HYDROGEOLOGY

Geology

The major geologic units in the Mountain Home Plateau are: 1) alluvium and younger terrace gravels, 2) Snake River Group, 3) Idaho Group, 4) Idavada Volcanics, and 5) Idaho Batholith. A description of each geologic unit and its water bearing characteristic is listed in Table 1 (Young, 1977). The areal extent of the geologic units and the location of the hydrogeologic cross sections are shown in Figure 3.

The cross sections, based on well logs, show that the basalts are considerably thicker in the northern section of the study area (Figures 4A-4D). The basalts of the Bruneau Formation thin rapidly to the east (cross section A) and to the south (cross sections B, C, & D). Two parallel northwest trending faults cut through the area (Bond, 1978). An apparent third fault, trending east from Cinder Cone Butte, bisects one of the northwest faults near Cleft. Several volcanic structures are present on the plateau including Crater Rings, Cinder Cone Butte, and Lockman Butte.

A deeper ground water system may exist below the Glenns Ferry Formation. Gravity data indicate that there may be 10,000 feet of material above the basement complex (Hill, 1963). If a system exists, artesian pressure may be great enough to allow development (pumping) for irrigation. Maximum

TABLE 1. Description and Water-Bearing Characteristics of Geologic Units in the Mountain Home Plateau Area (Young, 1977)

Period	Epoch	Geologic Unit	Description	Water-Bearing Characteristics
Quaternary	Holocene	Alluvium	Unconsolidated clay, silt, sand, and gravel occurring beneath flood plains of Boise and Snake Rivers. Crops out in narrow belts along major tributaries and in a broad belt near Mountain Home. Thickness probably does not exceed 70 ft.	Hydraulic conductivity generally high: however, because of thinness and irregularity of beds, yields to wells are generally small to moderate. Most important along Boise River flood plain where well yields of 2,500 gal/min are reported.
	Holocene and Pleistocene	Basalt of Snake River Group	Vesicular olivine basalt, light to dark gray, irregular to columnar jointing. Crops out on much of Mountain Home plateau and in Boise Valley. Intercalated in places with older terrace gravels. Thickness of flows probably does not exceed 550 ft.	Hydraulic conductivity variable. Where saturated, reported well yields range from 20 to 3,100 gal/min; however, the basalt is above water table in most of study area.
	Pleistocene	Older Terrace Gravel	Unconsolidated clay, sand, and fine to coarse gravel. Occurs only in western part of study area where thickness does not exceed 150 ft.	Hydraulic conductivity generally high. Reported well yields range from 20 to 2,700 gal/min.
Quaternary and Tertiary	Pleistocene and Pliocene	Idaho Group; undifferentiated	Poorly to well-stratified fluvial and lake deposits of unconsolidated to consolidated silt, sand, and gravel, with layers of ash and intercalated basaltic lava flows. Thickness unknown.	Hydraulic conductivity generally high. Reported well yields range from 15 to 3,000 gal/min.
Quaternary	Pleistocene	Bruneau Formation of Idaho Group	Includes fan deposits consisting largely of coarse sands derived from decayed granitic rocks. Thickness of fan deposits does not exceed 300 ft. Also includes vesicular olivine basalt, dark gray to black, weathers to reddish-gray-brown. Thickness of basaltic flows is about 800 ft. in study area. Unit also includes detrital material, dominated by massive lake beds of white-weathering fine silt, clay, diatomite, and minor amounts of sand.	Fan deposits are generally above water table. Basalt composes principal aquifer in Mountain Home area. Reported well yields from basalt range from 10 to 3,500 gal/min. Detrital material generally has low hydraulic conductivity.
Quaternary and Tertiary	Pleistocene and Pliocene	Glenns Ferry Formation of Idaho Group	Poorly consolidated detrital material and minor flows of olivine basalt. Includes lake and stream deposits consisting of massive silt layers, cemented sand beds, thin beds of dark clay, olive silt, and granitic sand and fine pebble gravel. Maximum thickness is about 2,000 ft.	Hydraulic conductivity generally low. Reported well yields range from 3 to 350 gal/min.
Tertiary	Miocene	Idavada Volcanics	Silicic latite; chiefly thick layers of devitrified welded tuff, but includes some vitric tuff and lava flows. Maximum thickness is about 2,000 ft.	Hydraulic conductivity variable.
Cretaceous		Idaho Batholith	Quartz monzonite and granodiorite, light to medium gray.	Hydraulic conductivity low. Yields to wells small.

