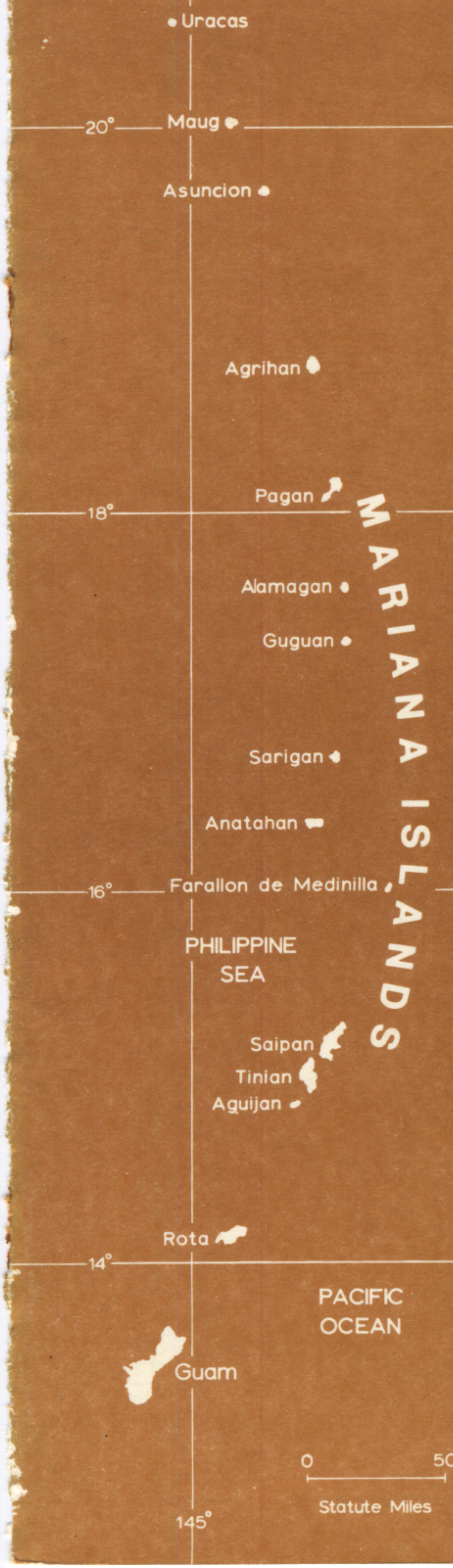

NUMERICAL MODELING OF SALT-WATER INTRUSION IN THE NORTHERN GUAM LENS

By

Dinshaw N. Contractor

Jerry F. Ayers

Stephen J. Winter

Water and Energy Research Institute of the Western Pacific

UNIVERSITY OF GUAM

Technical Report No. 27

August, 1981

NUMERICAL MODELING OF SALT-WATER INTRUSION IN THE NORTHERN GUAM LENS

By

Dinshaw N. Contractor
Jerry F. Ayers
Stephen J. Winter

UNIVERSITY OF GUAM

Water and Energy Research Institute
of the
Western Pacific

Technical Report No. 27

August, 1981

The work on which this report is based was supported in part by funds provided by the Guam Environmental Protection Agency in accordance with the Mathematical Modeling Sector of the Northern Guam Lens Study.

ABSTRACT

This study deals with the application of a two-dimensional, salt-water intrusion model (SWIGS2D) to the lens in northern Guam. The model uses finite element theory and the Galerkin, weighted-residual approach as its basis. A description of the model and program is provided in WERI Technical Report No. 26. The northern Guam lens was discretized into 299 linear, triangular elements and 189 nodes. The model was calibrated using 1978 hydrologic data. Elevations of the impervious basement of the aquifer were obtained from a seismic-refraction study. Hydrologic data necessary as input to the program consisted of recharge to the aquifer, water-production figures of all wells and elevations of the ocean. The recharge was obtained from an analysis of rainfall and streamflow in southern Guam. Results from the model were compared with the measured water levels in six observation wells. Calibration consisted of varying the permeability and porosity in the aquifer until acceptable agreement was obtained between measured and predicted water levels in all six wells. The calibrated values of permeability and porosity were then used to verify the model using 1979 data. The agreement between measured and predicted water levels in the six wells was good, the errors being slightly lower than those obtained in the calibration run.

A calibrated model can be used to make an infinite variety of management and planning studies. In this study, a few applications are provided that would be considered typical management runs and a few are provided that demonstrate the behavior and characteristics of the aquifer. Steady-state runs were made to compare the four conditions of no pumping, 1978 pumping levels, twice 1978 pumping levels and five times 1978 pumping levels. The differences in these conditions are shown in plan and in cross sections of the aquifer. The effect of zero recharge to the aquifer is demonstrated for conditions existing during 1978. An additional run shows how long the aquifer takes to reach steady state when the pumping rate is increased from the 1978 pumping level to twice that value. The program can be used for numerous other studies for management and planning purposes.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

Guam is located at 13° 28' N latitude and 144° 45' E longitude and is the largest and southernmost of the Mariana Islands. Guam is approximately 30 miles long, ranges from 4 to 11½ miles wide, and has a land area of 212 square miles excluding reefs (Fig. 1). The population of Guam is approximately 105,000 (1980 census). The island is divided into two nearly equal areas of different geology (Tracy et al, 1964). The northern half is a broad limestone plateau bounded by cliffs and the southern half is a dissected volcanic upland fringed with limestone along the east coast. The limestone plateau of northern Guam slopes gently to the southwest from an altitude of about 600 feet in the north to less than 100 feet at the narrow midsection of the island. Various limestone units rest on a basement complex of older volcanic rocks. Because of their low permeability, the volcanic rocks act generally as a barrier to groundwater movement.

The Mariana and the older Barrigada Limestone constitute the main aquifer of northern Guam. Taken together, the two limestone formations may be described as a permeable, massive, clean limestone that is relatively free of clay and volcanic detritus. An important exception is the Agana argillaceous member of the Mariana Limestone which contains from 2 to 6% clay (Tracy et al, 1964; p. A-48). The most important characteristics of the limestones in relation to groundwater movement are their high hydraulic conductivity and porosity. The distribution of conductivity over the northern half of the island is not uniform; the lowest conductivities are found in the Agana argillaceous member.

Almost all residences on Guam are served by the public water supply system. The approximate amount of water produced from all sources is 28.5 million gallons per day (mgd). Most of this water (56%) is withdrawn from the aquifer underlying the northern half of the island by means of approximately 75 wells. The remainder of the water is obtained from surface water sources in southern Guam (28%) and springs (16%). The largest single source of surface water is Fena Lake, a man-made lake in south central Guam. This reservoir is controlled by the Navy and produces approximately 8 mgd.

The economic growth and development of Guam is inextricably intertwined with the water resources available on the island. Increased quantity of water made available to the public is essential to future growth in population, industry and agriculture (Marsh and Winter, 1975; PUAG, 1971). Pumping water from the northern Guam lens is a very cost-effective method of increasing the water supply. Increased pumping, however, should provide that the quality of the water is not compromised at the higher levels of pumping. The quality of the water can be impaired by the sea water intruding into the aquifer or by the contamination of the lens from sewage, storm run-off, fertilizers, pesticides, industrial effluents, etc. Sea water intrusion depends on the recharge to the aquifer and the distribution and rate of pumping from the aquifer. If the rate of pumping exceeds the recharge rate, then mining of water from the aquifer takes place and it will be only a matter of time before the lens is depleted and the aquifer is contaminated with salt water. Recovery of the aquifer from such a condition would be a very slow process. The safe yield of the aquifer should be such that the equilibrium conditions reached after sustained pumping will not result in any adverse effect on the aquifer. To determine the safe yield of the Guam aquifer is the purpose of a project sponsored by the Guam Environmental Protection Agency. One of the tasks of the project was the development of a mathematical model for salt water intrusion. Contractor (1981) describes the finite element theory and the computer program (SWIGS2D) which was developed to solve a wide variety of groundwater flow problems. This report describes its application to the northern Guam lens.

GEOLOGY AND HYDROLOGY OF THE AQUIFER

Guam is divided into two nearly equal areas of different geology (Tracy, et al., 1964). The southern half of the island is a disected upland underlain by volcanic rocks of Eocene age. Minor amounts of limestone crop out along the eastern shoreline, in the Fena valley, along the ridge crest from Mt. Alifan to Mt. Lamlam, and on Orote pennisula. In contrast, the northern half of Guam is characterized by a broad, gently undulating limestone plateau. The plateau slopes southwestward from an altitude of about 600 feet in the north to less than 100 feet at the narrow midsection of the island. High wave-cut cliffs bound the plateau on the east, north, and west sides. The southern boundary is the east-west trending Adelup-Pago fault which separates the limestone plateau from the volcanic terraine of the south.

Two formations, the Mariana and older Barrigada, make up most of the rock of the northern plateau and together form the principal aquifer (Ward et al., 1965; Mink 1976). These major units form a thick sequence of limestone consisting of shoal, complex reef, and lagoonal facies. Permeability within the limestone units is highly variable due to numerous fissures and solution features and, for the Agana argillaceous member of the Mariana, varying amounts of clay.

Impervious volcanic rocks of probable Eocene age underlie the limestone aquifer of the northern plateau (Ward et al., 1965). Volcanic rocks crop out at three locations forming Mr. Santa Rosa, Mataguac Hill, and Palia Hill. Where exposed on the plateau, the volcanics are composed primarily of bedded tuffaceous shale and sandstone containing lapilli tuff with minor amounts of breccias conglomerate and basic flow rocks and dikes. These lithologic units have been assigned to the Alutom formation by Tracey et al., (1964).

The topographic relief of and depth to the impervious volcanic basement was determined by a seismic-refraction survey (Biehler and Walen, 1981). Application of the seismic-refraction method was successful because the volcanic rocks of the basement complex have a consistently higher seismic velocity (7000-9000 ft/sec) than the overlying limestones comprising most of the aquifer. The relatively lower velocities found in the limestones are probably related to the distribution of primary and secondary porosity. On most profiles, a two-layer system was observed; limestone overlying volcanic rocks or porous limestone overlying a limestone unit of lower porosity. However, in some profiles obtained at the north end of the plateau, a three-layer system was observed. Near surface velocities in the range of 2500-3000 ft/sec overlie an intermediate velocity limestone in the range of 5000-7000 ft/sec, which in turn overlie the volcanic basement with velocities in excess of 9000 ft/sec. The basement map of Figure 2 was constructed utilizing the results from the seismic-refraction survey in addition to drilling information.

Basement elevations at the nodes of the element network were interpolated from the map of Figure 2. As inferred from the contour lines of the basement map, there are a number of major topographic features that influence the flow of groundwater in the northern plateau. Of special interest are the topograhic highs over much of the north-central plateau and the 'Yigo trough' which extends from Dededo northeastward through Yigo between Mt. Santa Rosa and Mataguac Hill.

The trough is floored by volcanics located well below sea level and bounded on three sides by volcanic rocks which rise well above sea level.

Rainfall in northern Guam undergoes a loss due to evapotranspiration; the rest recharges the aquifer. There is no surface runoff (streamflow) on the limestone plateau. On the other hand, rainfall in southern Guam undergoes a loss due to evapotranspiration; the rest becomes direct runoff and streamflow. Very little infiltration occurs because of the impermeable volcanic rocks exposed at the surface in the south. This contrasting hydrologic feature is made use of by Mink (1976) to calculate the recharge to the aquifer in the north (the same technique is used in this report). The USGS publishes streamflow records for many streams in the south of Guam (U. S. Geological Survey, 1978). The annual flow in these streams can be converted to inches of runoff. Evapotranspiration in the south is then equal to the difference between the average rainfall in the south and this runoff. Evapotranspiration in the north can be taken to be equal to that in the south. Alternatively, evapotranspiration in the south can be corrected to give that in the north, by multiplying it by the ratio of the average rainfall in the south to the average rainfall in the north. The differences in the two procedures are only minor. Recharge to the northern aquifer is then equal to the average rainfall in the north minus the evapotranspiration. Over areas where the volcanic basement rises above sea level, recharge water percolating downward reaches the limestone-volcanic contact and then flows under gravity along the contact finally entering the groundwater-flow system. Thus, a flow boundary condition exists for that part of the aquifer where the volcanic basement is near sea level.

ELEMENT NETWORK

The aquifer was descretized into 299 linear triangular elements with 189 nodes. This element network is shown in Fig. 3. If fewer elements and nodes were used, the accuracy of the model would suffer. If more elements and nodes were used, computer memory limitations would be exceeded. For 189 nodes and 299 elements, the memory required was between 900K and 950K. The latter figure was used to be safe. Thus, the program could be run in a 1.0 mega-byte partition.

The element map was drawn to a scale of 1:24000. The 13°30'N latitude line was taken as the X axis and the 144°50'E longitude was taken as the Y axis. The X and Y coordinates of each node were determined from the Cartesian coordinate axes. These coordinates are entered into the program data set; a sample of this data is provided in Appendix B. The element data follow the nodal data and consist of the nodes comprising the element (anti-clockwise direction), the permeability and porosity of the element and whether the element is confined or unconfined and leaky or not.

There are 41 elements that have freshwater flow specified past one side. Thirty elements have one side along the sea coast and 40 nodes along the sea coast have a specified saltwater head. There are 77 pumps in Guam operated by different agencies for which flow data are available. The locations of these pumps do not always coincide with the nodes of the network. The pumps generally fall within an element and therefore the discharge of the pump has to be weighted to the three nodes of the element. Thus, a node may have weighted discharges from all the elements surrounding it. Table 1 gives the node numbers and proportion of pump discharge ascribed to them. Figure 4 shows the location of the production wells, and rain gages.

Some preliminary runs were made with the model to determine the accuracy of results when the time interval Δt is changed. Three runs were made starting from identical initial conditions. The first run was made using Δt = 1 week and results were obtained at the end of the month. The second run used Δt = 2 weeks, and results were also obtained at the end of 1 month. The last run used Δt = 1 month and results were obtained for one time increment. These results are presented in Table 2 for selected nodes. Using the run with Δt = 1 week as the standard, the differences of the results of the other runs is also shown in Table 2. It can be seen that using a time interval of 2 weeks results in an average absolute change of .628% and using a time interval of 1 month changes results in an average absolute change of 1.96%. For very accurate work, time intervals of 1 or 2 weeks should be used. Use of Δt = 1 month, however, does not result in much error and the execution time for running a program for a real time of 1 year will be much less. Hence, the calibration and verification runs described in the next two sections were made using Δt = 1 month.

CALIBRATION OF THE MODEL

The model was calibrated using the historical hydrological data of 1978. The parameters that were calibrated were the permeability and porosity in three different regions of the aquifer. Region I consisted of elements 1 thru 24; region II consisted of elements 25-83; and region III comprised the rest of the elements. Recharge to the aquifer was calculated in the manner indicated in the section on hydrology and the results are given in Table 3. It can be seen that the runoff of the streams in southern Guam in March was greater than the average rainfall in that region. This is due to the fact that some rainfall that occurred in the last few days of February caused runoff extending into the first few days of March. Also, the estimated evapotranspiration in northern Guam in July exceeded the rainfall for that month, resulting in no recharge to the aquifer. Recharge values from this table were converted to feet per second and input into the program. They were also used to calculate the flow rate entering the aquifer thru the boundaries around the Mataguac Hill, Mt. Santa Rosa, and Barrigada.

These daily levels were converted to a linear variation within a given month using least-square-error techniques. This was necessary because the calibrated runs were to be made using a time interval of 1 month. The pump rates, reported by the different agencies, were more or less constant throughout the year. Hence, constant pumping rates were used for the entire year. The total pumping rate for the year came to 18.5 mgd. The USGS has published daily water levels in six wells for 1978. These daily water levels were converted into linear variations within a month by least-square-error techniques. The model results were matched against these levels.

Several calibration runs were made in which the permeability and porosity of the three regions were changed until a good comparison was obtained between measured and computed results. It was found that the results were most sensitive to changes in permeability and not as sensitive to changes in porosity.

After several trials, the following values of the parameters were obtained that gave satisfactory results.

Final Calibrated Parameters

Region	Element Nos.	Permeability ft/day	Porosity
I	1-24	100	0.80
II	25-83	5000	0.45
III	84-299	20000	0.40

Figures 5 to 10 show the results of the calibration. The root-mean-square error for each well is shown in the figures and the average for the six wells is 0.462 feet. This level of calibration is satisfactory for many planning and management purposes. It should be pointed out that the comparison could possibly have been improved for any given observation well if the permeability in the element in which the well occurs was changed, while keeping the permeability in the region the same as before. Indeed, it is quite likely that the permeability in one element in the field is different from the permeability of neighboring elements. This could be referred to as fine tuning of the model, where the permeability of individual elements is changed. In the present stage of calibration, only the permeability of the three regions was determined.

Water elevation data in six observation wells is the only data available at present that can be used for calibration purposes. Another task of the northern Guam Lens Study is to drill exploratory wells for the purpose of obtaining geophysical data and information on the location of the interface. Interface data collected on a regular basis could also be used to calibrate the model. In this case an additional parameter can be calibrated. The additional parameter could be the salt-water permeability. There is reason to believe that the permeability of the aquifer in the salt-water region may be different from that in the fresh-water region. The model could easily simulate this condition.

VERIFICATION OF THE MODEL

One of the tests for any model is to see if the calibrated parameters are good for simulation in a time period different from the period used in calibration. In this case, data from the water year 1979 (USGS, 1979) was used for the verification. Even though the annual rainfall in 1979 was not very different from rainfall in 1978, the monthly distribution was different. The pumpage rates were approximately the same during the two years. The variation of ocean levels were different. Thus, the hydrologic conditions in 1979 were sufficiently different from those in 1978 to provide a good test of the model and its calibrated parameters.

Figures 11 to 16 show the verification of the model at the same six wells that were used in the calibration process. Root-mean-square errors at each well are indicated on the diagrams. The average of all these errors is 0.448 feet. This average error is slightly lower than the average error obtained in the final calibration run. Thus, the model gives reliable results, at least in the vicinity of the observation wells.

The USGS has published water elevation data for a new observation well for 1979 for the first time. Model results are compared with measured elevations for this well in Fig. 17. It can be seen that the computer results are far lower than the measured results. This suggests that the permeability in region I should be much less than 100 feet/day. It should probably be about 10 feet/day. If this permeability is compared with the permeability of region II, one can see ratios of 2 to 3 orders of magnitude. In routine groundwater work, one would make region I an impermeable zone and an impervious boundary to region II. If the program is to take region I into account with a permeability of 10 feet/day, then the verification run would have to use a much smaller time interval, Δt, than the value of 1 month that was used. Use of a time interval of a week or less, would increase the total execution time required for a year's simulation to an impractical value.

MANAGEMENT STUDIES

The calibrated and verified model can now be used for an infinite number of management and planning studies. Some of these studies can be made in the steady-state mode and considerable information can be obtained from them. The data is easy to obtain and input into the program and the execution time and cost are small. There are other studies that can only be made in the unsteady mode. Such studies, of necessity, are more complicated. They require more data and generally longer execution times. In this section, the results of a few management runs will be described. Both steady- and unsteady-state cases are discussed.

Steady-state runs show the consequence of various pumping conditions on the status of the phreatic surface and interface. Pumping scenaries considered are no pumping, 1978 pumping, twice 1978 pumping and five times 1978 pumping. Figure 18 shows a map of the northern Guam aquifer with contours of the phreatic surface on it for 1978 steady pumping rates. In most of the aquifer the water table is at most 2 or 3 feet above MSL. However, in the Yigo Trough, water levels can reach 8 or 9 feet above MSL. Map contours also indicate the general direction of movement of water in the aquifer. Figure 18 also indicates the location of the salt-water and the fresh-water toes in the aquifer. It can be seen that in the major area of the aquifer, freshwater occurs as a lens; i.e., the freshwater has a soft bottom (the interface) and is referred to as basal water. Between the salt-water toe and the boundary only freshwater exists; i.e., the fresh-water has a hard bottom (basement rock) and is referred to as para-basal water. The fresh-water toe is located very close to the boundary around Mataguac Hill, Mt. Santa Rosa and Barrigada. The differences in the location of the salt-water toe for different pumping rates are only minor. The major changes can be seen in figures 20 to 26 which present cross sections of the aquifer. (Locations of cross sections are shown in figure 19). It can be seen that the phreatic surface falls and the interface rises with increasing pumping rates. Table 4 shows the volume of the aquifer and the average depth of freshwater in the aquifer for the different pumping rates.

Two runs were made with the program in the unsteady mode. These runs studied the response of the aquifer to two different events. The first one dealt with the effects of the aquifer receiving no recharge for a year. The second one dealt with response of the aquifer when the pumping rate is suddenly doubled.

The first run tries to answer the question: What will happen if the aquifer does not receive any recharge for a whole year? Such an event is unlikely to occur in reality. However, it may be informative as an estreme case. The final calibration run of 1978 was rerun this time with the recharge made equal to zero throughout the year. Results of this run are presented in figures 27 to 32 at each of the observation wells. The water level in each well fluctuates from month to month even though the recharge to the aquifer is zero and the pumping rates are constant throughout the year. This, of course, is due to monthly fluctuations in sea level. The curves with and without recharge are separated very little and have similar shapes for the first six months of the year. This occurs because the calculated recharge is small during the first six months and the water elevations are sea-level dominated. In the second half of the year, the water elevations are dominated by the monthly recharge and the curves with and without recharge are dissimilar. Table 5 shows the volume of the aquifer on a monthly basis with and without recharge.

The final management run studied the unsteady transition from the steady state conditions during 1978 to one in which the pumping rate is doubled. Figures 33 and 34 show the effects of the increased pumping at two nodes. The phreatic surface declines substantially within the first month and then declines at a much lower rate to its final steady-state position. The interface, on the other hand, rises gradually over a much longer time frame. In the case of node 29 (Fig. 34) the interface is moving even after a year. Thus, one can say that the phreatic surface responds quickly to changes in flow conditions, while the interface moves much more slowly. The implication of this behavior is that it would be difficult to conduct a pump test and make measurements on the interface. Any measurement made on the location of the interface today would be a result of flow changes made several months ago.

CONCLUSIONS

The two-dimensional finite element salt-water intrusion model (SWIGS2D) has been applied to the northern Guam lens. Hydrologic data for the year 1978 was assembled to calibrate the model using water elevation data from six wells. The aquifer was subdivided into three regions and the permeability and porosity in these regions were the variables in the calibration process. Root-mean-square errors averaged about 0.462 ft. in the six wells. Hydrologic data for the water year 1979 were used for the verification run. Root-mean-square errors averaged 0.448 feet in the six wells. It was felt that, even though additional data obtained in the future can be used to fine-tune the model, the present level of calibration is adequate for most planning and management purposes.

The model can be used for an infinite variety of management studies. Only a few examples of typical management studies are provided in this report. First, steady-state runs were made using the 1978 hydrologic data. Runs were made with no pumping, 1978 pumping, twice 1978 pumping and five times 1978 pumping. These runs showed that there were only minor changes in water levels and aquifer volumes for the first three pumping rates. However, significant changes did occur for five times the 1978 pumping rate. The second management run was concerned with the effects of zero recharge to the aquifer during 1978.

