ,\quad u_3' = \frac{1.87r_3^2S}{Tt_2'}$$

where: parameters are the same as before plus:

u_1' = recovery well function variable for pumping well 1

u_2' = recovery well function variable for pumping well 2

u_3' = recovery well function variable for pumping well 3

t_1' = time since pumping of wells 1 and 2 stopped, in minutes

t_2' = time since pumping of well 3 stopped, in minutes

The well functions of this residual-drawdown form of Theis' equation can be approximated by using only the first two terms in the well function series. The following equations present the semi-log form of the Theis recovery equation for three pumping wells with wells being turned off at two different times:

$$T = \frac{264}{s'}\log\left[(t/t_1')^{(Q_1 + Q_2)}\ (t/t_2')^{Q_3}\right]$$

The Theis equation for one pumping well which is continuously pumped at three different discharge rates during the test is as follows:

$$T = \frac{114.6}{s'} \left[W(u_1)Q_1 - W(u_1')Q_1 + W(u_2)Q_2 - W(u_2')Q_2 + W(u_3)Q_3 - W(u')Q_3 \right]$$

$$u_1 = \frac{1.87r^2S}{Tt_1}, \quad u_1' = \frac{1.87r^2S}{Tt_2}, \quad u_2 = \frac{1.87r^2S}{Tt_2}$$

$$u_2' = \frac{1.87r^2S}{Tt_3}, \quad u_3 = \frac{1.87r^2S}{Tt_3}, \quad u' = \frac{1.87r^2S}{Tt'}$$

where: parameters are the same as before, except:

u_1 = well function variable for the first discharge rate

u_1' = recovery well function variable for the first discharge rate

u_2 = well function variable for the first discharge rate

u_2' = recovery well function variable for the first discharge rate

u_3 = well function variable for the third discharge rate

u' = recovery well function varia ble for the third discharge rate

t_1 = time since pumping started at first discharge rate, in min.

t_2 = time since pumping started at second discharge rate, in min.

t_3 = time since pumping started at third discharge rate, in min.

t' = time since pumping stopped, in min.

Q_1 = first discharge rate, in gpm

Q_2 = second discharge rate, in gpm

Q_3 = third discharge rate, in gpm

The semi-log form of the recovery equation for one pumping well with three separate discharge rates is as follows:

$$T = \frac{264}{s'} \log \left[(t_1/t_2)^{Q_1} (t_2/t_3)^{Q_2} (t_3/t')^{Q_3} \right]$$

A plot of the variables inside the parentheses of the log term versus the residual drawdown is used to determine the aquifer transmissivity from the straight line fit of the data.

The normal straight line equation for drawdown can be written in the following form with the combination of drawdown and discharge as the variable:

$$T = \frac{264}{\Delta(s/Q)}$$

where: T = transmissivity, in gal/day/ft.

$\Delta(s/Q)$ = change in the ratio of the drawdown and the discharge over one log cycle of time on a semi-log plot, in ft/gpm

The filling of the well casing after a short period of evacuation fits the above case for very low transmissivity aquifers. (See Schafer, 1980, for additional discussion.) The discharge is computed from the volume of water which filled the casing divided by the time value of the filling. The ratio of drawdown to discharge is plotted on semi-log paper against time since the start of the evacuation. The straight line fit of this data is used to estimate the transmissivity of the aquifer.