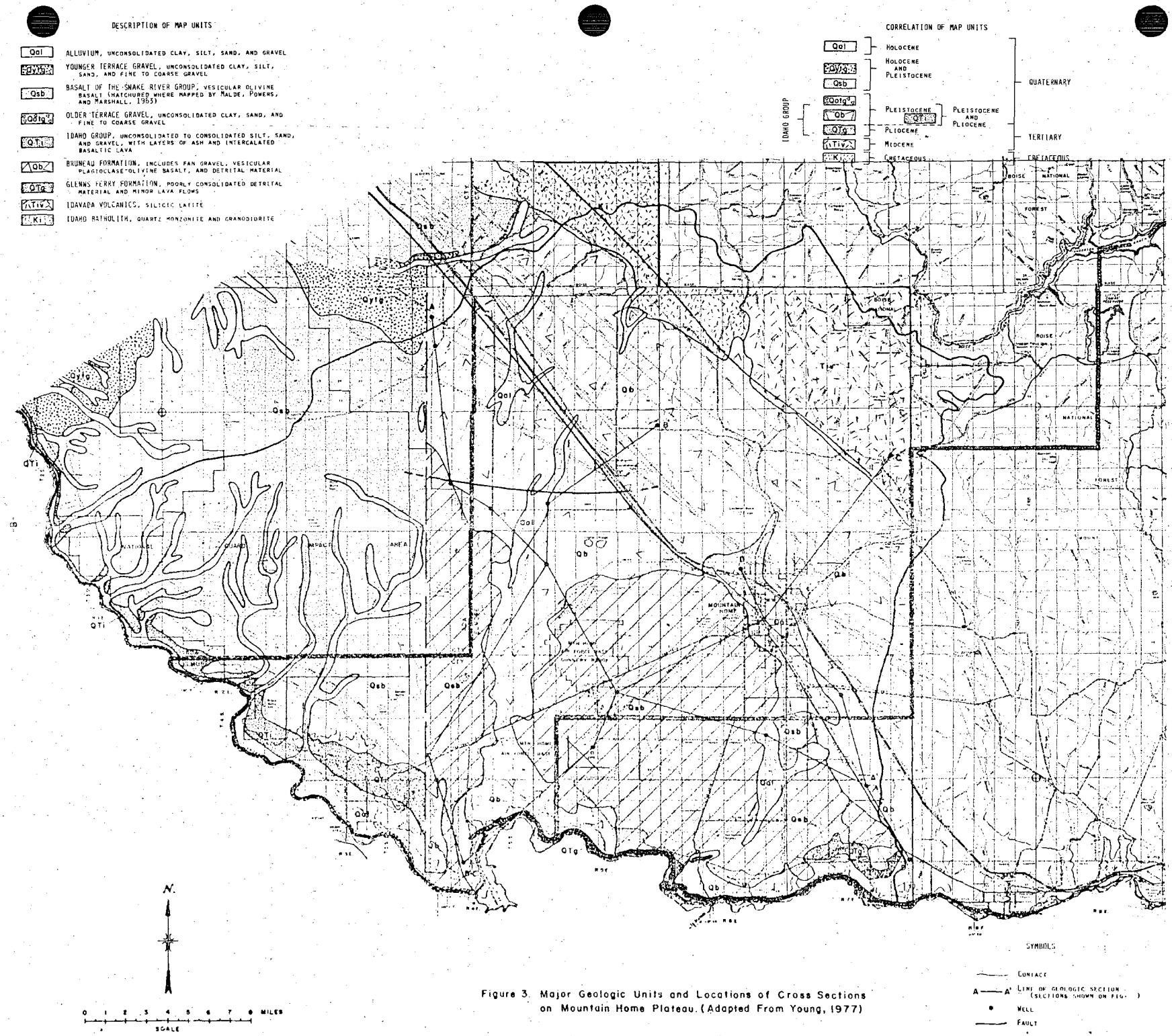

Figure 3. Major Geologic Units and Locations of Cross Sections on Mountain Home Plateau. (Adapted From Young, 1977)