During the dry months of the year, the water levels in the wells are controlled by the sea level changes and, in the rainy months, the water levels respond to the recharge. The final management run was concerned with the response of the aquifer to a sudden increase in the pumping rate. The pumping rate was doubled and the unsteady changes in the phreatic surface and the interface elevation were studied. The phreatic surface declines substantially in a short period of time and then declines at a much lower rate to its final steady value. However, the interface moves much more gradually over a much longer period of time. The implication of this is that a measurement made of the location of the interface at a given time may be a consequence of flow changes that occurred many months previously. The model is useful in making any number of management studies of the sort illustrated.

LITERATURE CITED

Bichler, S., and P. A. Walen. 1981. Geophysical investigations for the Northern Guam lens study. ECO Systems Management Associates, Inc. San Diego, California.

Contractor, D. N. 1981. A two-dimensional, finite element model of salt water intrusion in groundwater systems. Univ. Guam, WERI Tech. Rept. 26.

Marsh, J. A., Jr., and S. J. Winter. 1975. Environmental issues. In The social-economic impact of modern technology upon a developing insular region: Guam. Univ. Guam Press. 3(5):87.

Mink, J. F. 1976. Groundwater resources of Guam: occurrence and developement. Univ. Guam, WERI Tech. Rept. 1:276.

PUAG. 1971. Water Master Plan for the Public Utility Agency of Guam. Prepared by Austin, Smith and Associates, Agana, Guam.

Tracey, J. I., Jr., Schlanger, S. O., Stark, J. T., Doan, D. B., and May, H. G. 1964. Geology of Guam USGS Prof. Pap 403-A, 104 p.

U. S. Geological Survey. 1978. Water resources data for Hawaii and other Pacific areas: Trust Territory of the Pacific Islands, Guam, American Samoa and the Northern Mariana Islands. U. S. Geol. Survey Water-data Rept. HI-78-2.

_____. 1979. Water resources data for Hawaii and other Pacific areas: Trust Territory of the Pacific Islands, Guam, American Samoa and the Northern Mariana Islands. U. S. Geol. Survey Water-data Rept. HI-79-2.

Ward, P. E., Hofford, S. H., Davis, D. A. 1965. Hydrology of Guam. USGS Prof. Pap 403-H 28 p.

WERI Staff. 1980. Five-Year water research and development plan for Guam and Micronesia, FY 82 to FY 85. Univ. Guam, WERI Misc. Rept.

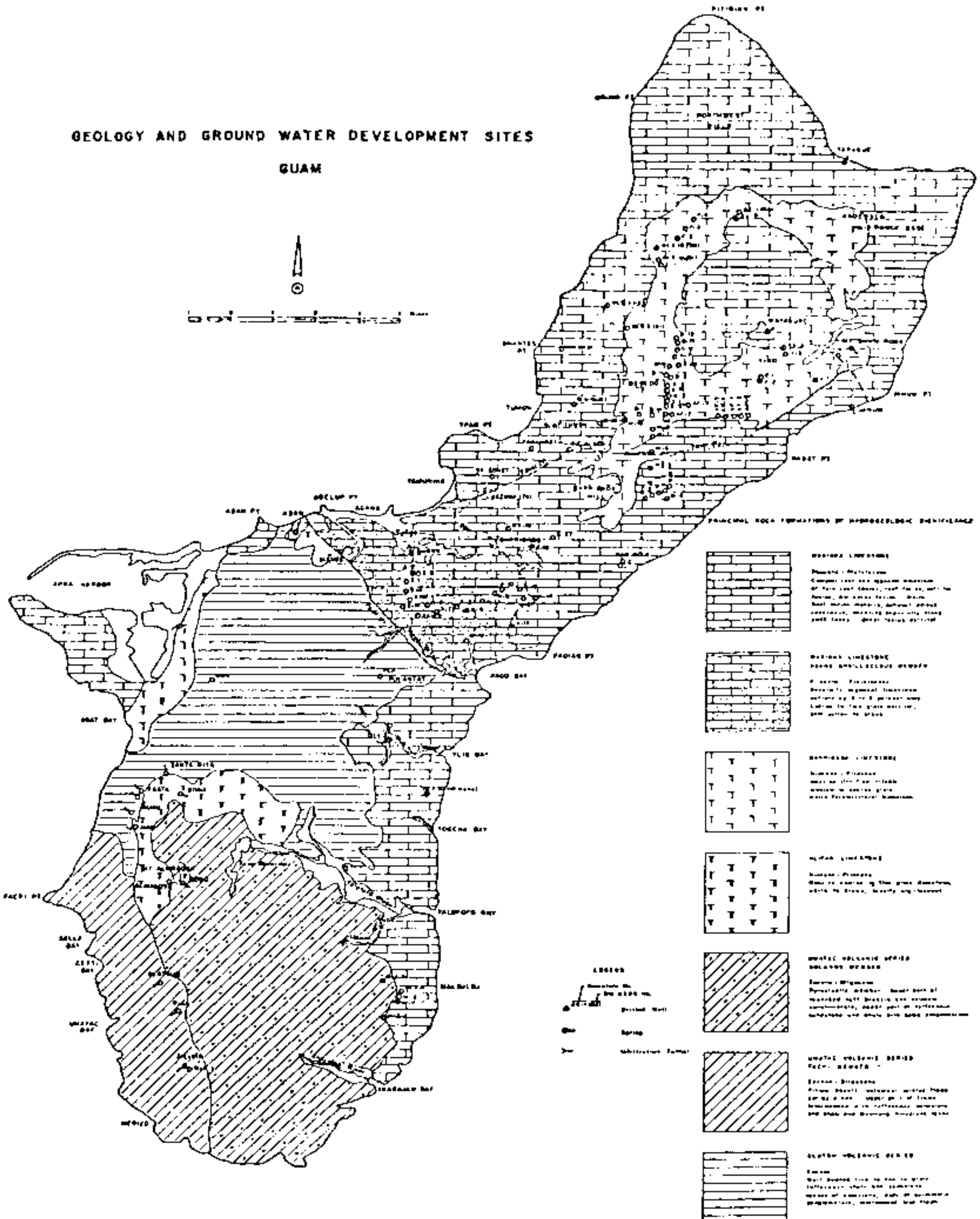

Figure 1. Guam geology and groundwater development sites.

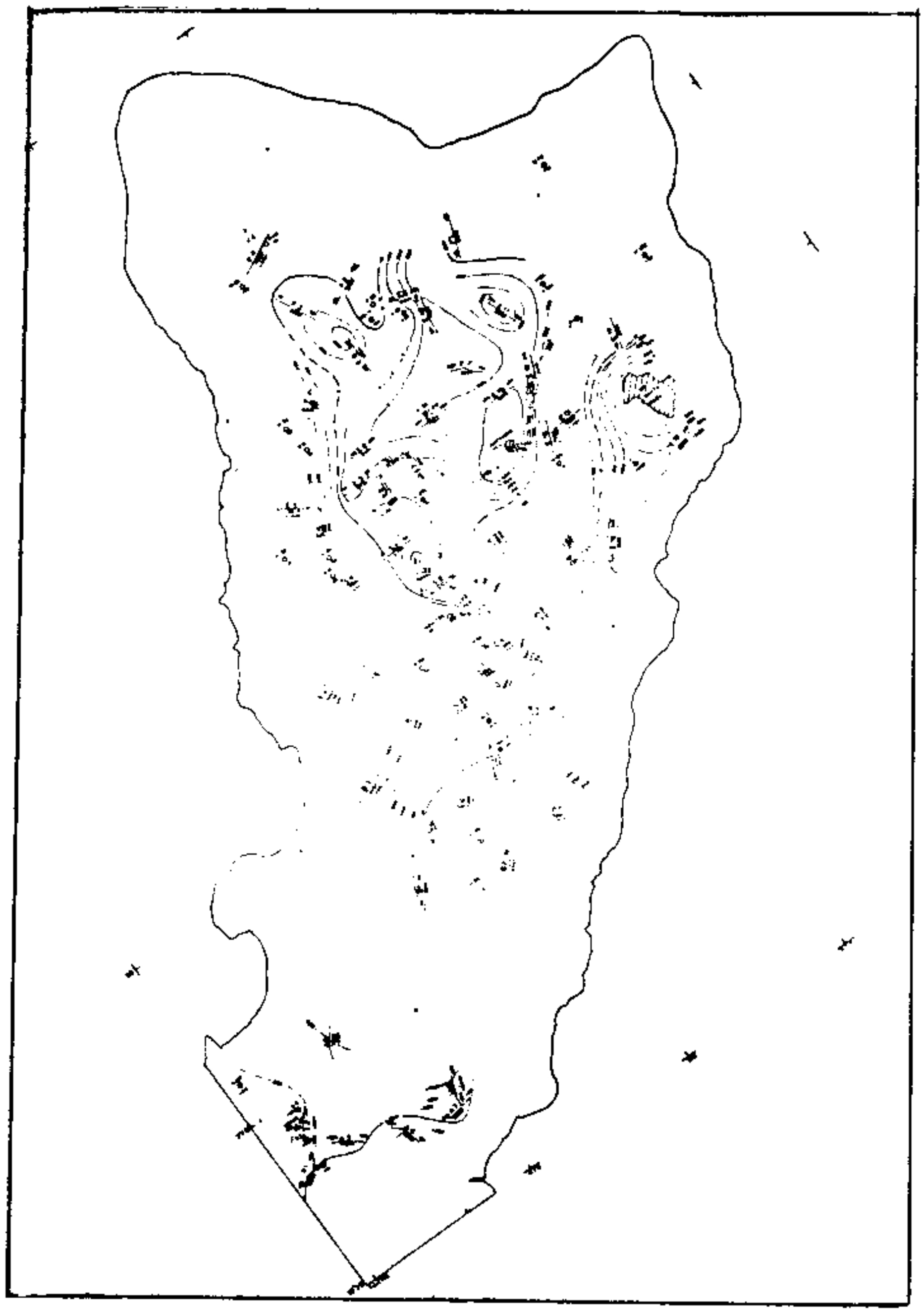

Figure 2. Contour map of volcanic basement. (Large blue-line print of this figure available upon request.)

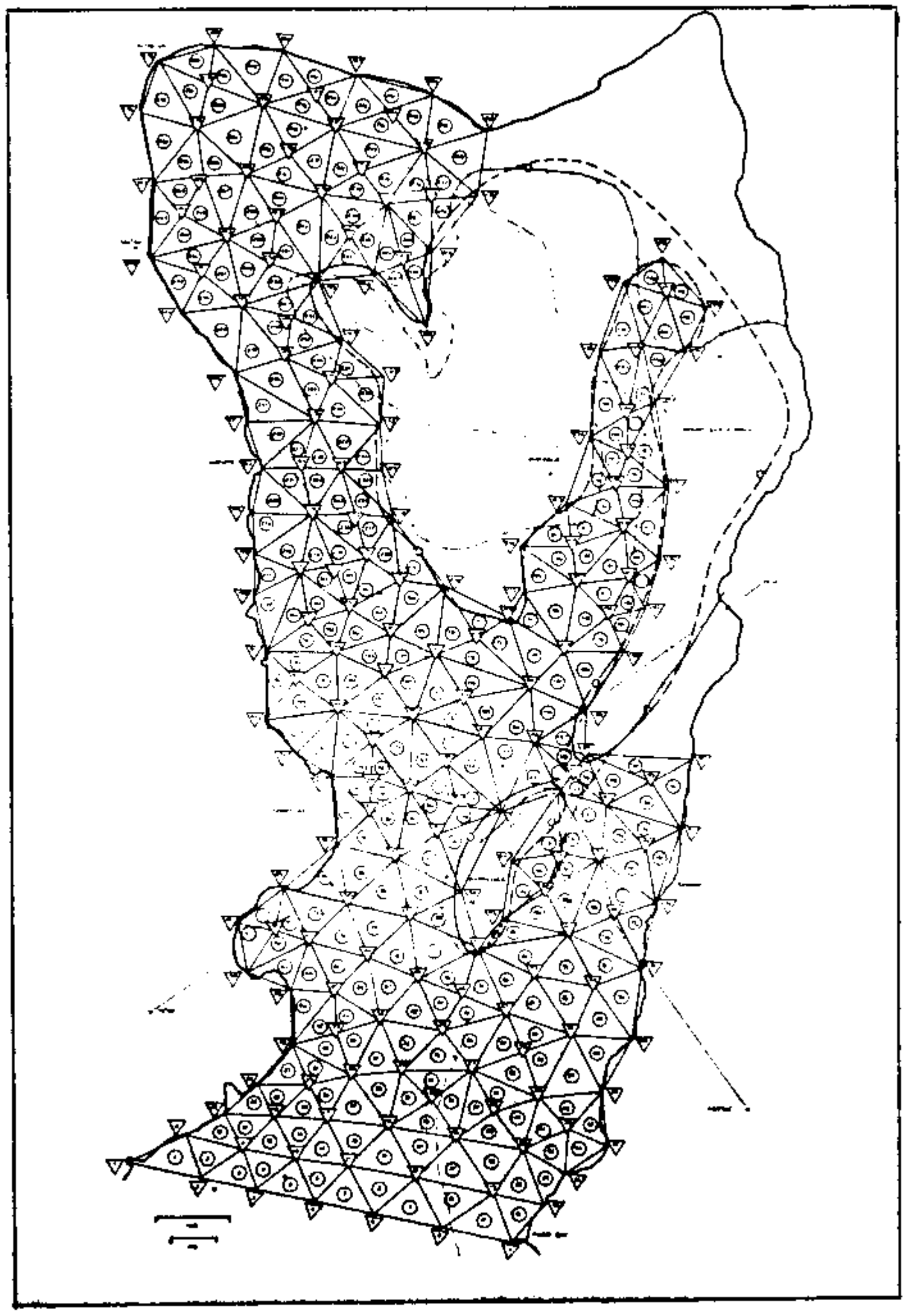

Figure 3. Element network of northern Guam aquifer. (Large blue-line print of this figure available upon request.)

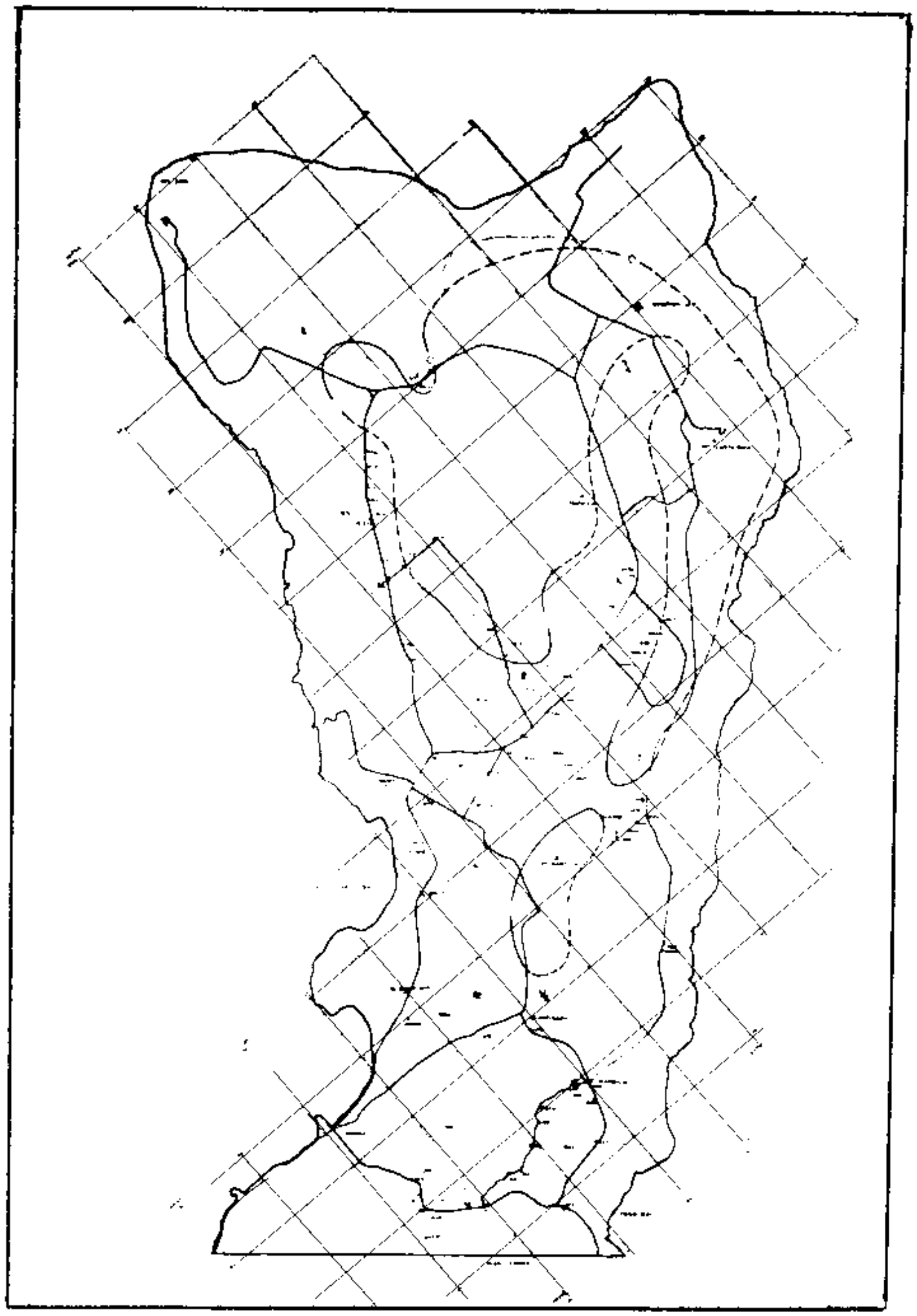

Figure 4. Location of wells and rain gages. (Large blue-line print of this figure available upon request.)

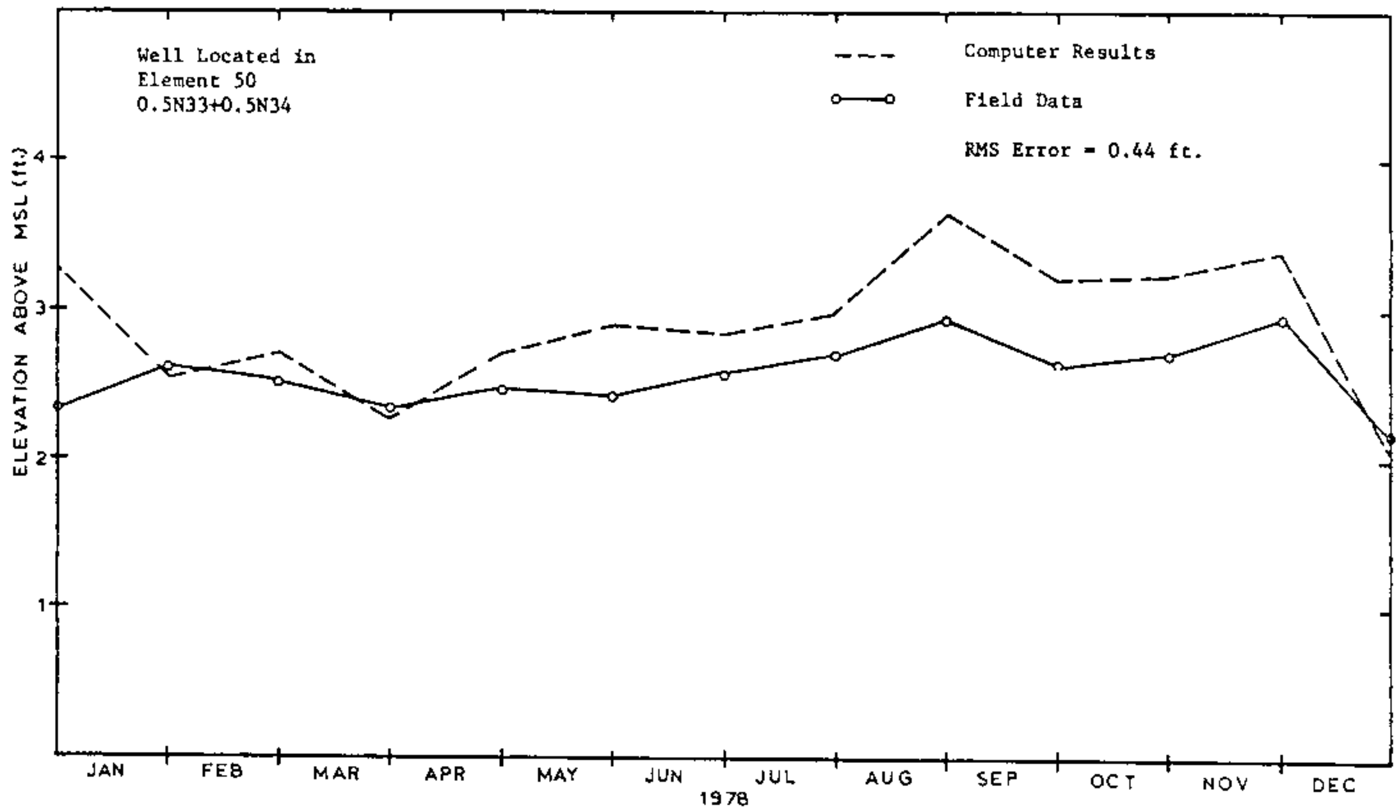

Figure 5. Calibration results at ACEORP tunnel.

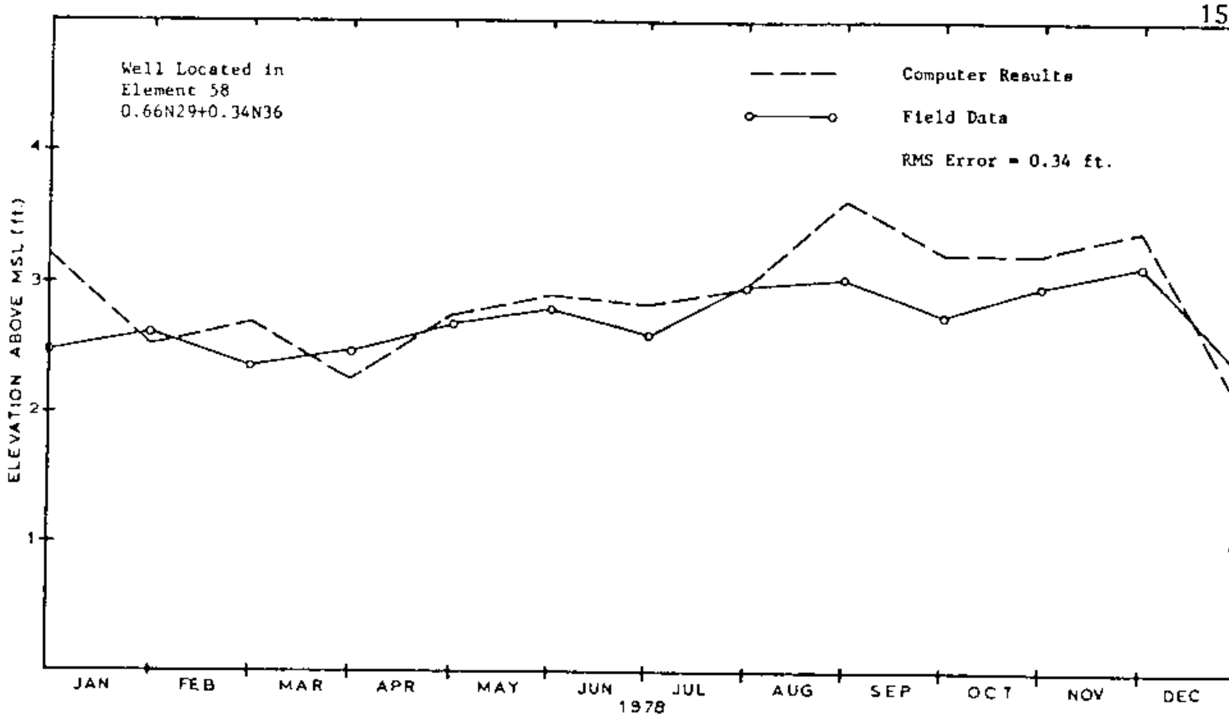

Figure 6. Calibration results at BPM Well #1.

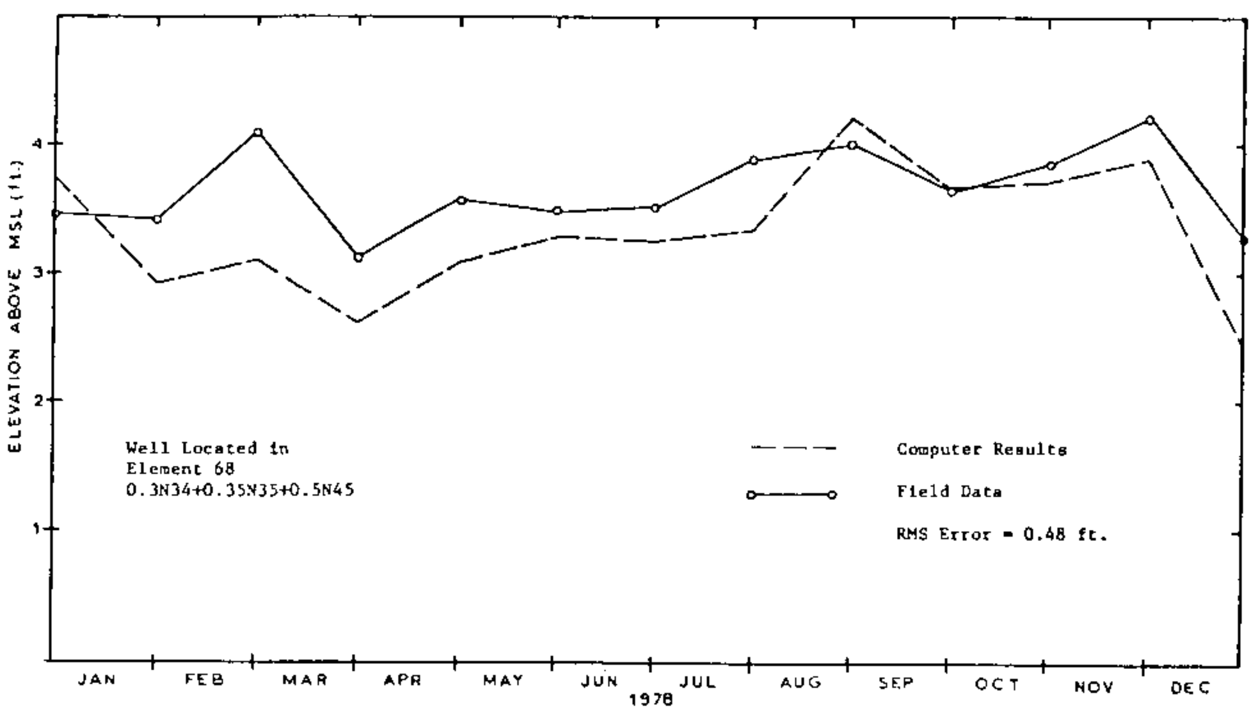

Figure 7. Calibration results at Pump A-16.

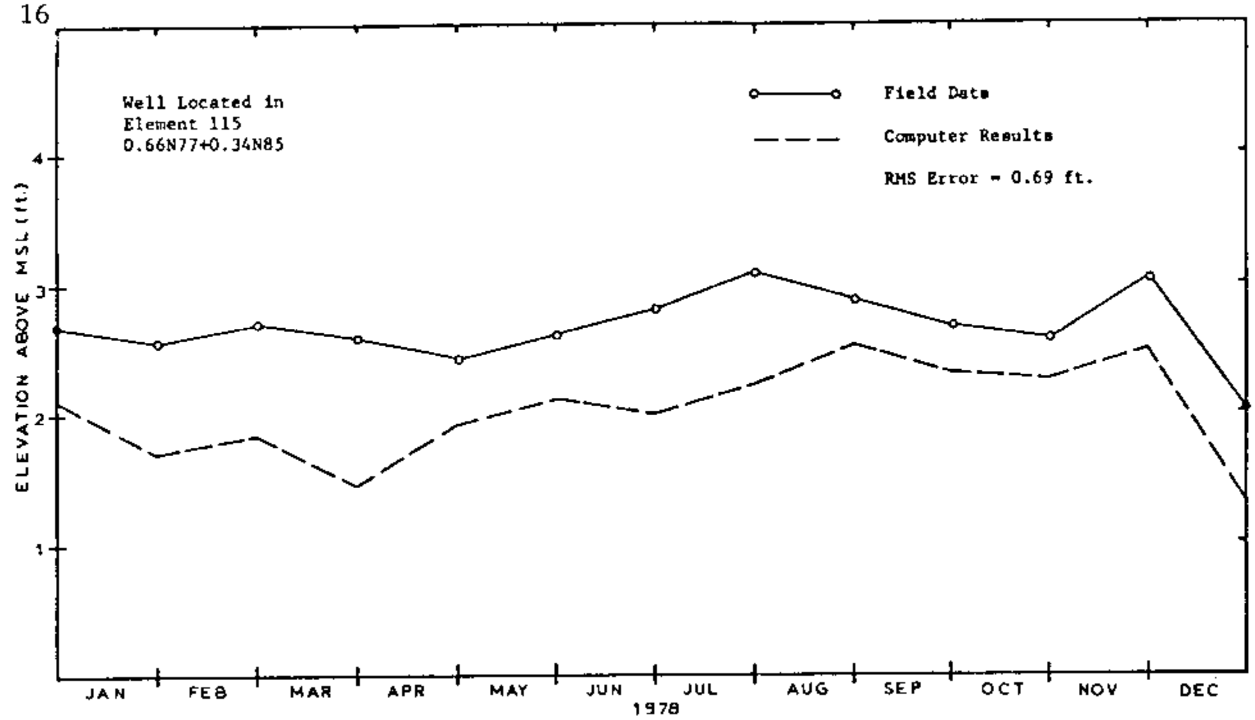

Figure 8. Calibration results at Harmon Well #1.

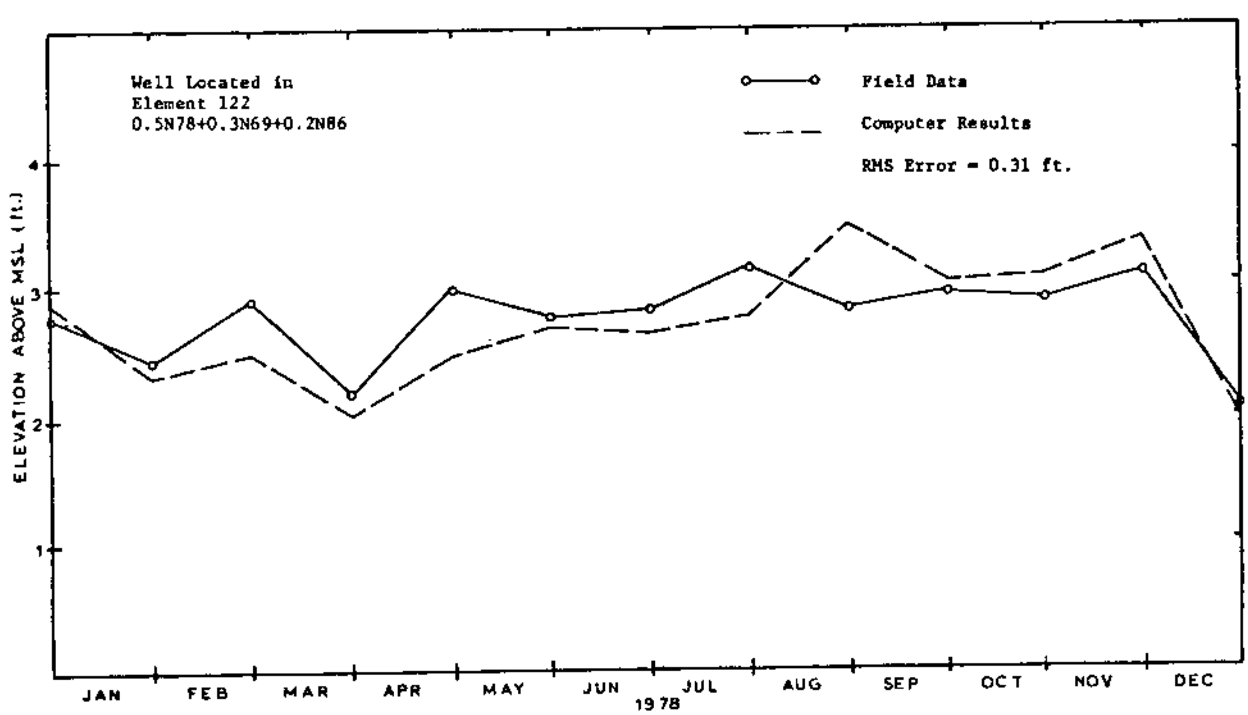

Figure 9. Calibration results at Well M-10A.

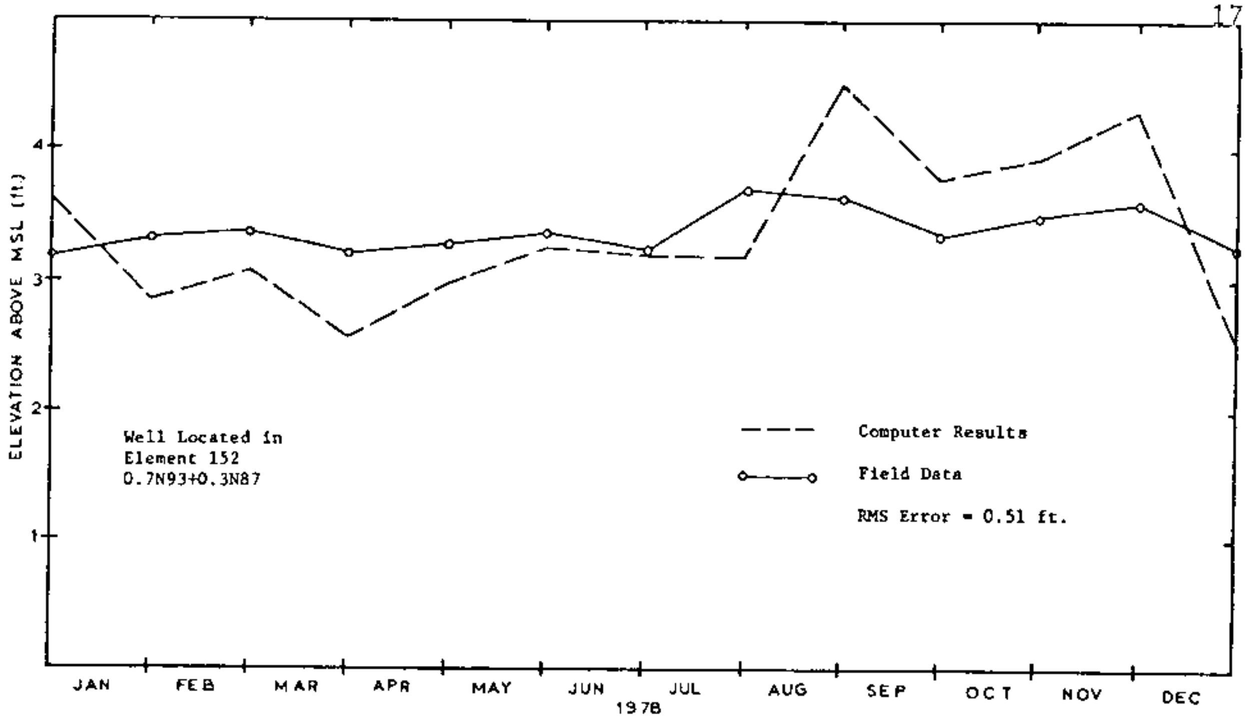

Figure 10. Calibration results at Well M-11.

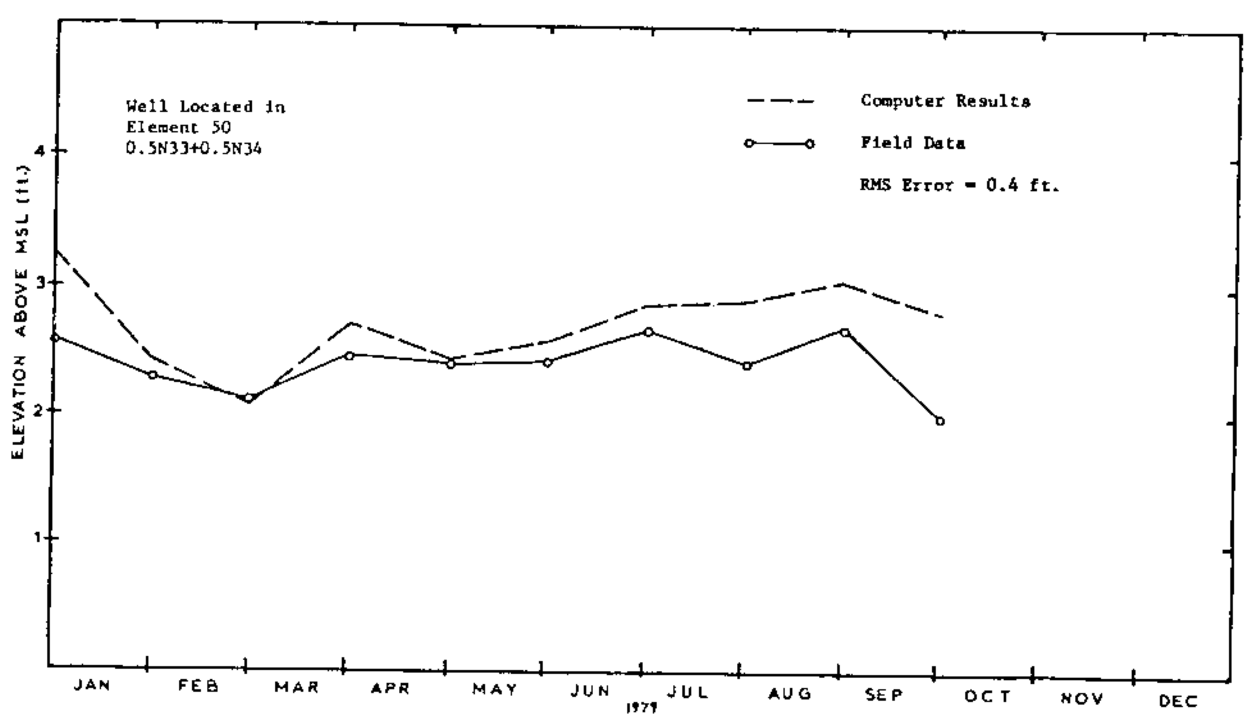

Figure 11. Verification at ACEORP tunnel. See Figure 5. for calibration results for ACEORP tunnel.

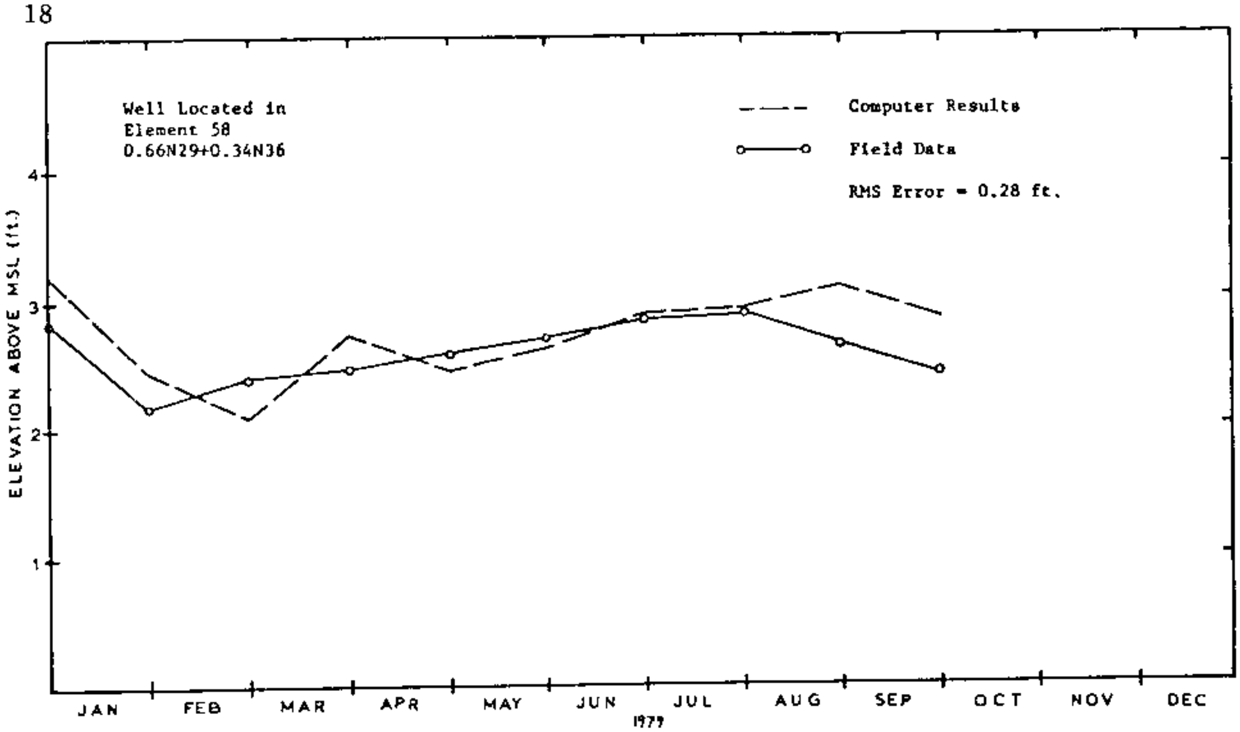

Figure 12. Verification at BPM Well #1. See Figure 6 for calibration results at BPM Well #1.

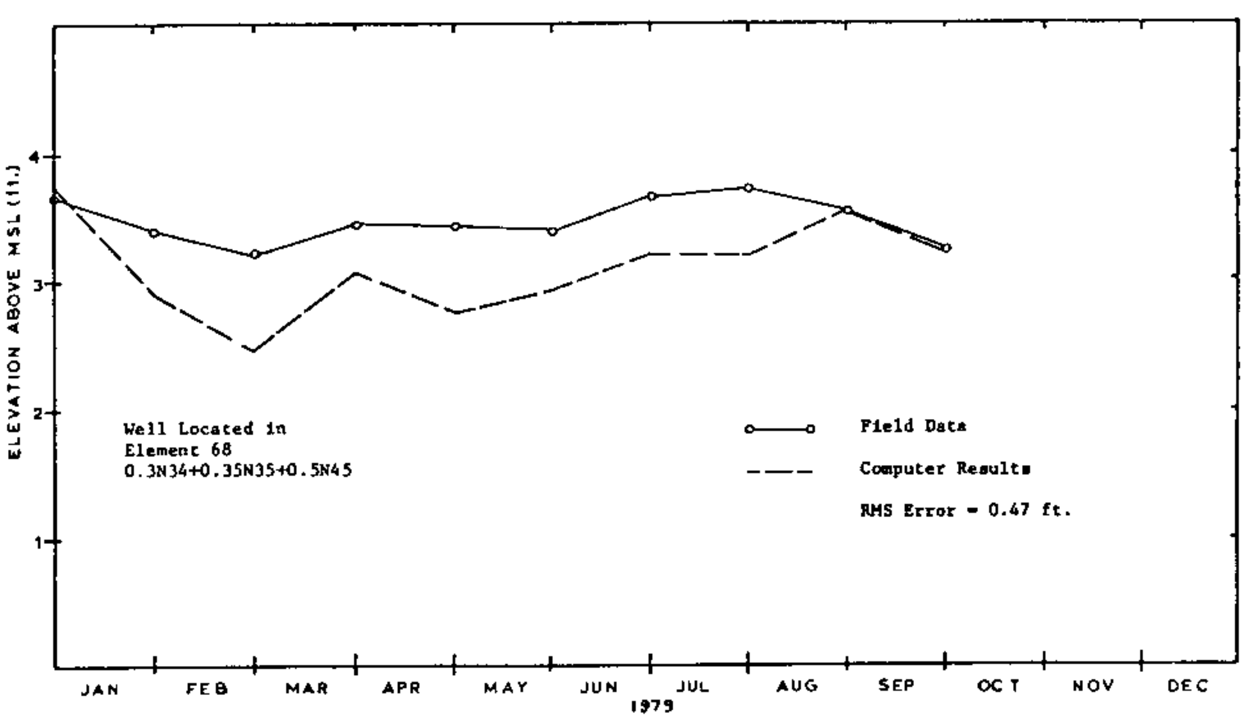

Figure 13. Verification at Well A-16. See Figure 4 for calibration results at Pump A-16.

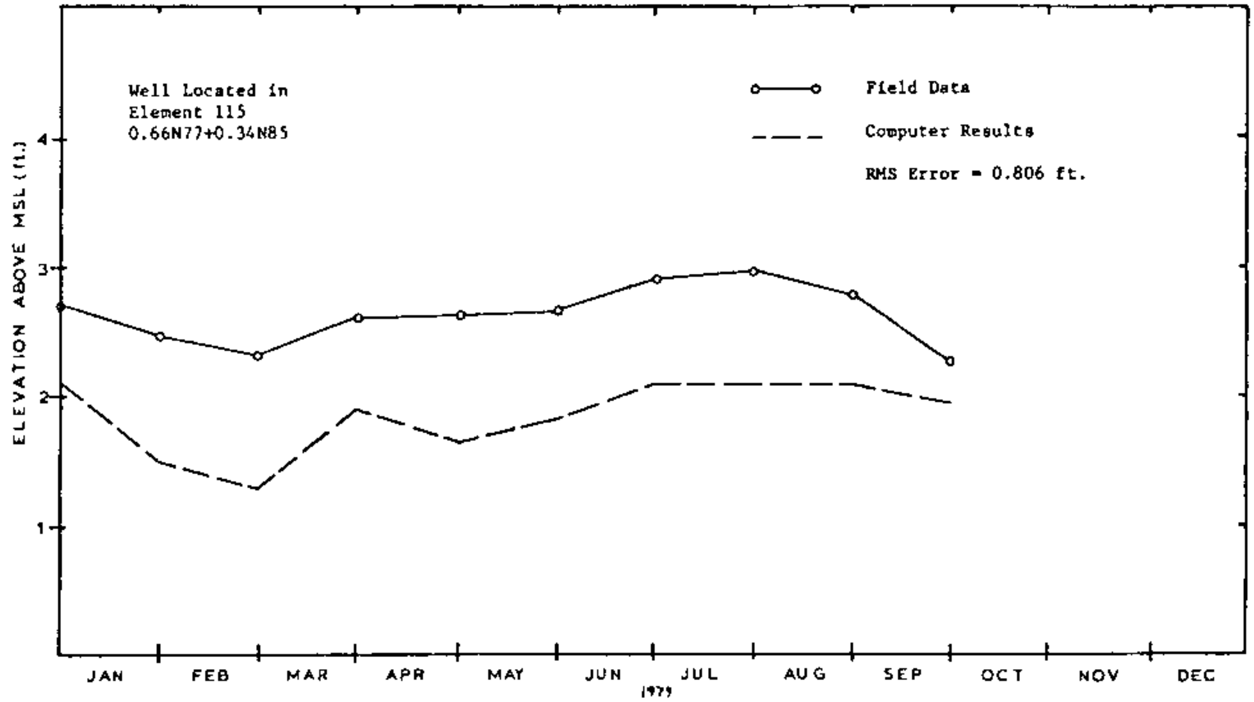

Figure 14. Verification at Harmon Well #1. See Figure 8 for calibration results at Harmon Well #1.

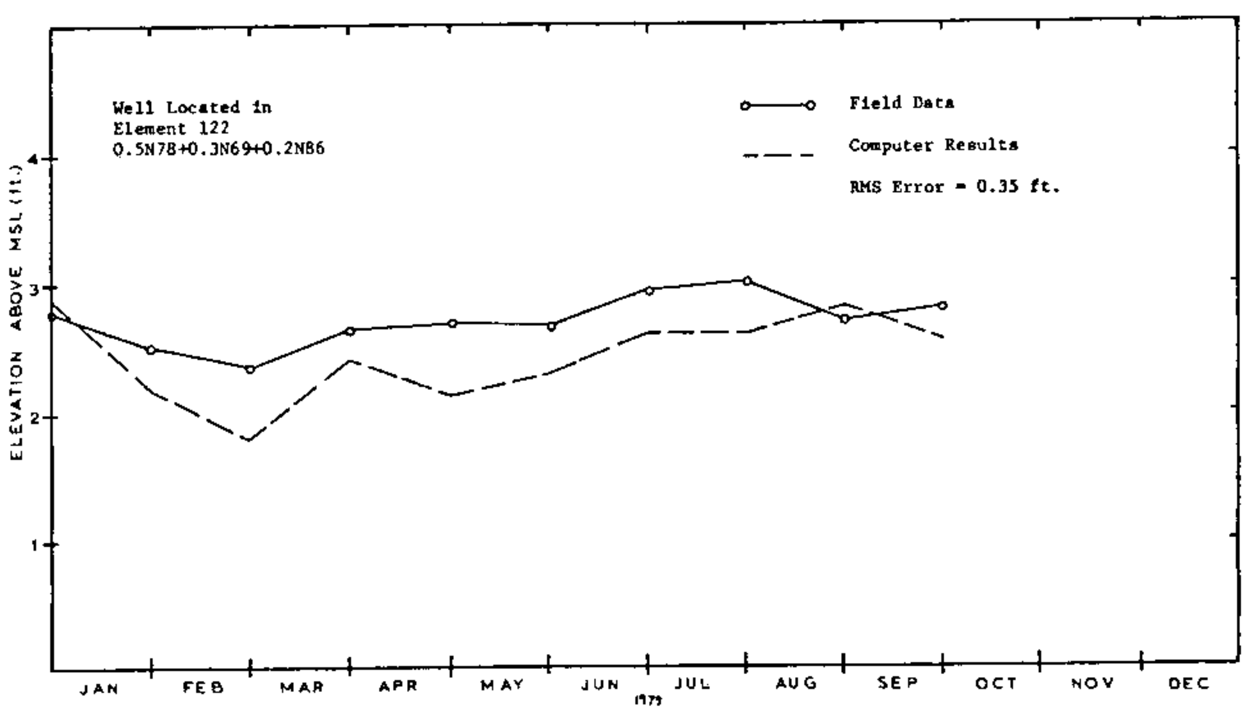

Figure 15. Verification at Well M-10A. See Figure 9 for calibration results at Well M-10A.

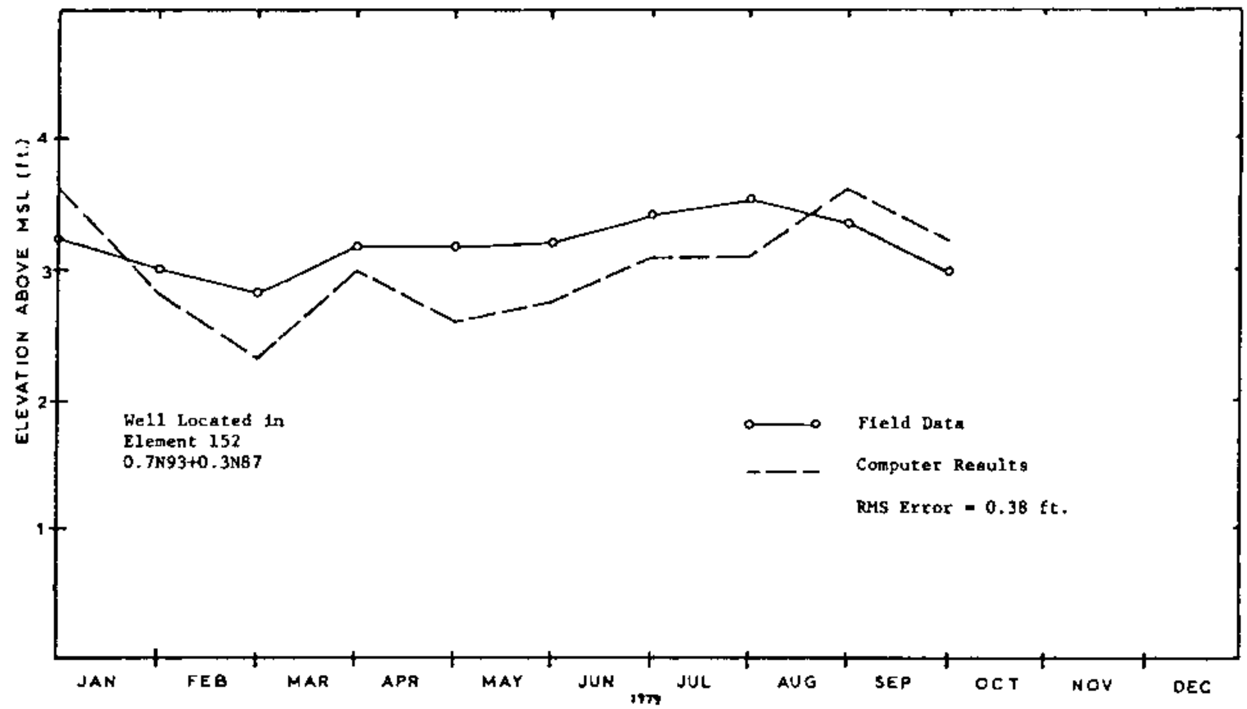

Figure 16. Verification at Well M-11. See Figure 10 for calibration results at Well M-11.

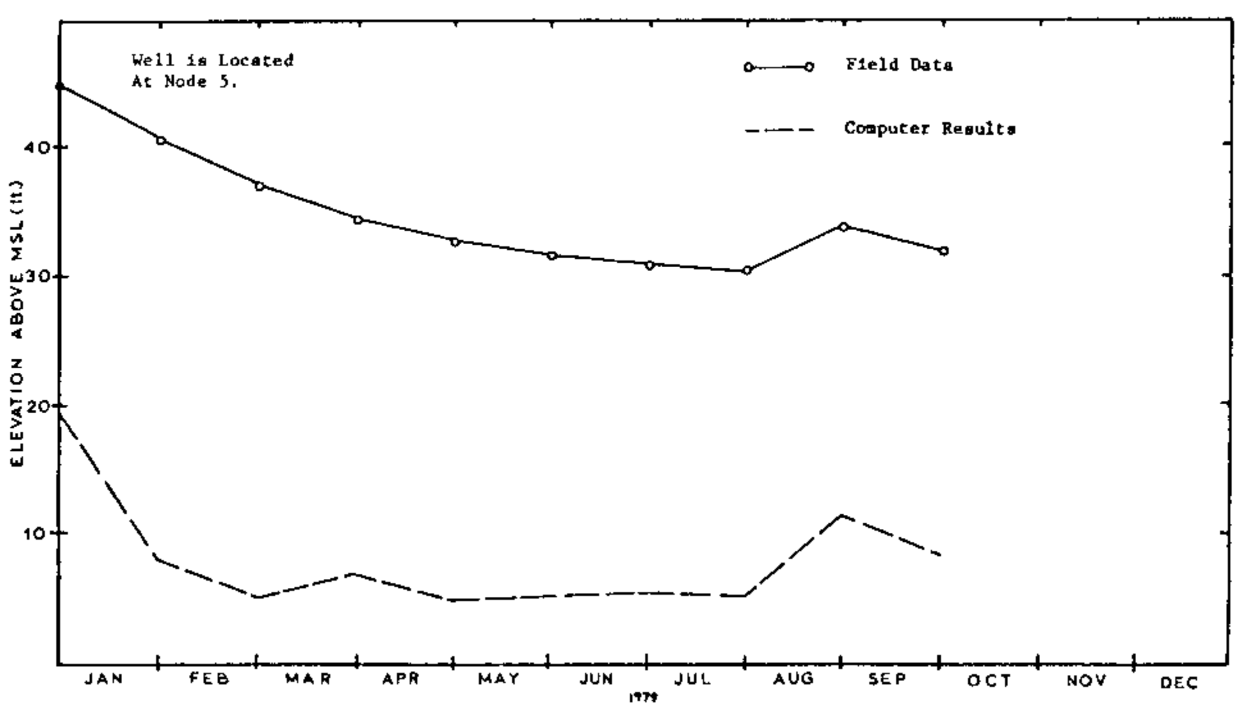

Figure 17. Verification at Well A-20.

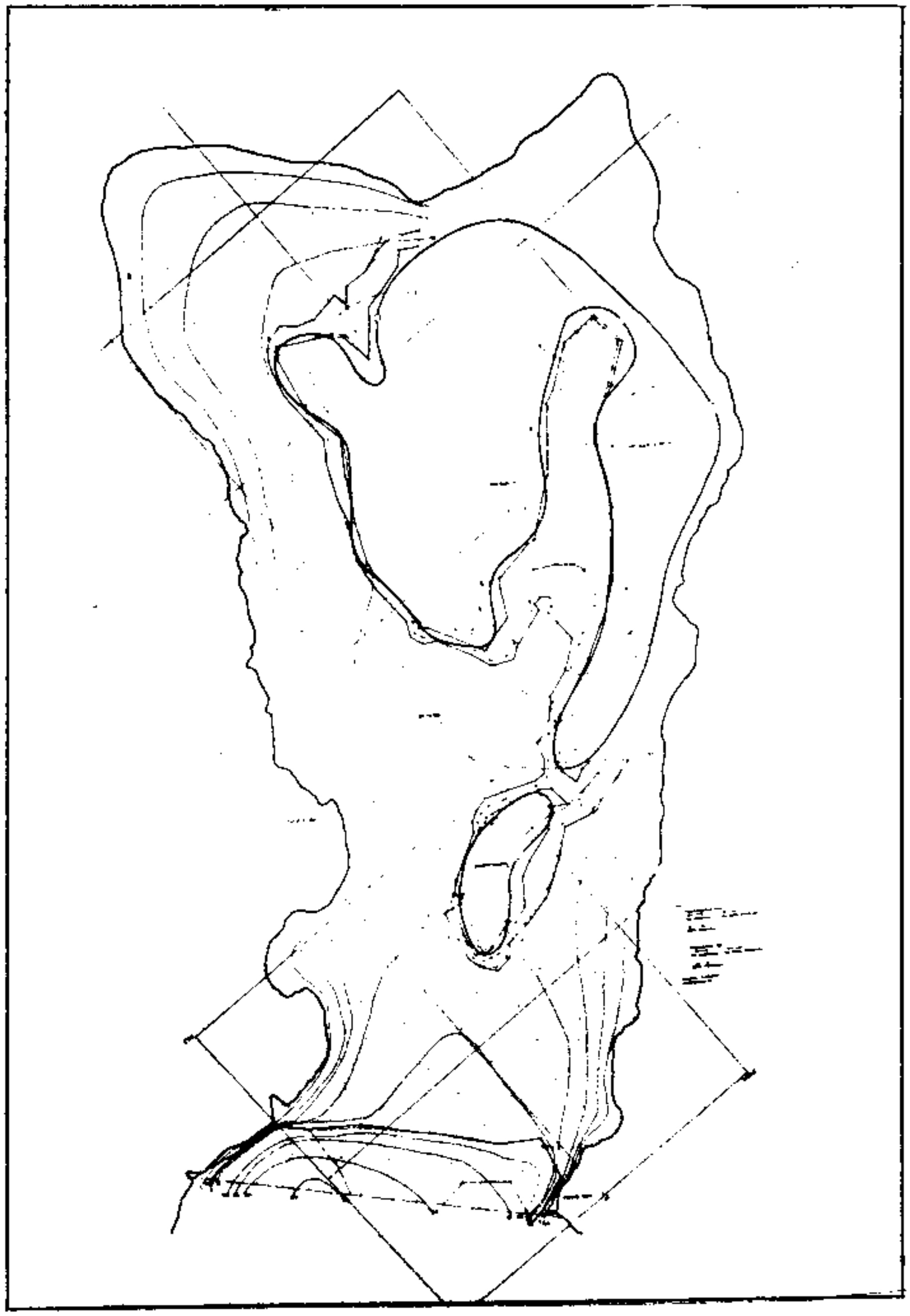

Figure 18. Contours of phreatic surface and location of toes. (Large blue-line print of this figure available upon request.)

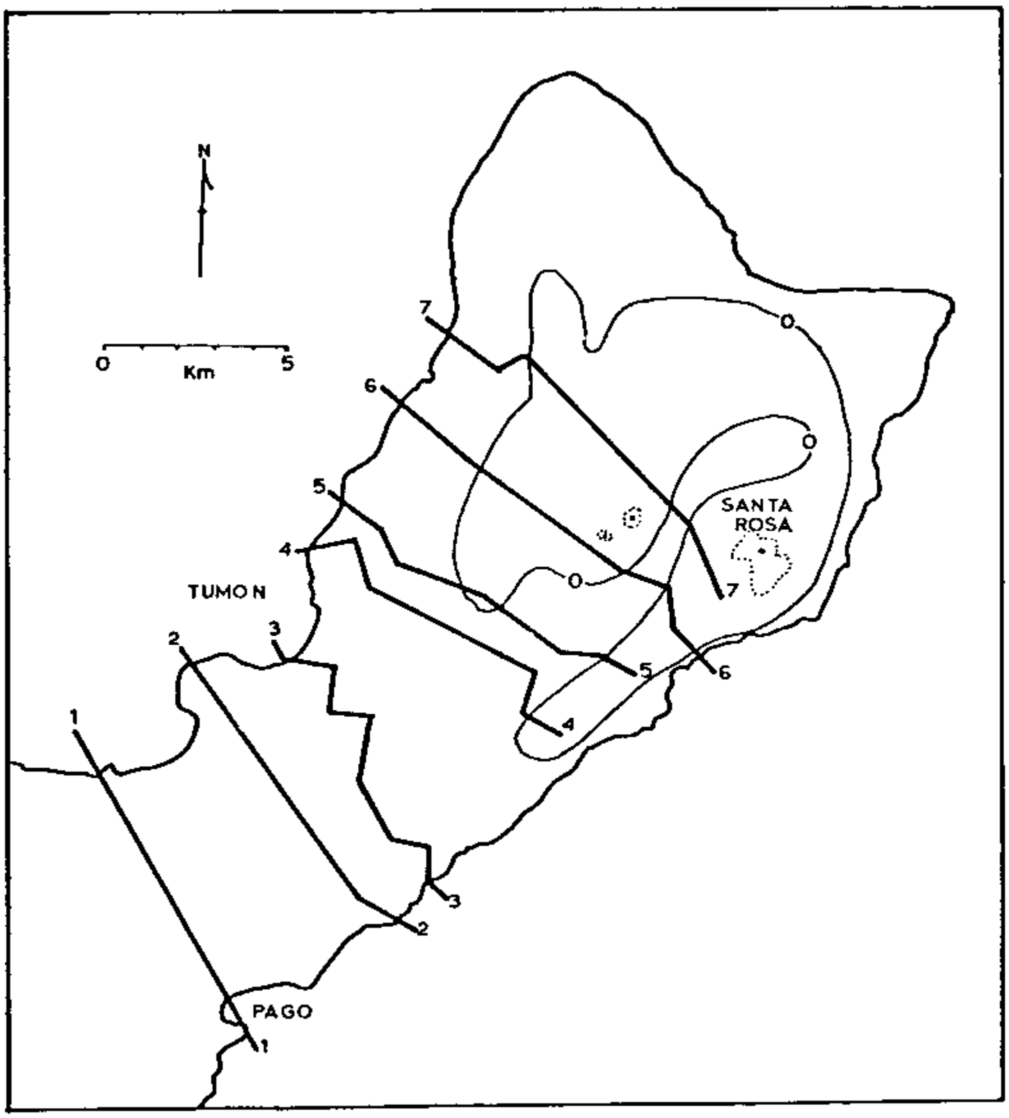

Figure 19. Locations of crosssections of aquifer.

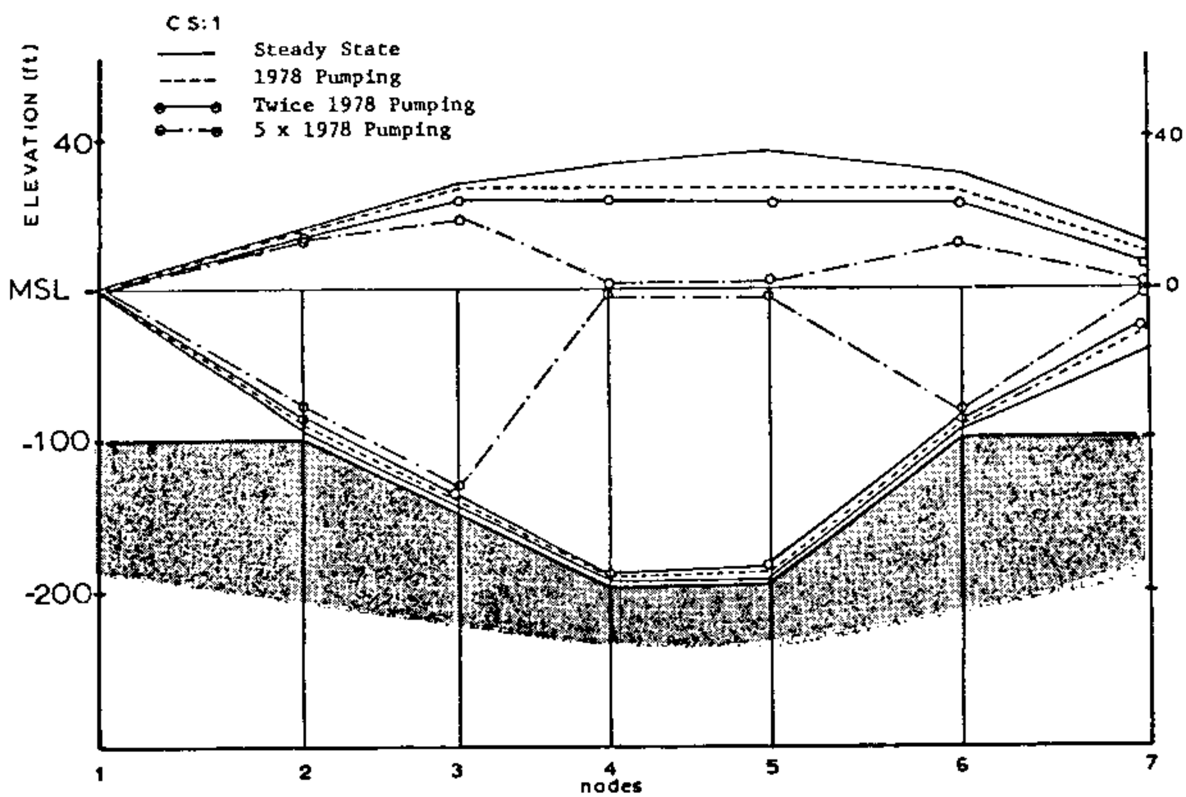

Figure 20. Crossection 1 of aquifer.

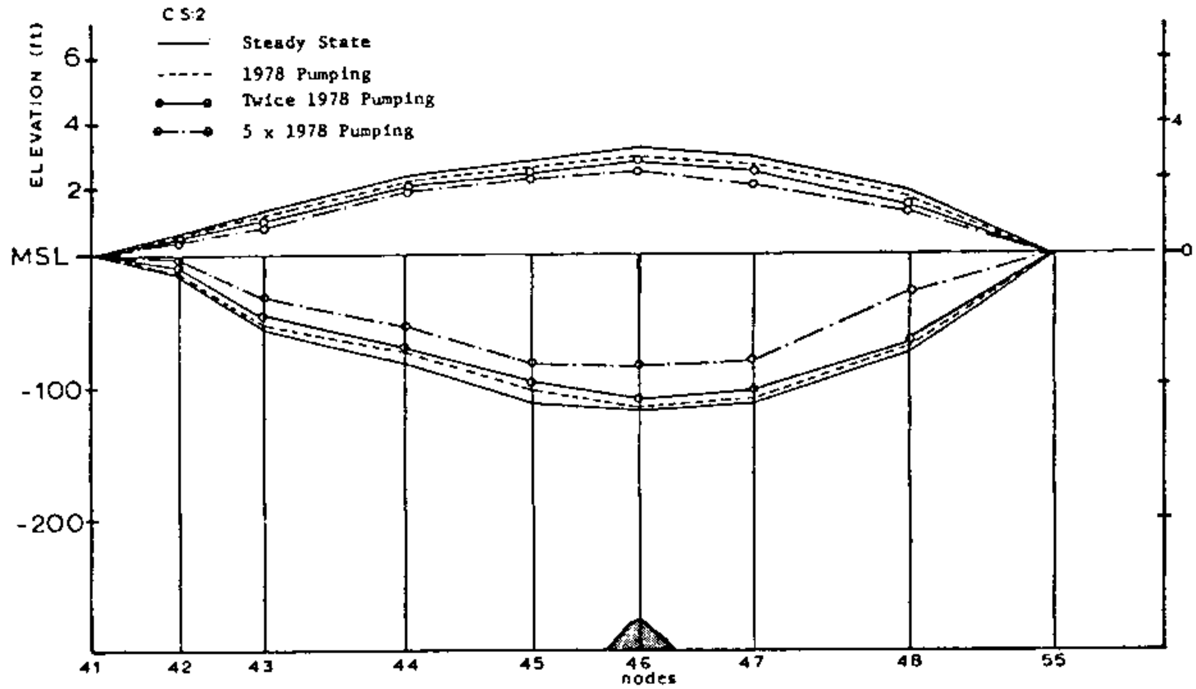

Figure 21. Crossection 2 of aquifer.

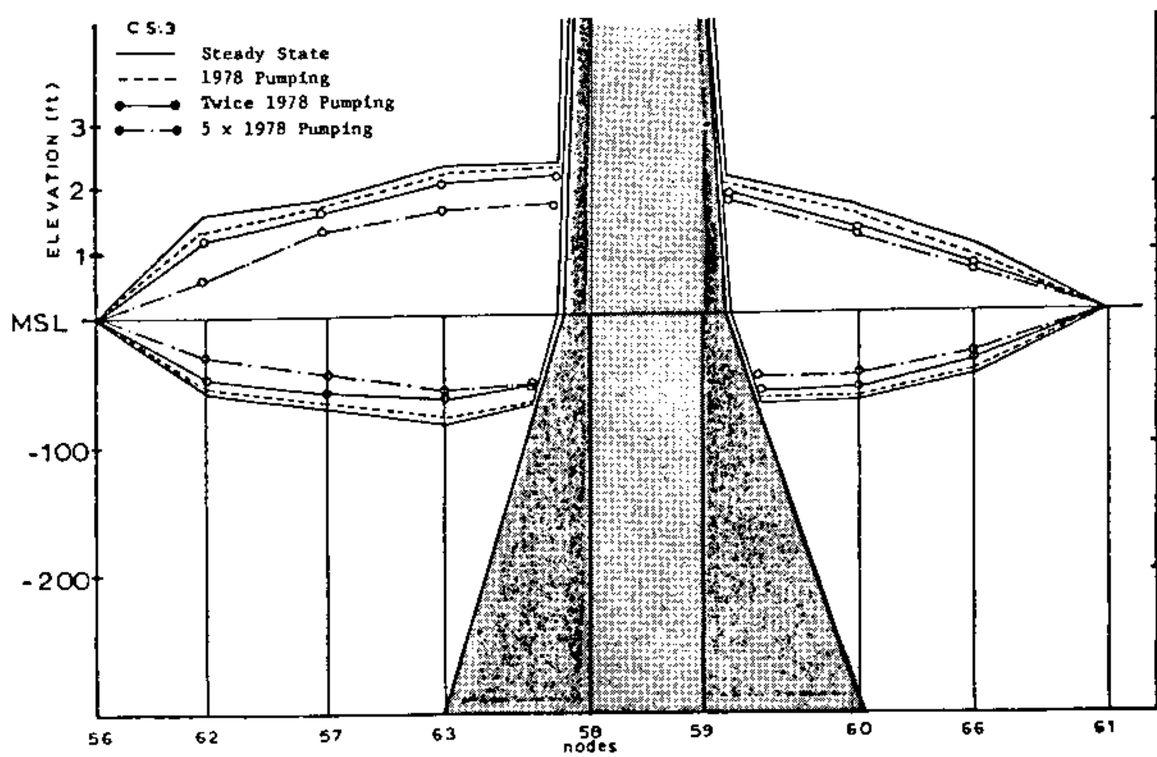

Figure 22. Crossection 3 of aquifer.

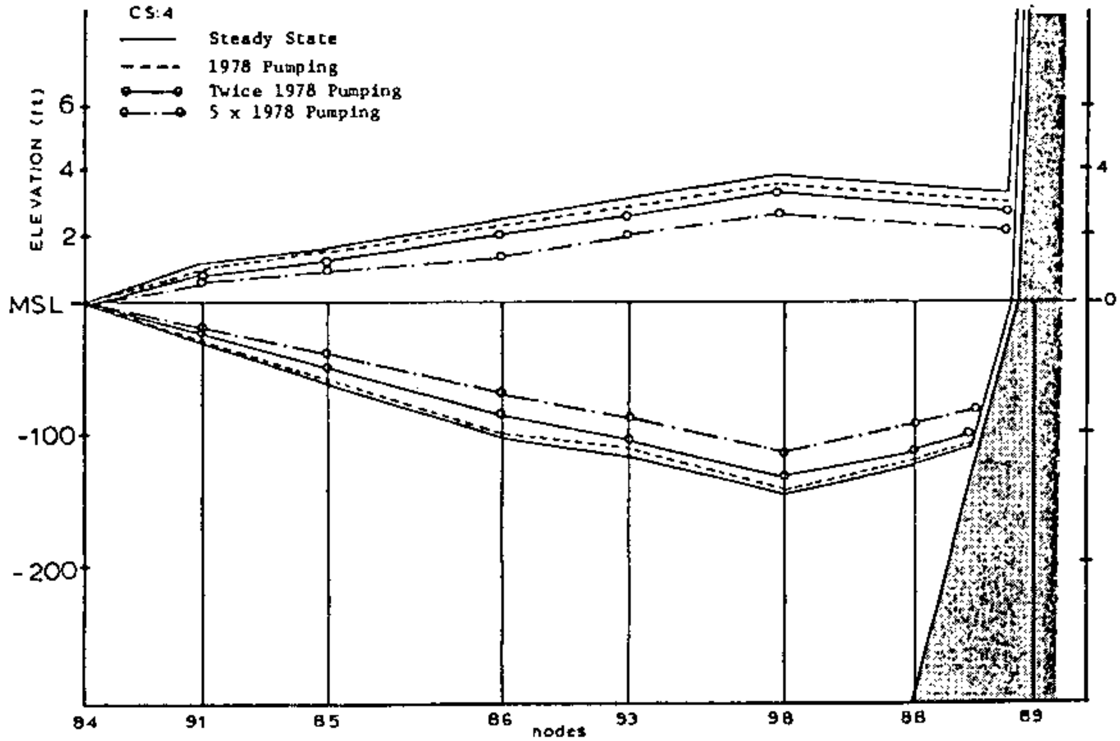

Figure 23. Crossection 4 of aquifer.

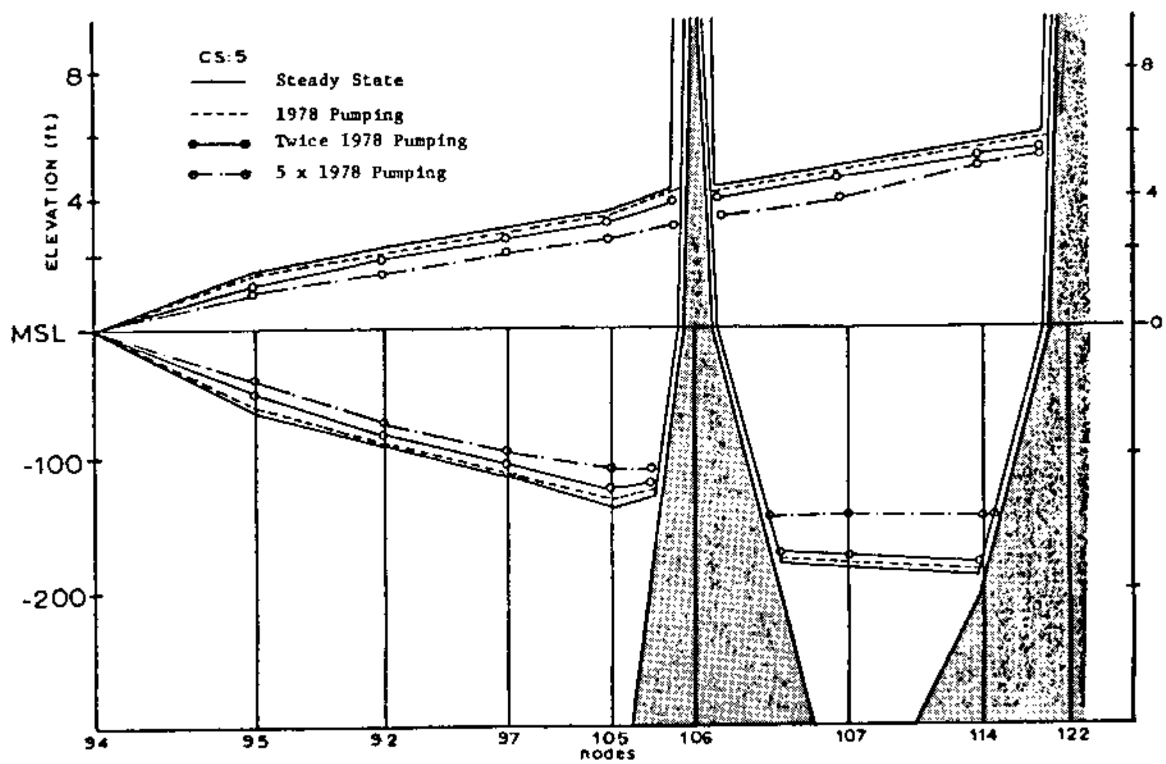

Figure 24. Crossection 5 of aquifer.

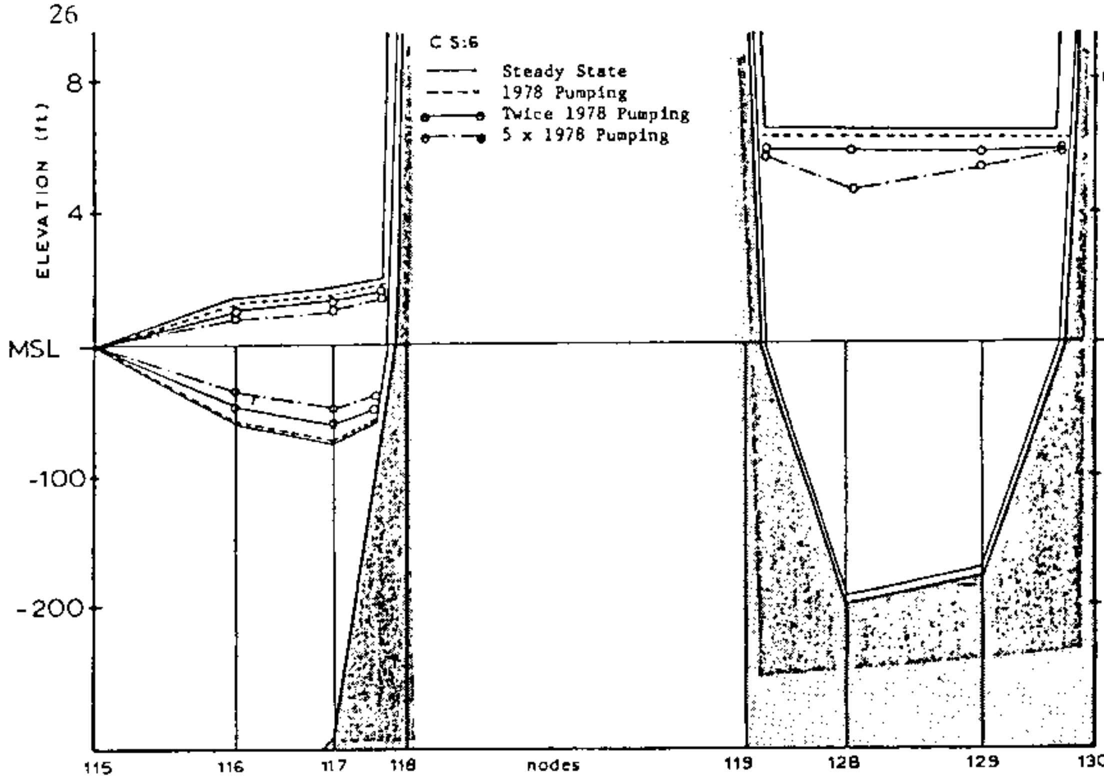

Figure 25. Crossection 6 of aquifer.

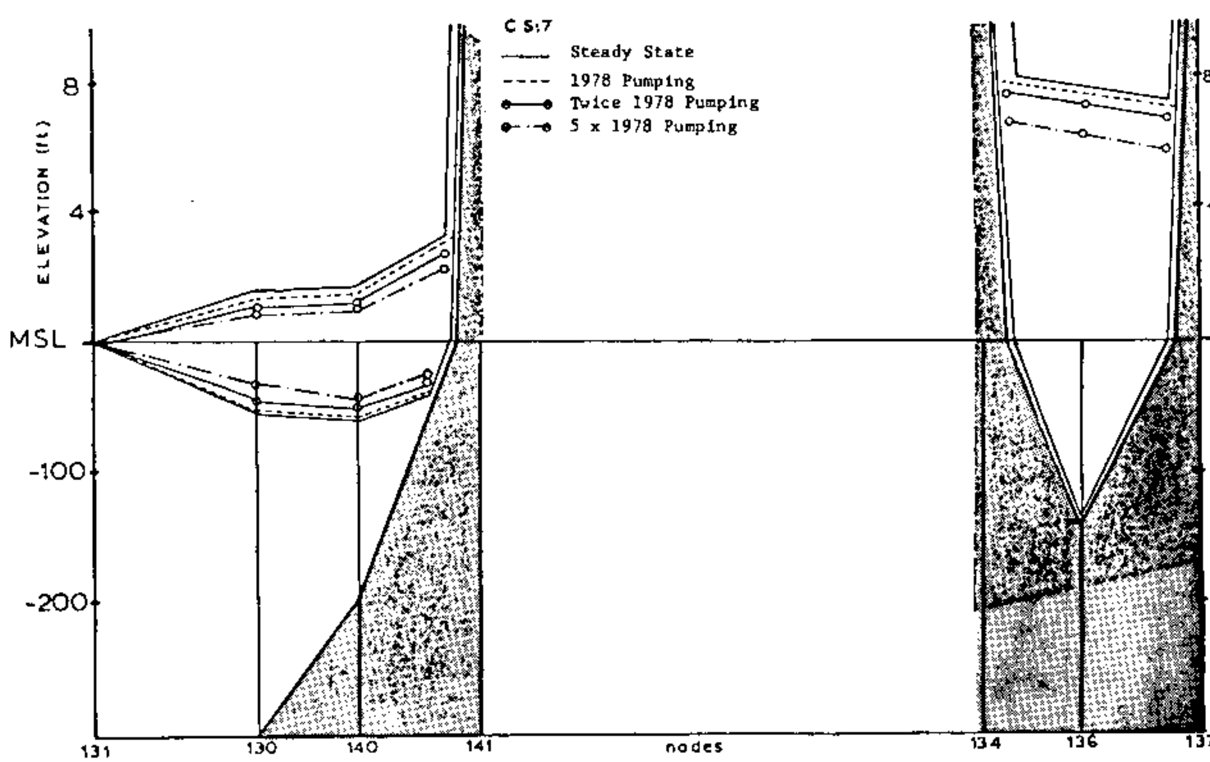

Figure 26. Crossection 7 of aquifer.

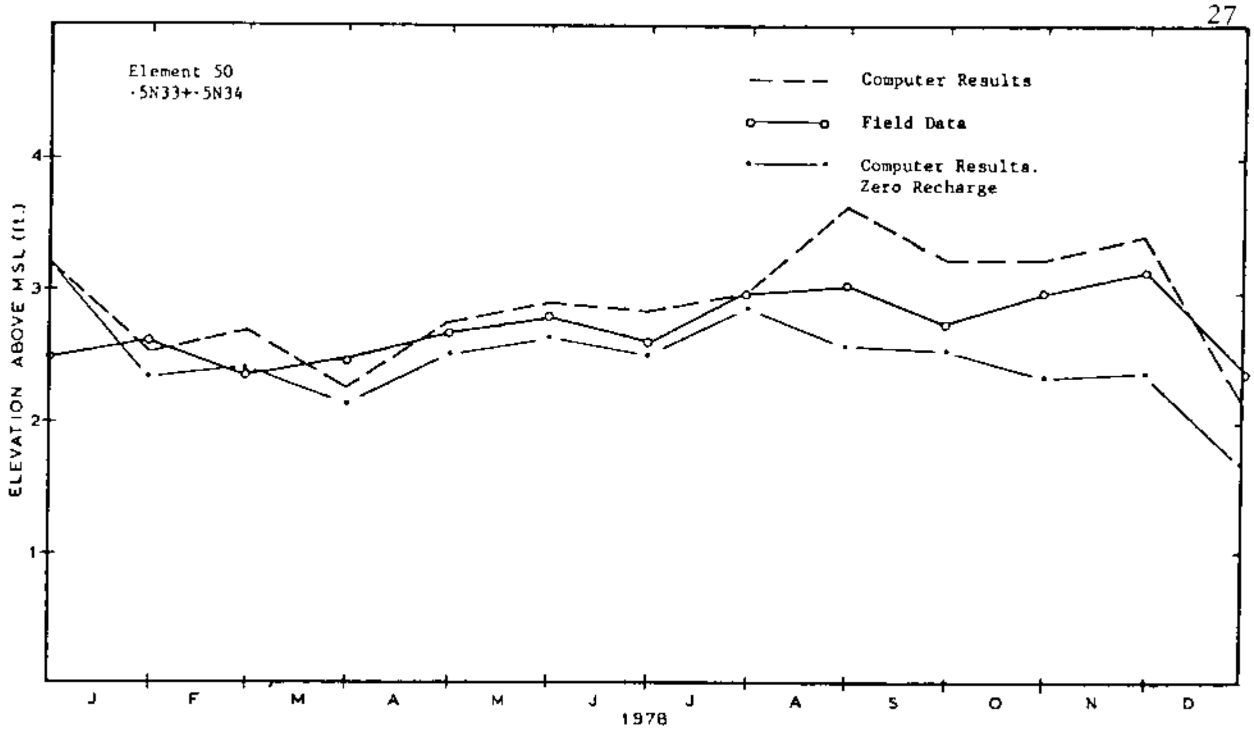

Figure 27. Effect of Zero Recharge during 1978 at ACEORP Tunnel.

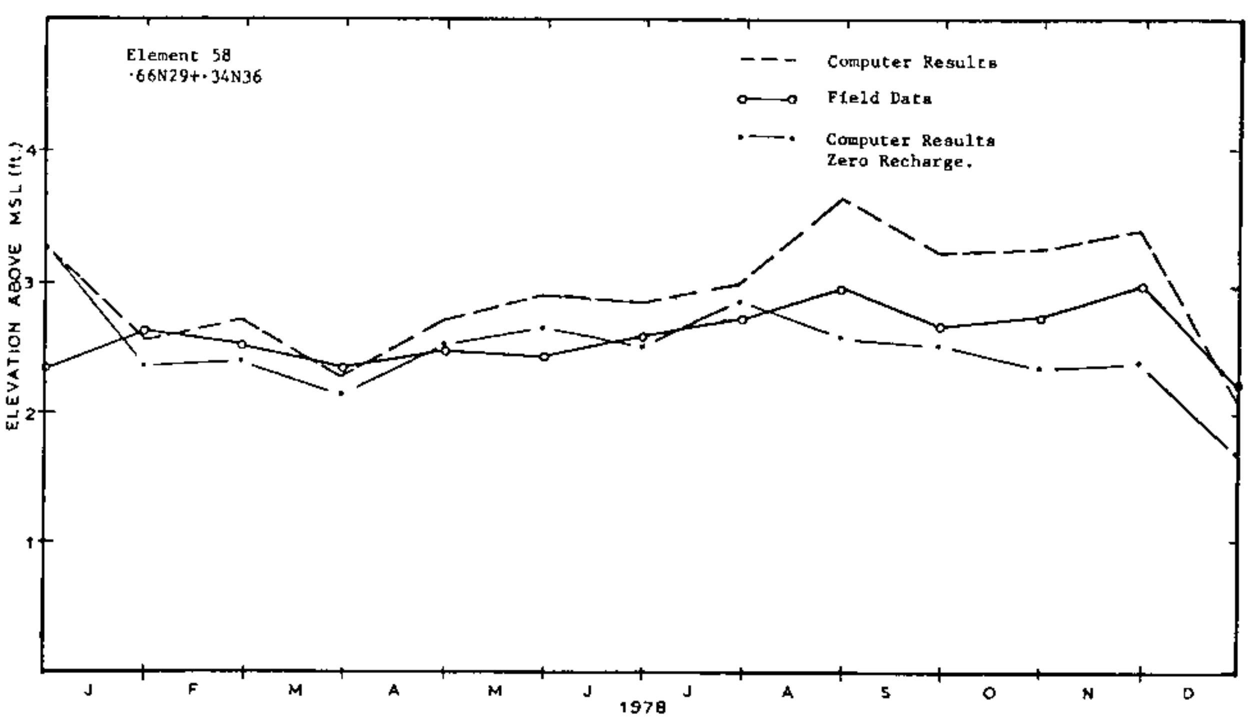

Figure 28. Effect of Zero Recharge in 1978 at BPM Well #1.

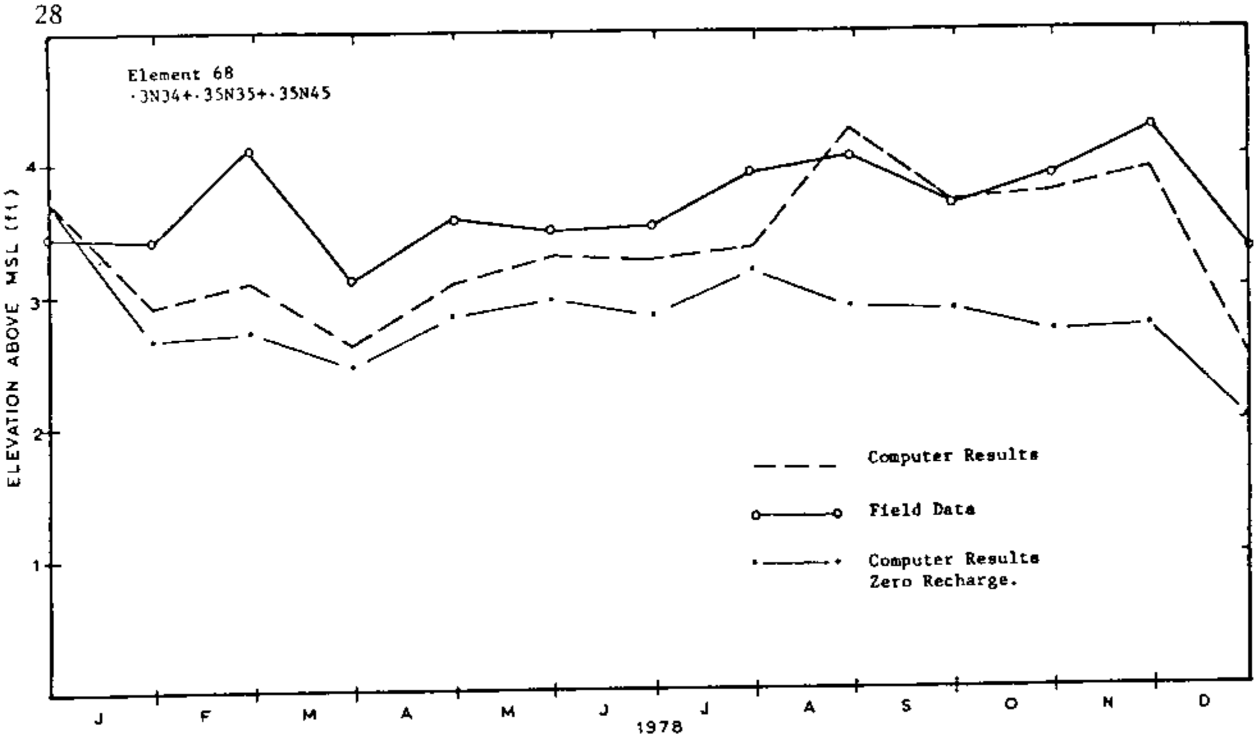

Figure 29. Effect of Zero Recharge in 1978 at Well A-16.

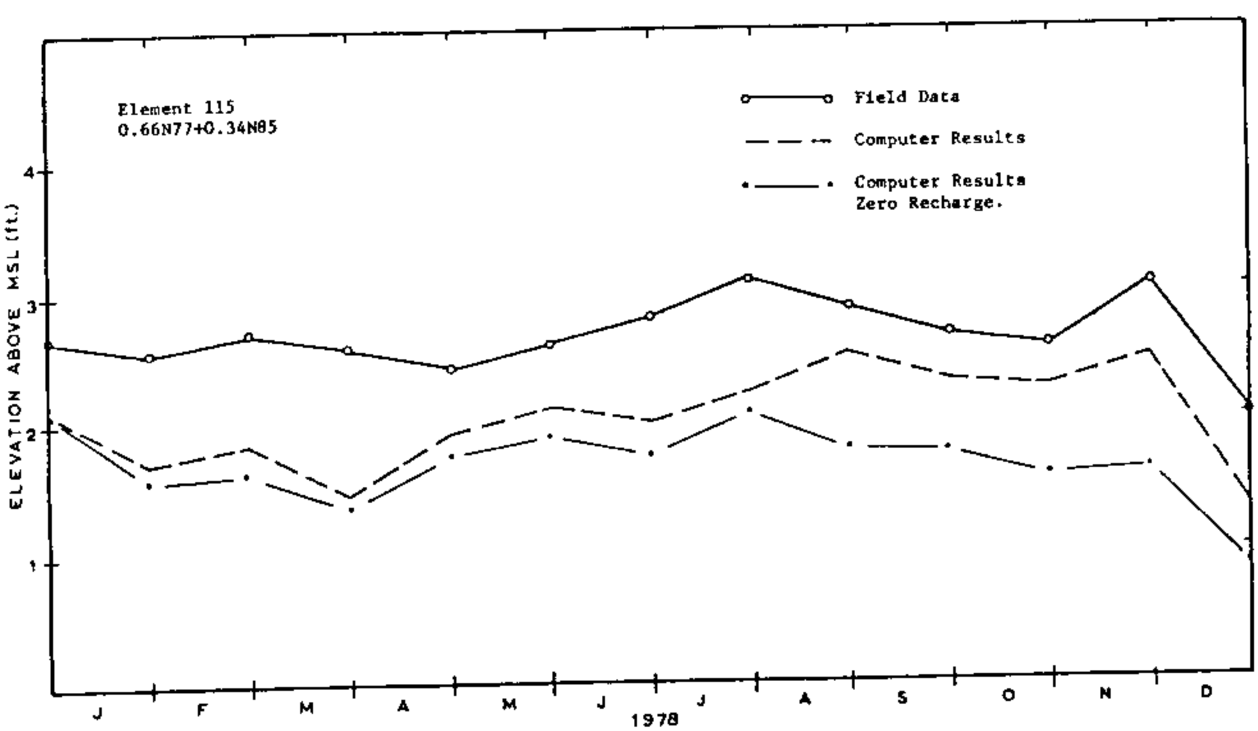

Figure 30. Effect of Zero Recharge in 1978 at Harmon Well #1.

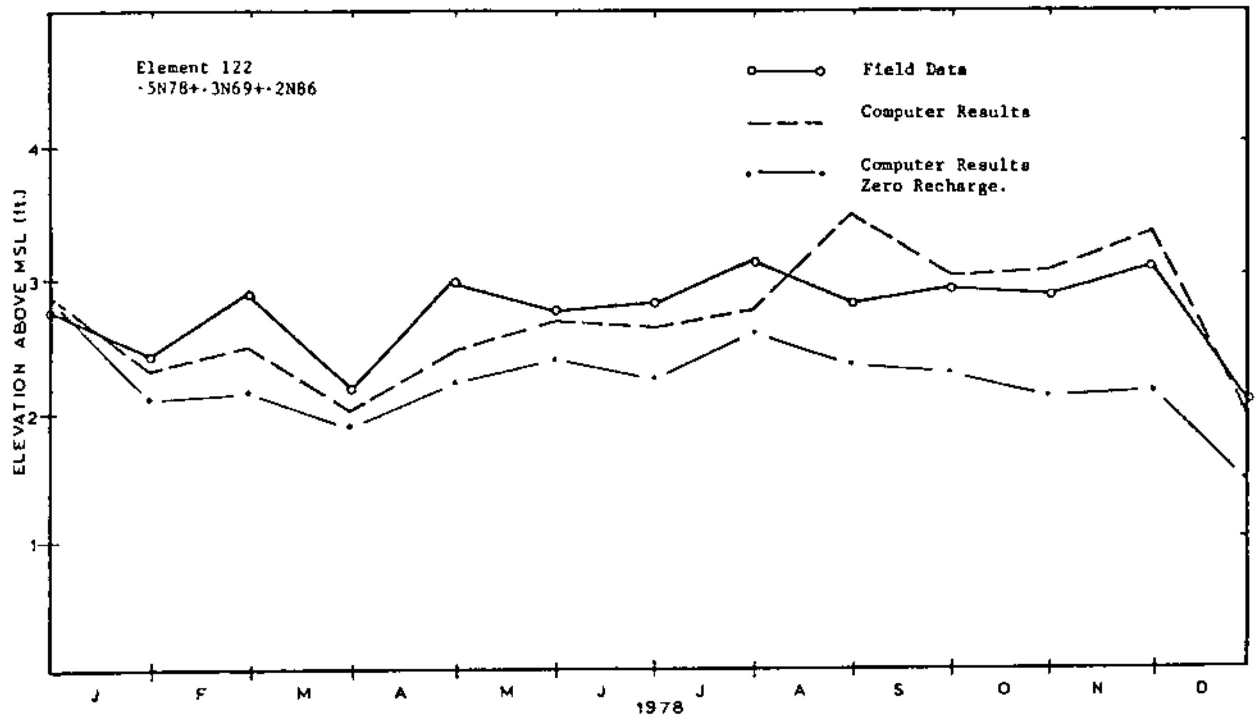

Figure 31. Effect of Zero Recharge in 1978 at Well M-10A.

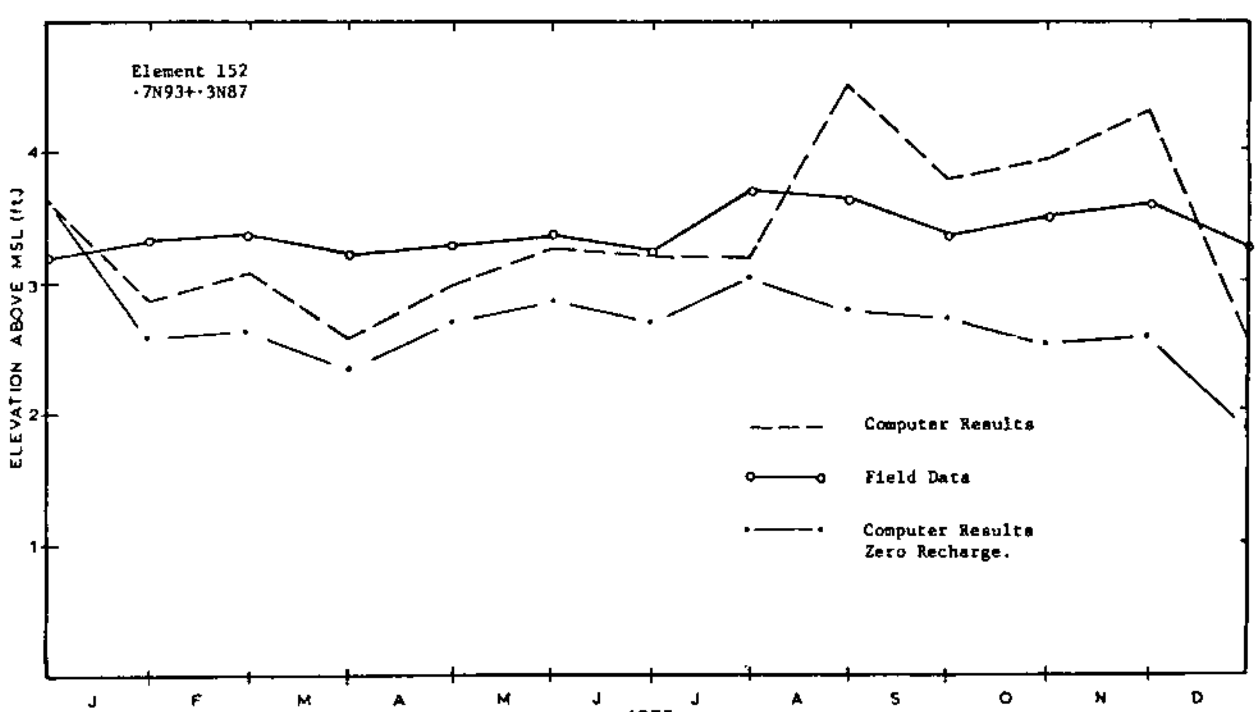

Figure 32. Effect of Zero Recharge in 1978 at Well M-11.

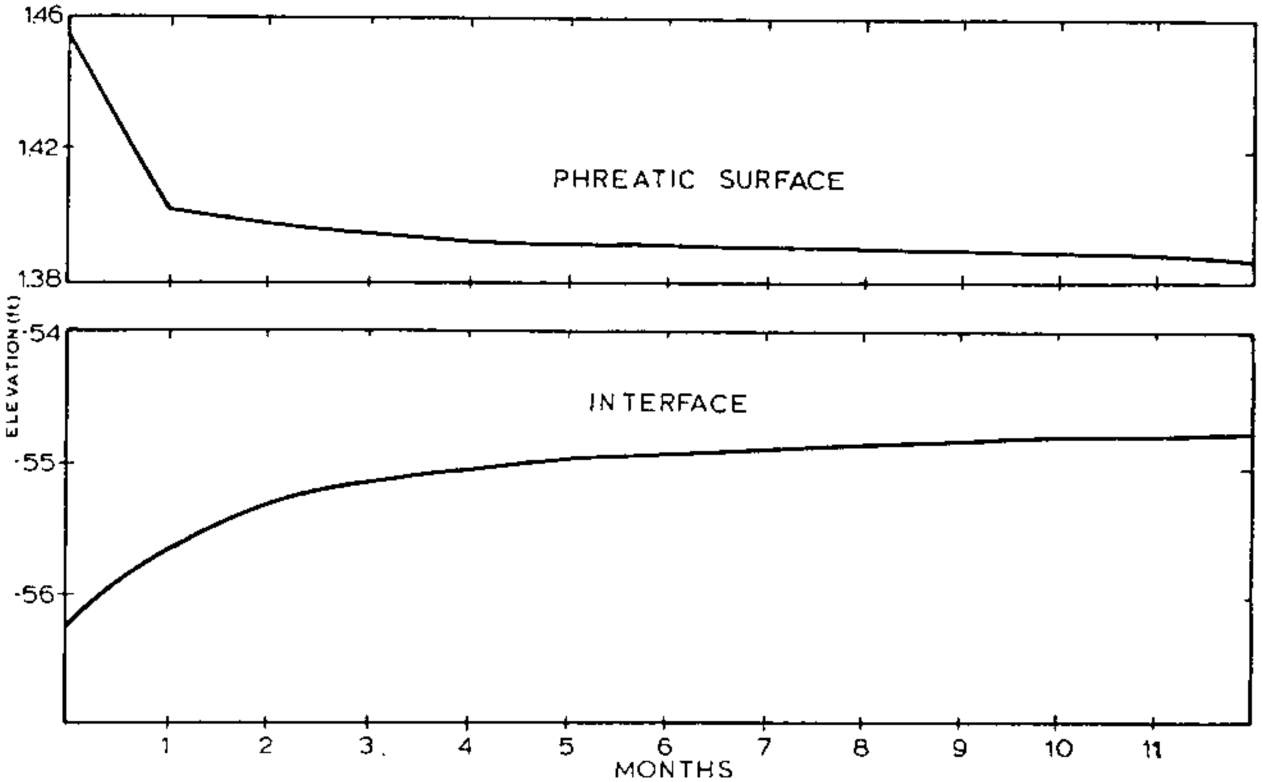

Figure 33. Unsteady effects of doubling 1978 pumping rate at Node 62.

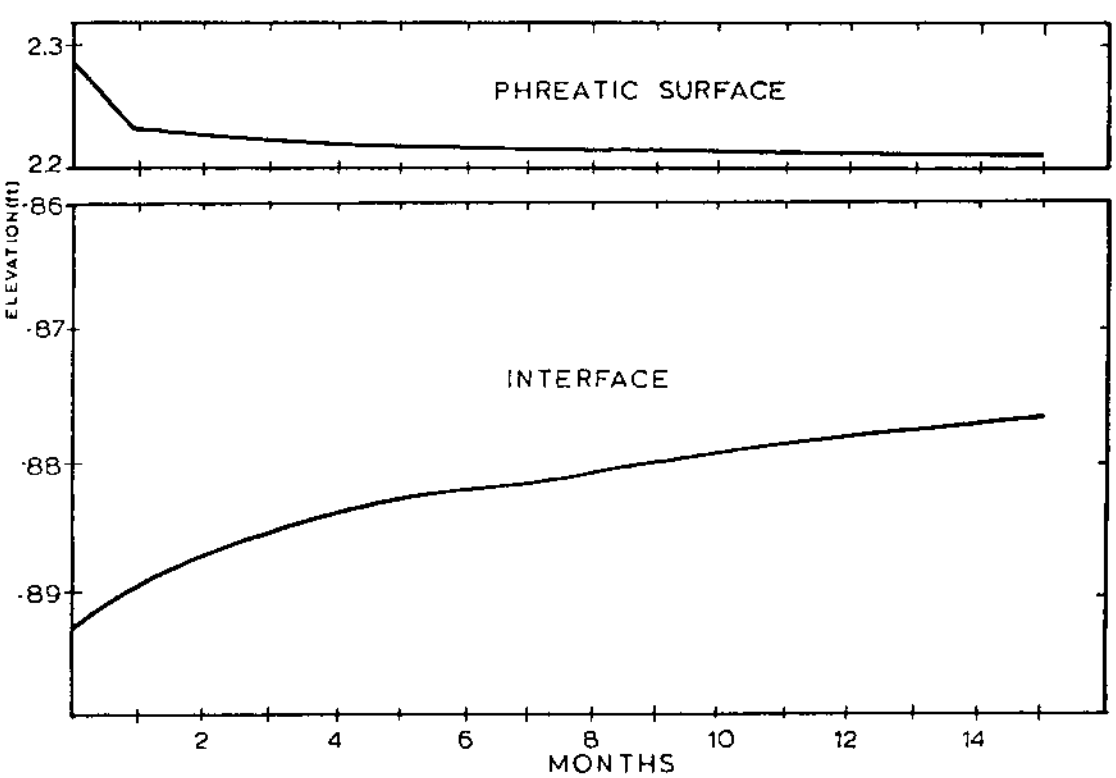

Figure 34. Unsteady effects of doubling 1978 pumping rate at Node 29.

Table 1. Node numbers and weighted pump discharge.

Serial No.	Node No.	Weighted Pump Discharge
1	4	0.5A1+0.7A3+0.5A11+0.3A12
2	5	0.5A7+0.8A8+0.5A11+0.7A12
3	6	0.3A19
4	10	0.4A5+0.05A6
5	11	0.5A1+0.3A3+0.6A5+0.9A6+0.1A8
6	12	0.8A2+0.6A4+0.5A7+0.1A8
7	13	A13+0.7A19
8	17	0.05A6
9	19	0.2A2+0.4A4+0.6A9+0.4A10
10	20	A17
11	27	0.4A9+0.6A10+0.5A18
12	29	0.5A14+0.5A18+A21
13	34	0.3A16
14	35	0.4A15+0.4A16
15	36	0.5A14
16	40	0.3ISEQ
17	43	0.4ISEQ
18	44	0.3ISEQ
19	45	0.3A16
20	46	0.3A15+0.2A22
21	47	0.3A15+0.2A22
22	50	0.2FORE
23	52	0.6A22
24	56	0.4FORE
25	57	0.4FORE+0.1HF4
26	60	0.1HRP12
27	61	0.4HRP12
28	62	TUMON TUNNEL
29	63	0.6HF4
30	66	0.5HRP12
31	69	0.3HF4
32	73	0.4M1+0.1M2
33	78	0.2M12
34	79	0.4M1+0.45M2+0.35M8
35	80	0.2M1+0.45M2+M3+0.7M4+0.5M8+M9
36	82	0.15M8
37	86	0.4M12+M14
38	87	0.33M6+0.4M12
39	88	M5+0.33M6+M7
40	89	0.3M4
41	91	H1
42	93	0.7D14

Table 1. Continued.

Serial No.	Node No.	Weighted Pump Discharge
43	97	0.8D15
44	98	0.4D1+0.4D2+0.2D4+0.5D5+0.3D12+0.3D14+ 0.2D15+0.33M6+0.7USM1+0.6USM2
45	102	0.5NCS2
46	103	0.3NCS2
47	104	0.1D6+0.6D7+0.7D8+0.45D9+0.4D10+0.2D11+D13
48	105	0.3D1+0.3D2+0.6D3+0.5D4+0.25D5+0.45D6+0.1D9 +0.6D11+0.3USM1
49	106	0.3D1+0.3D2+0.4D3+0.3D4+0.25D5+0.45D6+0.4D7 +0.3D8+0.45D9+0.6D10+0.2D11+0.7D12+0.2USM2+ +0.5USM3
50	107	0.2USM2+0.5USM3+0.3USM9
51	112	0.2NCS2
52	114	0.2USM6+0.7USM7+USM8+0.7USM9
53	117	0.9F6+0.4F7
54	118	0.65F5+0.1F6+0.2F7+0.4F8
55	120	0.3Y4
56	121	0.2Ya+0.2USM5+0.4USM6+0.15M7
57	122	0.6USM5+0.4USM6+0.15USM7
58	125	0.7F1+0.35F5+0.4F7+0.4NCS1
59	126	0.6F8
60	127	0.1Y1+0.1Y2
61	129	0.8Y1+0.8Y2+0.5Y4
62	130	0.2USM5
63	132	0.25F2+0.6NCS1
64	133	0.3F1+0.5F2+0.35F3
65	135	0.1Y1+0.1Y2+0.3Y3
66	136	0.6Y3
67	137	0.1Y3
68	140	0.25F2+0.65F3+0.65F4
69	141	0.35F4
70	154	0.2AG1+0.2AG2
71	155	0.6AG1+0.7AG2
72	164	0.2AG1

Table 2. Comparison of results with different time intervals.

Node	F. W. Head Δt = 1 week	F. W. Head Δt = 2 weeks	% Change, Δ	F. W. Head Δt = 1 month	% Change, Δ
4	27.47	27.46	- .036	27.4	- 0.25
20	3.54	3.52	0.0	3.51	- 0.28
36	4.10	4.11	0.24	4.12	0.48
51	7.24	7.17	- 0.96	7.16	- 1.1
63	8.52	8.48	- 0.47	8.75	2.7
70	8.74	8.71	- 0.34	8.85	1.26
82	14.92	14.86	- 0.40	14.93	0.20
88	12.55	12.53	- 0.16	12.72	1.35
98	12.71	12.71	0.0	12.96	1.97
105	11.33	11.85	4.6	12.07	6.53
114	18.03	18.06	0.16	18.58	3.05
121	20.13	20.16	0.15	20.71	2.88
136	27.83	27.86	0.11	28.48	2.34
146	6.81	6.61	- 2.8	6.64	- 2.50
157	37.80	37.80	0.0	38.42	1.64
165	10.04	10.06	0.2	10.53	4.88
172	8.37	8.34	- 0.16	8.54	2.03
179	1.77	1.78	0.56	1.75	1.13
184	2.60	2.57	- 0.59	2.58	- 0.77
Average Absolute Change = Δ Ave			0.628		1.96

Table 3. Rainfall, evapotranspiration and recharge for 1978.

Month	Southern Guam			Northern Guam		
	Average Rainfall (inches)	Average Runoff (inches)	Evapotranspiration (inches)	Average Rainfall (inches)	Evapotranspiration (inches)	Recharge (inches)
Jan	1.81	1.36	0.45	1.91	0.426	1.48
Feb	2.65	1.17	1.48	3.97	0.988	2.982
Mar	0.44	0.699	0.0	0.745	0.0	0.745
Apr	2.17	0.59	1.58	2.72	1.26	1.46
May	2.73	.445	2.29	3.83	1.63	2.20
June	8.61	.909	7.70	9.78	6.78	3.00
July	10.97	3.01	7.96	8.99	9.71	0.0
Aug	18.86	14.07	4.79	17.86	5.06	12.8
Sept	12.18	9.66	2.52	10.14	3.03	7.11
Oct	7.64	7.16	0.48	9.94	.369	9.57
Nov	15.01	12.09	2.92	14.81	2.96	11.85
Dec	4.98	3.75	1.23	4.31	1.42	2.89
Totals	88.05	54.9	33.5	89.01	33.63	56.09

Table 4. Aquifer volumes for different pumping rates.

		No Pumping	1978 Pumping	Twice 1978 Pumping	Five Times 1978 Pumping
Aquifer Volume *	(cft)	0.616×10^{11}	0.5889×10^{11}	0.5611×10^{11}	0.3567×10^{11}
	(cu.mi)	0.4185	0.4001	0.3812	0.2423
	(gals)	4.620×10^{11}	$4.4.7 \times 10^{11}$	4.208×10^{11}	2.675×10^{11}
Average Thickness of Freshwater Lens	(ft)	68.73	65.63	62.44	43.57

* Area of aquifer = 1.8506×10^{9} sq. ft.
= 66.38 sq. mi.
= 42,484.6 acres.

Table 5. Monthly volumes of aquifer in 1978 with and without recharge.

Month	With Recharge		Without Recharge	
	Volume (10^{11})cft	Average Thickness of Aquifer (ft)	Volume (10^{11})cft	Average Thickness of Aquifer (ft)
January	0.6580	75.02	0.6554	74.69
February	0.6604	75.13	0.6522	74.16
March	0.6574	75.06	0.6575	74.71
April	0.6469	73.59	0.6434	72.88
May	0.6433	73.02	0.6347	71.77
June	0.6408	72.61	0.6251	70.72
July	0.6260	71.11	0.6203	69.97
August	0.6714	75.10	0.6119	68.94
September	0.6545	73.77	0.6046	68.03
October	0.6657	74.85	0.5979	67.18
November	0.6675	75.42	0.5917	66.42
December	0.6703	76.39	0.6099	68.72

APPENDIX A.

LISTING OF DATA ON GUAM AQUIFER.

STEADY STATE SOLUTION IN THE NORTHERN GUAM AQUIFER. FIVE TIMES '78 PUMPING RATE

```
 189  299    10    72    01    02     8     0     1     1
+2.635E+36 1.0      0.005     62.4      64.0      0.0       0.1
  41     0    38     0  040
```

1	-38200.	-7900.0	-100.	1000.1
2	-34600.	-11900.	-100.	1000.1
3	-31900.	-14840.	-150.	1000.1
4	-29040.	-17900.	-200.	1000.1
5	-26160.	-21200.	-200.	1000.1
6	-22800.	-24800.	-100.	1000.1
7	-19400.	-28500.	-100.	1000.1
8	-33700.	-8800.0	-100.	1000.1
9	-30900.	-11900.	-100.	1000.1
10	-28300.	-14700.	-150.	1000.1
11	-25600.	-17300.	-250.	1000.1
12	-22200.	-20800.	-200.	1000.1
13	-18400.	-24900.	-100.	1000.1
14	-15900.	-27600.	-100.	1000.1
15	-30500.	-9100.	-100.	1000.1
16	-27700.	-11300.	-250.	1000.1
17	-24800.	-13700.	-300.	1000.1
18	-21600.	-16600.	-400.	1000.1
19	-18200.	-20100.	-500.	1000.1
20	-14300.	-23500.	-200.	1000.1
21	-13300.	-26600.	-200.	1000.1
22	-27400.	-8800.0	-300.	1000.1
23	-24400.	-10800.	-400.	1000.1
24	-21600.	-12100.	-500.	1000.1
25	-18500.	-13900.	-500.	1000.1
26	-18000.	-16900.	-500.	1000.1
27	-14400.	-16700.	-500.	1000.1
28	-14900.	-20100.	-500.	1000.1
29	-11700.	-21100.	-500.	1000.1
30	-11400.	-24200.	-500.	1000.1
31	-9700.0	-26700.	-500.	1000.1
032	-23300.	-7800.0	-500.	1000.1
033	-20700.	-8900.0	-500.	1000.1
034	-17500.	-10000.	-500.	1000.1
035	-14500.	-13200.	-500.	1000.1
036	-10700.	-17700.	-500.	1000.1
037	-7800.0	-23300.	-500.	1000.1
038	-23300.	-1700.0	-500.	1000.1
039	-21500.	-4400.0	-500.	1000.1
040	-19900.	-6400.0	-500.	1000.1
041	-21900.	+1600.0	-500.	1000.1
042	-20000.	-300.00	-500.	1000.1
043	-18500.	-2400.0	-500.	1000.1
044	-15700.	-5700.0	-500.	1000.1
045	-13700.	-9000.0	-400.	1000.1
046	-11800.	-11800.	-300.	1000.1
047	-10000.	-14800.	-400.	1000.1
048	-7200.0	-18700.	-500.	1000.1
049	-17700.	+1700.0	-500.	1000.1
050	-14700.	-1700.0	-500.	1000.1
051	-11600.	-5100.0	-300.	1000.1
052	-9000.0	-9700.0	+50.0	1000.1
053	-6800.0	-13600.	-300.	1000.1
054	-3800.	-16800.	-500.	1000.1
055	-3900.0	-21500.	-500.	1000.1
056	-12900.	+2200.0	-500.	1000.1
057	-10000.	-1100.0	-500.	1000.1
058	-7600.0	-5700.0	+75.0	1000.1
059	-6400.0	-9000.0	+50.0	1000.1
060	-3200.0	-12600.	-300.	1000.1
061	-400.00	-17700.	-500.	1000.1
062	-9600.0	+2600.0	-500.	1000.1
063	-6500.0	-1400.0	-300.	1000.1
064	-3400.0	-6000.0	+50.0	1000.1
065	-2800.0	-9200.0	-50.0	1000.1
066	+200.00	-13500.	-500.	1000.1
067	-10400.	+6400.0	-500.	1000.1
068	-8000.0	+4300.0	-500.	1000.1
069	-6400.0	+2400.0	-500.	1000.1
070	-4300.0	-400.00	-250.	1000.1
071	-2000.0	-2600.0	+50.0	1000.1
072	-300.00	-7500.0	-50.0	1000.1
073	+1700.0	-9600.0	-300.	1000.1
074	+3200.0	-14400.	-500.	1000.1
075	+5000.0	-10700.	-500.	1000.1
076	-11500.	+9200.0	-500.	1000.1
077	-6500.0	+6900.0	-400.	1000.1
078	-3200.0	+2400.0	-400.	1000.1
079	+2200.0	-3200.0	+50.0	1000.1
080	+4400.0	-6600.0	-50.0	1000.1
081	+7700.0	-11100.	-500.	1000.1
032	+3700.0	-3500.0	-20.0	1000.1
083	+8000.0	-7000.0	-100.	1000.1
084	-11900.	+12400.	-500.	1000.1
085	-7200.0	+10000.	-300.	1000.1
086	-3200.0	+6500.0	-500.	1000.1
087	0.	+2500.0	-350.	1000.1
088	+2900.0	0.	-300.	1000.1
089	+5300.0	-2800.0	+50.0	1000.1
090	+11200.	-7500.	-100.	1000.1
091	-8400.0	+13600.	-500.	1000.1
092	-3000.0	+10200.	-500.	1000.1
093	+500.00	+5500.0	-450.	1000.1
094	-9000.0	+16400.	-500.	1000.1
095	-5000.0	+13500.	-500.	1000.1
096	-1000.0	+12300.	-500.	1000.1
097	+700.00	+9200.0	-500.	1000.1
098	+4900.0	+3400.0	-500.	1000.1
099	+7100.0	-300.00	+50.0	1000.1
100	-7400.0	+20200.	-500.	1000.1

101	-5300.0	+16500.	-500.	1000.1
102	-2400.	+15500.	-500.	1000.1
103	+1600.0	+15100.	-300.	1000.1
104	+4000.0	+12800.	+50.0	1000.1
105	+3800.0	+8500.0	-420.	1000.1
106	+6400.0	+8500.0	+50.0	1000.1
107	+8300.0	+4200.0	-400.	1000.1
108	+11800.	+1700.0	+50.0	1000.1
109	-5600.0	+22500.	-500.	1000.1
110	-3800.0	+19800.	-500.	1000.1
111	-1500.0	+18700.	-500.	1000.1
112	+700.00	+17900.	-400.	1000.1
113	+8400.0	+9300.0	+50.0	1000.1
114	+12400.	+4400.0	-200.	1000.1
115	-4100.0	+25200.	-500.	1000.1
116	-700.00	+22500.	-400.	1000.1
117	+1800.0	+20900.	-300.	1000.1
118	+3800.0	+19900.	+50.0	1000.1
119	+11000.	+12200.	+50.0	1000.1
120	+11800.	+7600.0	-230.	1000.1
121	+15200.	+5800.0	-200.	1000.1
122	+14800.	+3400.0	+50.0	1000.1
123	-1700.0	+27400.	-500.	1000.1
124	+600.00	+25300.	-500.	1000.1
125	+2900.0	+24100.	-300.	1000.1
126	+5200.0	+22300.	+50.0	1000.1
127	+14600.	+12700.	+50.0	1000.1
128	+13100.	+10000.	-200.	1000.1
129	+17000.	+3800.0	-180.	1000.1
130	+17800.	+5600.0	+50.0	1000.1
131	-700.00	+30700.	-500.	1000.1
132	+3400.0	+28000.	-300.	1000.1
133	+7000.0	+25000.	+50.0	1000.1
134	+18600.	+15600.	+50.0	1000.1
135	+18200.	+11600.	-150.	1000.1
136	+20200.	+13100.	-140.	1000.1
137	+21100.	+9400.0	+50.0	1000.1
138	+700.00	+34100.	-500.	1000.1
139	+4200.	+32900.	-300.	1000.1
140	+6200.0	+29700.	-200.	1000.1
141	+9200.0	+27800.	+50.0	1000.1
142	+21800.	+15400.	-130.	1000.1
143	+23900.	+15000.	+50.0	1000.1
144	0.	+39800.	-500.	1000.1
145	+3800.0	+37700.	-500.	1000.1
146	+6300.0	+35000.	-200.	1000.1
147	+8300.0	+31600.	+50.0	1000.1
148	+22700.	+20400.	+50.0	1000.1
149	+25500.	+18900.	-100.	1000.1
150	+27800.	+16700.	+50.0	1000.1
151	+2800.0	+41300.	-500.	1000.1
152	+7200.0	+39100.	-250.	1000.1
153	+9200.0	+36000.	+50.0	1000.1
154	+12750.	+34000.	+50.0	1000.1
155	+13600.	+28800.	+50.0	1000.1
156	+27000.	+23300.	+50.0	1000.1
157	+28950.	+20350.	-50.0	1000.1
158	+30400.	+23200.	+50.0	1000.1
159	+30900.	+18400.	+50.0	1000.1
160	+400.00	+44500.	-500.	1000.1
161	+4000.0	+44500.	-500.	1000.1
162	+5700.0	+42300.	-500.	1000.1
163	+9400.0	+41400.	-250.	1000.1
164	+13000.	+37400.	-150.	1000.1
165	+14875.	+33550.	-50.0	1000.1
166	+17000.	+33100.	+50.0	1000.1
167	+3900.0	+48600.	-500.	1000.1
168	+7000.0	+46900.	-500.	1000.1
169	+9500.0	+45200.	-500.	1000.1
170	+13000.	+41000.	-250.	1000.1
171	+16400.	+37700.	-100.	1000.1
172	+19200.	+36200.	-50.0	1000.1
173	+22000.	+34500.	+50.0	1000.1
174	+5800.0	+53300.	-500.	1000.1
175	+8400.0	+50000.	-500.	1000.1
176	+12800.	+44600.	-500.	1000.1
177	+15400.	+40600.	-500.	1000.1
178	+8900.0	+55600.	-500.	1000.1
179	+11000.	+52200.	-500.	1000.1
180	+13300.	+48700.	-500.	1000.1
181	+16600.	+44300.	-500.	1000.1
182	+20600.	+39400.	-100.	1000.1
183	+16600.	+47600.	-500.	1000.1
184	+20305.	+43200.	-500.	1000.1
185	+12900.	+54200.	-500.	1000.1
186	+16600.	+51000.	-500.	1000.1
187	+20000.	+46500.	-500.	1000.1
188	+23500.	+42200.	-500.	1000.1
189	+25200.	+37800.	-100.	1000.1

001	001	002	008	.00116	.00116	.00116	.00116	0.80
002	008	002	009	.00116	.00116	.00116	.00116	0.80
003	002	003	009	.00116	.00116	.00116	.00116	0.90
004	009	003	010	.00116	.00116	.00116	.00116	0.90
005	003	004	010	.00116	.00116	.00116	.00116	0.80
006	010	004	011	.00116	.00116	.00116	.00116	0.80
007	004	005	011	.00116	.00116	.00116	.00116	0.80
008	011	005	012	.00116	.00116	.00116	.00116	0.80
009	005	006	012	.00116	.00116	.00116	.00116	0.80
010	012	006	013	.00116	.00116	.00116	.00116	0.80
011	006	007	013	.00116	.00116	.00116	.00116	0.90
012	013	007	014	.00116	.00116	.00116	.00116	0.80
013	008	009	015	.00116	.00116	.00116	.00116	0.80
014	015	009	016	.00116	.00116	.00116	.00116	0.80
015	009	010	016	.00116	.00116	.00116	.00116	0.80
016	016	010	017	.00116	.00116	.00116	.00116	0.80
017	010	011	017	.00116	.00116	.00116	.00116	0.80
018	017	011	018	.00116	.00116	.00116	.00116	0.80
019	011	012	018	.00116	.00116	.00116	.00116	0.80
020	018	012	019	.00116	.00116	.00116	.00116	0.80

021	012	013	019	.00116	.00116	.00116	.00116	0.80
022	019	013	020	.00116	.00116	.00116	.00116	0.80
023	013	014	020	.00116	.00116	.00116	.00116	0.80
024	020	014	021	.00116	.00116	.00116	.00116	0.80
025	015	016	022	.058	.058	.058	.058	0.45
026	022	016	023	.058	.058	.058	.058	0.45
027	022	023	032	.058	.058	.058	.058	0.45
028	016	017	023	.058	.058	.058	.058	0.45
029	032	023	024	.058	.058	.058	.058	0.45
030	023	017	024	.058	.058	.058	.058	0.45
031	017	018	024	.058	.058	.058	.058	0.45
032	024	018	025	.058	.058	.058	.058	0.45
033	025	018	026	.058	.058	.058	.058	0.45
034	018	019	026	.058	.058	.058	.058	0.45
035	025	026	027	.058	.058	.058	.058	0.45
036	026	019	027	.058	.058	.058	.058	0.45
037	019	029	027	.058	.058	.058	.058	0.45
038	019	020	028	.058	.058	.058	.058	0.45
039	027	028	029	.058	.058	.058	.058	0.45
040	028	020	029	.058	.058	.058	.058	0.45
041	020	030	029	.058	.058	.058	.058	0.45
042	020	021	030	.058	.058	.058	.058	0.45
043	029	030	037	.058	.058	.058	.058	0.45
044	030	021	031	.058	.058	.058	.058	0.45
045	030	031	037	.058	.058	.058	.058	0.45
046	039	032	040	.058	.058	.058	.058	0.45
047	032	033	040	.058	.058	.058	.058	0.45
048	032	024	033	.058	.058	.058	.058	0.45
049	033	034	040	.058	.058	.058	.058	0.45
050	033	024	034	.058	.058	.058	.058	0.45
051	024	025	034	.058	.058	.058	.058	0.45
052	025	035	034	.058	.058	.058	.058	0.45
053	025	027	035	.058	.058	.058	.058	0.45
054	035	027	047	.058	.058	.058	.058	0.45
055	027	036	047	.058	.058	.058	.058	0.45
056	027	029	036	.058	.058	.058	.058	0.45
057	036	048	047	.058	.058	.058	.058	0.45
058	036	029	048	.058	.058	.058	.058	0.45
059	029	037	048	.058	.058	.058	.058	0.45
060	048	037	055	.058	.058	.058	.058	0.45
061	038	042	041	.058	.058	.058	.058	0.45
062	038	043	042	.058	.058	.058	.058	0.45
063	038	039	043	.058	.058	.058	.058	0.45
064	039	040	043	.058	.058	.058	.058	0.45
065	040	044	043	.058	.058	.058	.058	0.45
066	040	034	044	.058	.058	.058	.058	0.45
067	034	045	044	.058	.058	.058	.058	0.45
068	034	035	045	.058	.058	.058	.058	0.45
069	035	046	045	.058	.058	.058	.058	0.45
070	035	047	046	.058	.058	.058	.058	0.45
071	041	042	049	.058	.058	.058	.058	0.45
072	042	043	049	.058	.058	.058	.058	0.45
073	043	050	049	.058	.058	.058	.058	0.45
074	043	044	050	.058	.058	.058	.058	0.45
075	044	051	050	.058	.058	.058	.058	0.45
076	044	045	051	.058	.058	.058	.058	0.45
077	045	052	051	.058	.058	.058	.058	0.45
078	045	046	052	.058	.058	.058	.058	0.45
079	046	047	052	.058	.058	.058	.058	0.45
080	047	053	052	.058	.058	.058	.058	0.45
081	047	048	053	.058	.058	.058	.058	0.45
082	053	049	054	.058	.058	.058	.058	0.45
083	048	055	054	.058	.058	.058	.058	0.45
084	049	050	056	.232	.232	.232	.232	0.40
085	050	057	056	.232	.232	.232	.232	0.40
086	050	051	057	.232	.232	.232	.232	0.40
087	051	058	057	.232	.232	.232	.232	0.40
088	051	052	056	.232	.232	.232	.232	0.40
089	052	060	059	.232	.232	.232	.232	0.40
090	052	053	060	.232	.232	.232	.232	0.40
091	053	054	060	.232	.232	.232	.232	0.40
092	054	061	060	.232	.232	.232	.232	0.40
093	054	055	061	.232	.232	.232	.232	0.40
094	056	062	067	.232	.232	.232	.232	0.40
095	056	057	062	.232	.232	.232	.232	0.40
096	067	062	068	.232	.232	.232	.232	0.40
097	062	069	068	.232	.232	.232	.232	0.40
098	057	069	062	.232	.232	.232	.232	0.40
099	057	063	069	.232	.232	.232	.232	0.40
100	063	070	069	.232	.232	.232	.232	0.40
101	057	058	063	.232	.232	.232	.232	0.40
102	063	058	071	.232	.232	.232	.232	0.40

103	063	071	070	.232	.232	.232	.232	0.40
104	059	065	064	.232	.232	.232	.232	0.40
105	059	060	065	.232	.232	.232	.232	0.40
106	064	065	072	.232	.232	.232	.232	0.40
107	065	073	072	.232	.232	.232	.232	0.40
108	065	060	073	.232	.232	.232	.232	0.40
109	060	066	073	.232	.232	.232	.232	0.40
110	060	061	066	.232	.232	.232	.232	0.40
111	066	074	073	.232	.232	.232	.232	0.40
112	066	061	074	.232	.232	.232	.232	0.40
113	076	085	084	.232	.232	.232	.232	0.40
114	076	067	085	.232	.232	.232	.232	0.40
115	067	077	085	.232	.232	.232	.232	0.40
116	067	068	077	.232	.232	.232	.232	0.40
117	085	077	086	.232	.232	.232	.232	0.40
118	068	069	077	.232	.232	.232	.232	0.40
119	077	069	086	.232	.232	.232	.232	0.40
120	069	078	086	.232	.232	.232	.232	0.40
121	078	087	086	.232	.232	.232	.232	0.40
122	069	070	078	.232	.232	.232	.232	0.40
123	070	071	078	.232	.232	.232	.232	0.40
124	078	071	087	.232	.232	.232	.232	0.40
125	087	071	088	.232	.232	.232	.232	0.40
126	071	079	088	.232	.232	.232	.232	0.40
127	088	079	082	.232	.232	.232	.232	0.40
128	088	082	089	.232	.232	.232	.232	0.40
129	079	080	082	.232	.232	.232	.232	0.40
130	082	080	089	.232	.232	.232	.232	0.40
131	064	072	079	.232	.232	.232	.232	0.40
132	072	073	079	.232	.232	.232	.232	0.40
133	079	073	080	.232	.232	.232	.232	0.40
134	073	075	080	.232	.232	.232	.232	0.40
135	073	074	075	.232	.232	.232	.232	0.40
136	080	075	081	.232	.232	.232	.232	0.40
137	075	074	081	.232	.232	.232	.232	0.40
138	089	080	083	.232	.232	.232	.232	0.40
139	089	083	090	.232	.232	.232	.232	0.40
140	080	081	083	.232	.232	.232	.232	0.40
141	083	081	090	.232	.232	.232	.232	0.40
142	084	091	094	.232	.232	.232	.232	0.40
143	094	091	095	.232	.232	.232	.232	0.40
144	084	085	091	.232	.232	.232	.232	0.40
145	091	085	095	.232	.232	.232	.232	0.40
146	085	092	095	.232	.232	.232	.232	0.40
147	085	086	092	.232	.232	.232	.232	0.40
148	095	092	096	.232	.232	.232	.232	0.40
149	092	097	096	.232	.232	.232	.232	0.40
150	092	086	097	.232	.232	.232	.232	0.40
151	086	093	097	.232	.232	.232	.232	0.40
152	086	087	093	.232	.232	.232	.232	0.40
153	093	098	097	.232	.232	.232	.232	0.40
154	087	098	093	.232	.232	.232	.232	0.40
155	087	088	098	.232	.232	.232	.232	0.40
156	088	099	098	.232	.232	.232	.232	0.40
157	088	089	099	.232	.232	.232	.232	0.40
158	100	094	110	.232	.232	.232	.232	0.40
159	094	101	110	.232	.232	.232	.232	0.40
160	101	102	110	.232	.232	.232	.232	0.40
161	094	095	101	.232	.232	.232	.232	0.40
162	101	095	102	.232	.232	.232	.232	0.40
163	110	102	111	.232	.232	.232	.232	0.40
164	111	102	112	.232	.232	.232	.232	0.40
165	102	103	112	.232	.232	.232	.232	0.40
166	095	096	102	.232	.232	.232	.232	0.40
167	102	096	103	.232	.232	.232	.232	0.40
168	096	104	103	.232	.232	.232	.232	0.40
169	096	097	104	.232	.232	.232	.232	0.40
170	097	105	104	.232	.232	.232	.232	0.40
171	105	106	104	.232	.232	.232	.232	0.40
172	097	098	105	.232	.232	.232	.232	0.40
173	105	098	106	.232	.232	.232	.232	0.40
174	098	107	106	.232	.232	.232	.232	0.40
175	106	107	113	.232	.232	.232	.232	0.40
176	113	107	120	.232	.232	.232	.232	0.40
177	098	099	107	.232	.232	.232	.232	0.40
178	107	114	120	.232	.232	.232	.232	0.40
179	107	108	114	.232	.232	.232	.232	0.40
180	107	099	108	.232	.232	.232	.232	0.40

181	120	114	121	.232	.232	.232	.232	0.40
182	114	122	121	.232	.232	.232	.232	0.40
183	114	108	122	.232	.232	.232	.232	0.40
184	113	120	119	.232	.232	.232	.232	0.40
185	119	128	127	.232	.232	.232	.232	0.40
186	119	120	128	.232	.232	.232	.232	0.40
187	120	129	127	.232	.232	.232	.232	0.40
188	120	129	128	.232	.232	.232	.232	0.40
189	120	121	129	.232	.232	.232	.232	0.40
190	121	130	129	.232	.232	.232	.232	0.40
191	121	122	130	.232	.232	.232	.232	0.40
192	127	135	134	.232	.232	.232	.232	0.40
193	134	135	136	.232	.232	.232	.232	0.40
194	127	129	135	.232	.232	.232	.232	0.40
195	135	137	136	.232	.232	.232	.232	0.40
196	129	137	135	.232	.232	.232	.232	0.40
197	129	130	137	.232	.232	.232	.232	0.40
198	134	142	148	.232	.232	.232	.232	0.40
199	142	143	149	.232	.232	.232	.232	0.40
200	134	136	142	.232	.232	.232	.232	0.40
201	136	143	142	.232	.232	.232	.232	0.40
202	136	137	143	.232	.232	.232	.232	0.40
203	148	142	149	.232	.232	.232	.232	0.40
204	148	149	156	.232	.232	.232	.232	0.40
205	149	150	157	.232	.232	.232	.232	0.40
206	149	143	150	.232	.232	.232	.232	0.40
207	156	149	157	.232	.232	.232	.232	0.40
208	156	157	158	.232	.232	.232	.232	0.40
209	157	159	158	.232	.232	.232	.232	0.40
210	157	150	159	.232	.232	.232	.232	0.40
211	100	110	109	.232	.232	.232	.232	0.40
212	109	116	115	.232	.232	.232	.232	0.40
213	109	110	116	.232	.232	.232	.232	0.40
214	110	111	116	.232	.232	.232	.232	0.40
215	111	112	116	.232	.232	.232	.232	0.40
216	116	112	117	.232	.232	.232	.232	0.40
217	112	118	117	.232	.232	.232	.232	0.40
218	112	103	118	.232	.232	.232	.232	0.40
219	103	104	118	.232	.232	.232	.232	0.40
220	115	116	123	.232	.232	.232	.232	0.40
221	123	116	124	.232	.232	.232	.232	0.40
222	116	125	124	.232	.232	.232	.232	0.40
223	116	117	125	.232	.232	.232	.232	0.40
224	117	118	125	.232	.232	.232	.232	0.40
225	125	118	126	.232	.232	.232	.232	0.40
226	123	132	131	.232	.232	.232	.232	0.40
227	123	124	132	.232	.232	.232	.232	0.40
228	124	125	132	.232	.232	.232	.232	0.40
229	125	133	132	.232	.232	.232	.232	0.40
230	125	126	133	.232	.232	.232	.232	0.40
231	131	132	138	.232	.232	.232	.232	0.40
232	138	132	139	.232	.232	.232	.232	0.40
233	132	140	139	.232	.232	.232	.232	0.40
234	139	140	147	.232	.232	.232	.232	0.40
235	140	141	147	.232	.232	.232	.232	0.40
236	132	133	140	.232	.232	.232	.232	0.40
237	140	133	141	.232	.232	.232	.232	0.40
238	144	138	145	.232	.232	.232	.232	0.40
239	138	139	145	.232	.232	.232	.232	0.40
240	139	146	145	.232	.232	.232	.232	0.40
241	145	146	153	.232	.232	.232	.232	0.40
242	146	147	153	.232	.232	.232	.232	0.40
243	139	147	146	.232	.232	.232	.232	0.40
244	144	151	150	.232	.232	.232	.232	0.40
245	160	151	162	.232	.232	.232	.232	0.40
246	144	145	151	.232	.232	.232	.232	0.40
247	151	145	162	.232	.232	.232	.232	0.40
248	145	152	162	.232	.232	.232	.232	0.40
249	162	152	163	.232	.232	.232	.232	0.40
250	145	153	152	.232	.232	.232	.232	0.40
251	152	153	163	.232	.232	.232	.232	0.40
252	163	153	170	.232	.232	.232	.232	0.40

253	153	164	170	.232	.232	.232	.232	0.40
254	164	171	170	.232	.232	.232	.232	0.40
255	153	154	164	.232	.232	.232	.232	0.40
256	164	154	171	.232	.232	.232	.232	0.40
257	154	155	165	.232	.232	.232	.232	0.40
258	165	155	166	.232	.232	.232	.232	0.40
259	154	165	171	.232	.232	.232	.232	0.40
260	165	166	171	.232	.232	.232	.232	0.40
261	171	166	172	.232	.232	.232	.232	0.40
262	166	173	172	.232	.232	.232	.232	0.40
263	160	161	167	.232	.232	.232	.232	0.40
264	161	168	167	.232	.232	.232	.232	0.40
265	160	162	161	.232	.232	.232	.232	0.40
266	161	162	168	.232	.232	.232	.232	0.40
267	162	169	168	.232	.232	.232	.232	0.40
268	162	163	169	.232	.232	.232	.232	0.40
269	169	163	170	.232	.232	.232	.232	0.40
270	169	170	176	.232	.232	.232	.232	0.40
271	176	170	181	.232	.232	.232	.232	0.40
272	170	177	181	.232	.232	.232	.232	0.40
273	177	182	181	.232	.232	.232	.232	0.40
274	170	171	177	.232	.232	.232	.232	0.40
275	177	171	182	.232	.232	.232	.232	0.40
276	182	171	172	.232	.232	.232	.232	0.40
277	172	173	182	.232	.232	.232	.232	0.40
278	182	173	189	.232	.232	.232	.232	0.40
279	174	175	178	.232	.232	.232	.232	0.40
280	167	175	174	.232	.232	.232	.232	0.40
281	178	175	179	.232	.232	.232	.232	0.40
282	167	168	175	.232	.232	.232	.232	0.40
283	175	180	179	.232	.232	.232	.232	0.40
284	168	169	175	.232	.232	.232	.232	0.40
285	175	169	180	.232	.232	.232	.232	0.40
286	169	176	180	.232	.232	.232	.232	0.40
287	180	176	181	.232	.232	.232	.232	0.40
288	178	179	185	.232	.232	.232	.232	0.40
289	179	180	185	.232	.232	.232	.232	0.40
290	185	180	186	.232	.232	.232	.232	0.40
291	180	183	186	.232	.232	.232	.232	0.40
292	180	181	183	.232	.232	.232	.232	0.40
293	186	183	187	.232	.232	.232	.232	0.40
294	183	181	187	.232	.232	.232	.232	0.40
295	181	184	187	.232	.232	.232	.232	0.40
296	181	182	184	.232	.232	.232	.232	0.40
297	187	184	188	.232	.232	.232	.232	0.40
298	184	182	188	.232	.232	.232	.232	0.40
299	182	189	188	.232	.232	.232	.232	0.40

```
     1   298
.000000148.000000148.000000148.000000148.000000148.000000148.000000148.000000148
01       001  002

.000243   .000243    .000243    .000243    .000243    .000243    .000243    .000243
02       002  003
.000243   .000243    .000243    .000243    .000243    .000243    .000243    .000243
03       003  004
.000486   .000486    .000486    .000486    .000486    .000486    .000486    .000486
04       004  005
.000486   .000486    .000486    .000486    .000486    .000486    .000486    .000486
05       005  006
.000486   .000486    .000486    .000486    .000486    .000486    .000486    .000486
06       006  007
.000243   .000243    .000243    .000243    .000243    .000243    .000243    .000243
07       052  059
.0000881  .0000881   .0000881   .0000881   .0000881   .0000881   .0000881   .0000881
08       058  071
.000176   .000176    .000176    .000176    .000176    .000176    .000176    .000176
09       071  079
.0000924  .0000924   .0000924   .0000924   .0000924   .0000924   .0000924   .0000924
10       079  064
.000118   .000118    .000118    .000118    .000118    .000118    .000118    .000118
11       064  059
.000156   .000156    .000156    .000156    .000156    .000156    .000156    .000156
12       059  052
.0000855  .0000855   .0000855   .0000855   .0000855   .0000855   .0000855   .0000855
13       090  089
.0000     .0000      .0000      .0000      .0000      .0000      .0000      .0000
14       089  099
.000129   .000129    .000129    .000129    .000129    .000129    .000129    .000129
15       099  108
```

.000285	.000285	.000235	.000285	.000285	.000285	.000285	.000285
16	108	122					
.000309	.000309	.000309	.000309	.000309	.000309	.000309	.000309
17	122	130					
.000374	.000374	.000374	.000374	.000374	.000374	.000374	.000374
18	130	137					
.000317	.000317	.000317	.000317	.000317	.000317	.000317	.000317
19	137	143					
.000537	.000537	.000537	.000537	.000537	.000537	.000537	.000537
20	143	150					
.00027	.00027	.00027	.00027	.00027	.00027	.00027	.00027
21	150	159					
.000481	.000481	.000481	.000481	.000481	.000481	.000431	.000481
22	159	158					
.000196	.000196	.000196	.000196	.000196	.000195	.000196	.000196
23	158	156					
.000235	.000235	.000235	.000235	.000235	.000235	.000235	.000235
24	156	148					
.000323	.000323	.000323	.000323	.000323	.000323	.000323	.000323
25	143	134					
.000261	.000261	.000261	.000261	.000261	.000261	.000261	.000261
26	134	127					
.000177	.000177	.000177	.000177	.000177	.000177	.000177	.000177
27	127	119					
.00327	.00327	.00327	.00327	.00327	.00327	.00327	.00327
28	119	113					
.000433	.000433	.000433	.000433	.000433	.000433	.000433	.000433
29	113	106					
.000124	.000124	.000124	.000124	.000124	.000124	.000124	.000124
30	106	104					
.000144	.000144	.000144	.000144	.000144	.000144	.000144	.000144
31	104	118					
.000333	.000333	.000333	.000333	.000333	.000333	.000333	.000333
32	118	126					
.000294	.000294	.000294	.000294	.000294	.000294	.000294	.000294
33	126	133					
.000306	.000306	.000306	.000306	.000306	.000306	.000306	.000306
34	133	141					
.00375	.00375	.00375	.00375	.00375	.00375	.00375	.00375
35	141	147					
.000288	.000288	.000288	.000288	.000239	.000288	.000288	.000288
36	147	153					
.000191	.000191	.000191	.000191	.000191	.000191	.000191	.000191
37	153	154					
.000283	.000283	.000283	.000283	.000283	.000283	.000283	.000283
38	154	155					
.000255	.000255	.000255	.000255	.000255	.000255	.000255	.000255
39	155	166					
.00109	.00109	.00109	.00109	.00109	.00109	.00109	.00109
40	166	173					
.000251	.000251	.000251	.000251	.000251	.000251	.000251	.000251
41	173	189					
.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

001	007	014	0.00116
002	014	021	0.00116
003	021	031	0.058
004	031	037	0.058
005	037	055	0.058
006	055	061	0.232
007	061	074	0.232
008	074	081	0.232
009	081	090	0.232
010	189	188	0.232
011	188	187	0.232
012	187	186	0.232
013	186	185	0.232
014	185	178	0.232
015	178	174	0.232
016	174	167	0.232
017	167	160	0.232
018	160	144	0.232
019	144	138	0.232

020	133	131	0.232
021	131	123	0.232
022	123	115	0.232
023	115	109	0.232
024	109	100	0.232
025	100	094	0.232
026	094	084	0.232
027	084	076	0.232
028	076	067	0.232
029	067	056	0.232
030	056	049	0.232
031	049	041	0.232
032	041	038	0.058
033	038	039	0.058
034	039	032	0.058
035	032	022	0.058
036	022	015	0.058
037	015	008	0.00116
038	008	001	0.00116
001	007		
002	014		
003	021		
004	031		
005	037		
006	055		
007	061		
008	074		
009	081		
010	090		
011	189		
012	188		
013	197		
014	186		
015	185		
016	178		

017	174
018	167
019	160
020	144
021	138
022	131
023	123
024	115
025	109
026	100
027	094
028	084
029	076
030	067
031	056
032	049
033	041
034	038
035	039
036	032
037	022
038	015
039	008
040	001

4	3						
-4.37	-4.37	-4.37	-4.37	-4.37	-4.37	-4.37	-4.37
5	3						
-5.55	-5.55	-5.55	-5.55	-5.55	-5.55	-5.55	-5.55
6	3						
-.370	-.370	-.370	-.370	-.370	-.370	-.370	-.370
10	6						
-2.18	-2.18	-2.18	-2.18	-2.18	-2.18	-2.18	-2.18
11	6						
-5.75	-5.75	-5.75	-5.75	-5.75	-5.75	-5.75	-5.75
12	6						
-4.22	-4.22	-4.22	-4.22	-4.22	-4.22	-4.22	-4.22
13	6						
-2.86	-2.86	-2.86	-2.86	-2.86	-2.86	-2.86	-2.86
17	6						
-1.25	-1.25	-1.25	-1.25	-1.25	-1.25	-1.25	-1.25
19	7						
-2.94	-2.94	-2.94	-2.94	-2.94	-2.94	-2.94	-2.94
20	7						
-2.24	-2.24	-2.24	-2.24	-2.24	-2.24	-2.24	-2.24
27	8						
-2.81	-2.81	-2.81	-2.81	-2.81	-2.81	-2.81	-2.81
29	7						
-3.75	-3.75	-3.75	-3.75	-3.75	-3.75	-3.75	-3.75
34	7						

35	6						
-.510	-.510	-.510	-.510	-.510	-.510	-.510	-.510
36	4						
-.545	-.545	-.545	-.545	-.545	-.545	-.545	-.545
40	6						
-.115	-.115	-.115	-.115	-.115	-.115	-.115	-.115
43	7						
-.150	-.150	-.150	-.150	-.150	-.150	-.150	-.150
44	6						
-.115	-.115	-.115	-.115	-.115	-.115	-.115	-.115
45	6						
46	4						
-.545	-.545	-.545	-.545	-.545	-.545	-.545	-.545
47	7						
-.545	-.545	-.545	-.545	-.545	-.545	-.545	-.545
50	6						
-.060	-.060	-.060	-.060	-.060	-.060	-.060	-.060
52	7						
-.480	-.480	-.480	-.480	-.480	-.480	-.480	-.480
55	4						
-.120	-.120	-.120	-.120	-.120	-.120	-.120	-.120
57	7						
-.145	-.145	-.145	-.145	-.145	-.145	-.145	-.145
60	8						
-.240	-.240	-.240	-.240	-.240	-.240	-.240	-.240
61	4						
-.960	-.960	-.960	-.960	-.960	-.960	-.960	-.960
62	5						
-9.00	-9.00	-9.00	-9.00	-9.00	-9.00	-9.00	-9.00
63	5						
-.150	-.150	-.150	-.150	-.150	-.150	-.150	-.150
66	4						
-1.20	-1.20	-1.20	-1.20	-1.20	-1.20	-1.20	-1.20
69	8						
-.075	-.075	-.075	-.075	-.075	-.075	-.075	-.075
73	8						
-.835	-.835	-.835	-.835	-.835	-.835	-.835	-.835
78	5						
-.225	-.225	-.225	-.225	-.225	-.225	-.225	-.225
79	6						
-2.00	-2.00	-2.00	-2.00	-2.00	-2.00	-2.00	-2.00
80	7						
-6.95	-6.95	-6.95	-6.95	-6.95	-6.95	-6.95	-6.95
82	4						
-.260	-.260	-.260	-.260	-.260	-.260	-.260	-.260
86	8						
-2.54	-2.54	-2.54	-2.54	-2.54	-2.54	-2.54	-2.54
87	6						
-.940	-.940	-.940	-.940	-.940	-.940	-.940	-.940
88	7						
-4.58	-4.58	-4.58	-4.58	-4.58	-4.58	-4.58	-4.58
89	5						
-.460	-.460	-.460	-.460	-.460	-.460	-.460	-.460
91	4						
-.970	-.970	-.970	-.970	-.970	-.970	-.970	-.970
93	4						
-1.13	-1.13	-1.13	-1.13	-1.13	-1.13	-1.13	-1.13
97	7						
-1.49	-1.49	-1.49	-1.49	-1.49	-1.49	-1.49	-1.49
98	3						
-7.35	-7.35	-7.35	-7.35	-7.35	-7.35	-7.35	-7.35
102	7						
-.695	-.695	-.695	-.695	-.695	-.695	-.695	-.695
103	5						
-.420	-.420	-.420	-.420	-.420	-.420	-.420	-.420
104	5						
-5.20	-5.20	-5.20	-5.20	-5.20	-5.20	-5.20	-5.20
105	4						
-6.05	-6.05	-6.05	-6.05	-6.05	-6.05	-6.05	-6.05
106	4						
-9.45	-9.45	-9.45	-9.45	-9.45	-9.45	-9.45	-9.45
107	7						
-1.75	-1.75	-1.75	-1.75	-1.75	-1.75	-1.75	-1.75
112	6						

-.295	-.295	-.295	-.295	-.295	-.295	-.295	-.295
114	5						
-6.25	-6.25	-6.25	-6.25	-6.25	-6.25	-6.25	-6.25
117	4						
-2.10	-2.10	-2.10	-2.10	-2.10	-2.10	-2.10	-2.10
118	5						
-1.80	-1.80	-1.80	-1.80	-1.80	-1.80	-1.80	-1.80
120	7						
-.545	-.545	-.545	-.545	-.545	-.545	-.545	-.545
121	5						
-2.07	-2.07	-2.07	-2.07	-2.07	-2.07	-2.07	-2.07
122	3						
-2.40	-2.40	-2.40	-2.40	-2.40	-2.40	-2.40	-2.40
125	7						
-3.06	-3.06	-3.06	-3.06	-3.06	-3.06	-3.06	-3.06
126	2						
-1.15	-1.15	-1.15	-1.15	-1.15	-1.15	-1.15	-1.15
127	4						
-.365	-.365	-.365	-.365	-.365	-.365	-.365	-.365
129	7						
-3.82	-3.82	-3.82	-3.82	-3.82	-3.82	-3.82	-3.82
130	3						
-.280	-.280	-.280	-.280	-.280	-.280	-.280	-.280
132	8						
-2.27	-2.27	-2.27	-2.27	-2.27	-2.27	-2.27	-2.27
133	4						
-1.57	-1.57	-1.57	-1.57	-1.57	-1.57	-1.57	-1.57
135	5						
-.815	-.815	-.815	-.815	-.815	-.815	-.815	-.815
136	5						
-.905	-.905	-.905	-.905	-.905	-.905	-.905	-.905
137	4						
-.150	-.150	-.150	-.150	-.150	-.150	-.150	-.150
140	5						
-2.28	-2.28	-2.28	-2.28	-2.28	-2.28	-2.28	-2.28
141	2						
-.595	-.595	-.595	-.595	-.595	-.595	-.595	-.595
154	4						
-.615	-.615	-.615	-.615	-.615	-.615	-.615	-.615
155	2						
-1.61	-1.61	-1.61	-1.61	-1.61	-1.61	-1.61	-1.61
164	4						
-.260	-.260	-.260	-.260	-.260	-.260	-.260	-.260
001	1.90						
002	45.13						
003	31.2						
004	27.24						
005	32.1						
006	40.4						
007	4.70						

008	0.10
009	2.65
010	4.04
011	4.82
012	4.13
013	4.09
014	0.12
015	0.10
016	2.84
017	4.12
018	4.82
019	4.69
020	3.50
021	0.09
022	0.09
023	3.00
024	4.16
025	4.64
026	4.73
027	4.60
028	4.23
029	3.55
030	2.28
031	0.10
032	0.11
033	3.19
034	4.26
035	4.73
036	4.08
037	0.10
038	0.10
039	0.09
040	2.95
041	0.10
042	1.40
043	2.65
044	4.05
045	4.65
046	4.76
047	4.46
048	3.27
049	0.10
050	3.39
051	4.71
052	3.41
053	4.29
054	2.89
055	0.10
056	0.09
057	4.68
058	3.95
059	3.44
060	4.03
061	0.10
062	4.06
063	6.03
064	4.03
065	4.84
066	2.81
067	0.14
068	4.40
069	5.85
070	6.85
071	5.600
072	5.36
073	4.13
074	0.10
075	2.59
076	0.10
077	5.30
078	7.27
079	5.790
080	5.60

081	0.10
082	8.677
083	3.43
084	0.10
085	4.77
086	7.04
087	8.587
088	9.460
089	6.330
090	0.10
091	2.89
092	6.54
093	9.61
094	0.11
095	5.07
096	6.65
097	8.15
098	10.4
099	8.06
100	0.10
101	3.71
102	5.36
103	6.40
104	5.70
105	9.41
106	8.35
107	12.5
108	10.63
109	0.11
110	3.70
111	4.73
112	5.40
113	10.49
114	15.2
115	0.10
116	3.93
117	4.68
118	3.88
119	13.96
120	15.8
121	17.2
122	12.19
123	0.11
124	2.82
125	3.98
126	4.000
127	15.33
128	17.5
129	19.4
130	13.85
131	0.10
132	3.71
133	5.180
134	19.12
135	22.2
136	25.0
137	16.82
138	0.10
139	2.92
140	3.89
141	6.321
142	28.3
143	21.55
144	0.10
145	2.94
146	3.60
147	3.71
148	23.57
149	35.3
150	24.62
151	2.24
152	3.78
153	3.48
154	4.90
155	13.15
156	25.53
157	38.3

158	26.01	
159	26.02	
160	0.10	
161	2.23	
162	3.29	
163	3.91	
164	4.94	
165	6.65	
166	5.56	
167	0.10	
168	2.65	
169	3.41	
170	4.28	
171	4.82	
172	4.87	
173	3.25	
174	0.10	
175	2.43	
176	3.60	
177	4.12	
178	0.10	
179	1.68	
180	2.77	
181	3.27	
182	3.49	
183	2.24	
184	2.36	
185	0.10	
186	0.10	
187	0.10	
188	0.10	
189	0.10	
1	0.0	188
001	77.9	
002	145.	
003	181.	
004	227.	
005	232.	
006	140.	
007	106.	
008	4.00	
009	103.	
010	154.	
011	193.	
012	205.	
013	104.	
014	4.68	
015	3.95	
016	114.	
017	165.	
018	193.	
019	188.	
020	140.	
021	3.58	
022	3.65	
023	120.	
024	166.	
025	186.	
026	189.	
027	184.	
028	169.	
029	142.	
030	91.2	
031	4.00	
032	4.47	
033	127.	
034	170.	
035	189.	
036	163.	
037	4.20	
038	4.00	
039	3.75	
040	118.	
041	4.00	
042	55.9	
043	106.	
044	162.	
045	186.	

046	192.
047	179.
048	131.
049	4.00
050	136.
051	188.
052	0.10
053	171.
054	115.
055	4.00
056	3.73
057	187.
058	0.10
059	0.10
060	161.
061	3.94
062	162.
063	241.
064	0.10
065	54.7
066	112.
067	5.72
068	176.
069	234.
070	257.
071	0.10
072	55.3
073	165.
074	4.03
075	104.
076	4.00
077	212.
078	291.
079	0.10
080	55.5
081	3.81
082	28.6
083	103.
084	4.00
085	191.
086	281.
087	343.
088	309.
089	0.10
090	3.84
091	115.
092	262.
093	344.
094	4.57
095	203.
096	266.
097	326.
098	418.
099	0.10
100	4.00
101	149.
102	215.
103	256.
104	0.100
105	377.
106	0.100
107	412.
108	0.10
109	4.53
110	148.
111	189.
112	215.
113	0.100
114	215.
115	4.00
116	157.
117	187.

118	0.10	001	0.10	071	0.100	141	0.100
119	0.10	002	0.10	072	0.100	142	0.100
120	246.	003	0.10	073	139.	143	0.100
121	217.	004	0.10	074	496.	144	495.
122	0.10	005	0.10	075	399.	145	385.
123	4.55	006	0.10	076	495.	146	59.4
124	113.	007	0.10	077	193.	147	0.100
125	159.	008	96.1	078	116.	148	0.100
126	0.10	009	0.100	079	0.100	149	0.100
127	0.10	010	0.100	080	0.100	150	0.100
128	217.	011	61.9	081	496.	151	413.
129	199.	012	0.100	082	0.100	152	102.
130	0.10	013	0.100	083	0.100	153	0.100
131	4.00	014	95.4	084	496.	154	0.100
132	148.	015	96.2	085	114.	155	0.100
133	0.10	016	139.	086	226.	156	0.100
134	0.10	017	139.	087	15.4	157	0.100
135	172.	018	212.	088	0.100	158	0.100
136	165.	019	317.	089	0.100	159	0.100
137	0.10	020	63.3	090	96.3	160	496.
138	4.17	021	197.	091	387.	161	413.
139	117.	022	296.	092	245.	162	372.
140	156.	023	283.	093	114.	163	97.3
141	0.10	024	338.	094	496.	164	0.100
142	158.	025	319.	095	302.	165	0.100
143	0.870	026	315.	096	240.	166	0.100
144	4.00	027	320.	097	182.	167	496.
145	118.	028	335.	098	92.7	168	397.
146	144.	029	362.	099	0.100	169	367.
147	0.10	030	411.	100	496.	170	82.9
148	6.590	031	496.	101	355.	171	0.100
149	135.	032	496.	102	290.	172	0.100
150	0.100	033	376.	103	58.5	173	0.100
151	89.4	034	334.	104	0.100	174	496.
152	151.	035	316.	105	52.8	175	405.
153	0.10	036	341.	106	0.100	176	360.
154	0.10	037	496.	107	0.100	177	339.
155	0.100	038	496.	108	0.100	178	496.
156	0.102	039	496.	109	496.	179	435.
157	88.2	040	385.	110	356.	180	392.
158	0.105	041	496.	111	315.	181	372.
159	0.108	042	446.	112	189.	182	0.100
160	4.00	043	397.	113	0.100	183	413.
161	89.1	044	342.	114	0.100	184	408.
162	132.	045	219.	115	495.	185	495.
163	157.	046	113.	116	247.	186	496.
164	155.	047	226.	117	117.	187	496.
165	56.6	048	372.	118	0.100	188	496.
166	0.10	049	496.	119	0.100	189	96.3
167	3.89	050	368.	120	0.100		
168	106.	051	116.	121	0.100		
169	137.	052	0.10	122	0.100		
170	171.	053	133.	123	496.		
171	105.	054	387.	124	390.		
172	54.8	055	496.	125	145.		
173	0.10	056	496.	126	0.100		
174	4.00	057	317.	127	0.100		
175	97.0	058	0.100	128	0.100		
176	144.	059	0.100	129	0.100		
177	165.	060	143.	130	0.100		
178	4.00	061	496.	131	496.		
179	67.1	062	342.	132	155.		
180	111.	063	64.7	133	0.100		
181	131.	064	0.100	134	0.100		
182	103.	065	0.100	135	0.100		
183	89.7	066	390.	136	0.100		
184	94.3	067	494.	137	0.100		
185	4.00	068	328.	138	496.		
186	4.00	069	272.	139	186.		
187	3.96	070	0.100	140	48.2		
188	4.00						
189	3.81						

11111111111111111111111111111111111111111111111111111111111111111111111111111111
11111111111111111111111111111111111111111111111111111111111111111111111111111111
11111111111111111111111111111