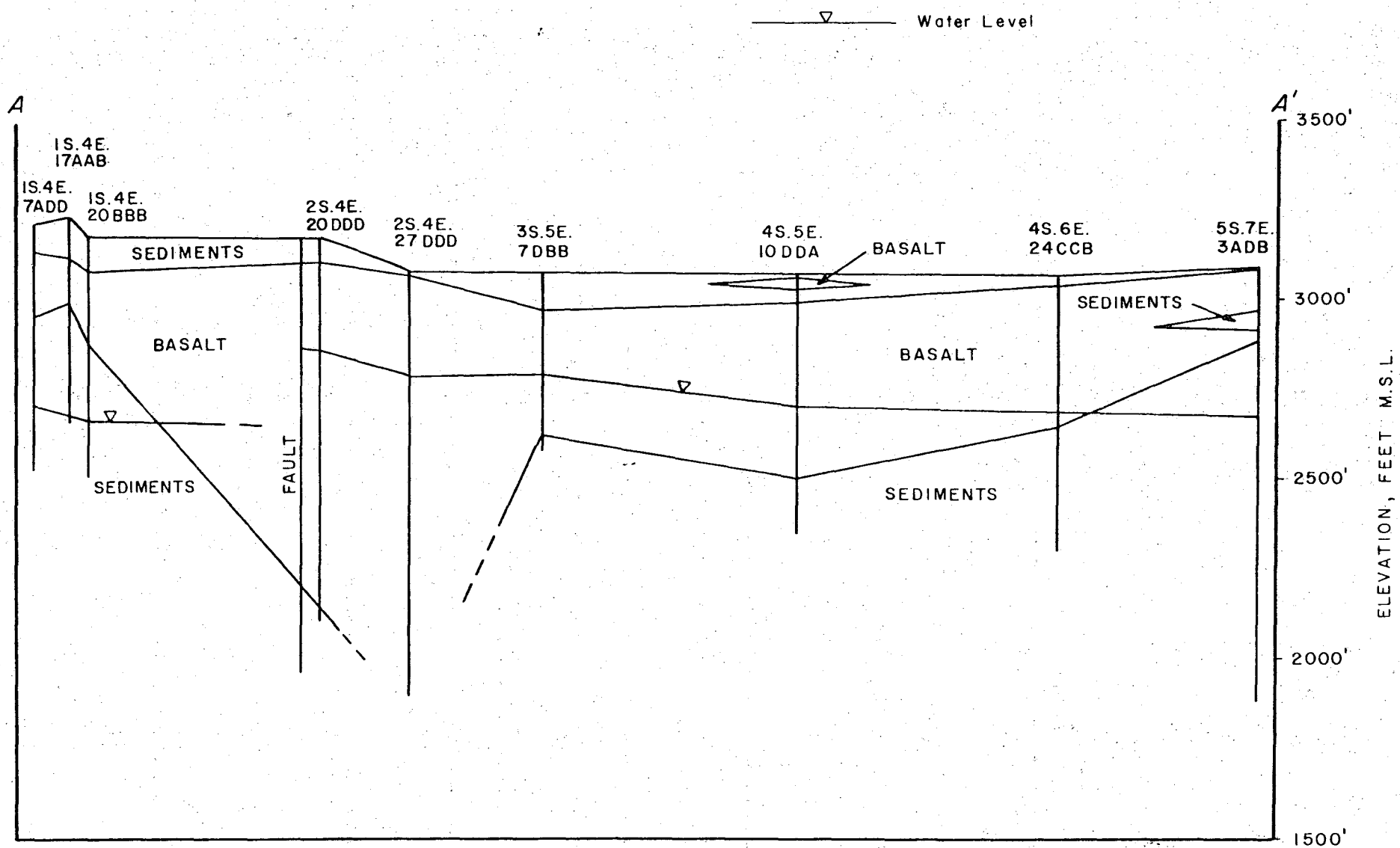

Figure 4A. Cross Section A

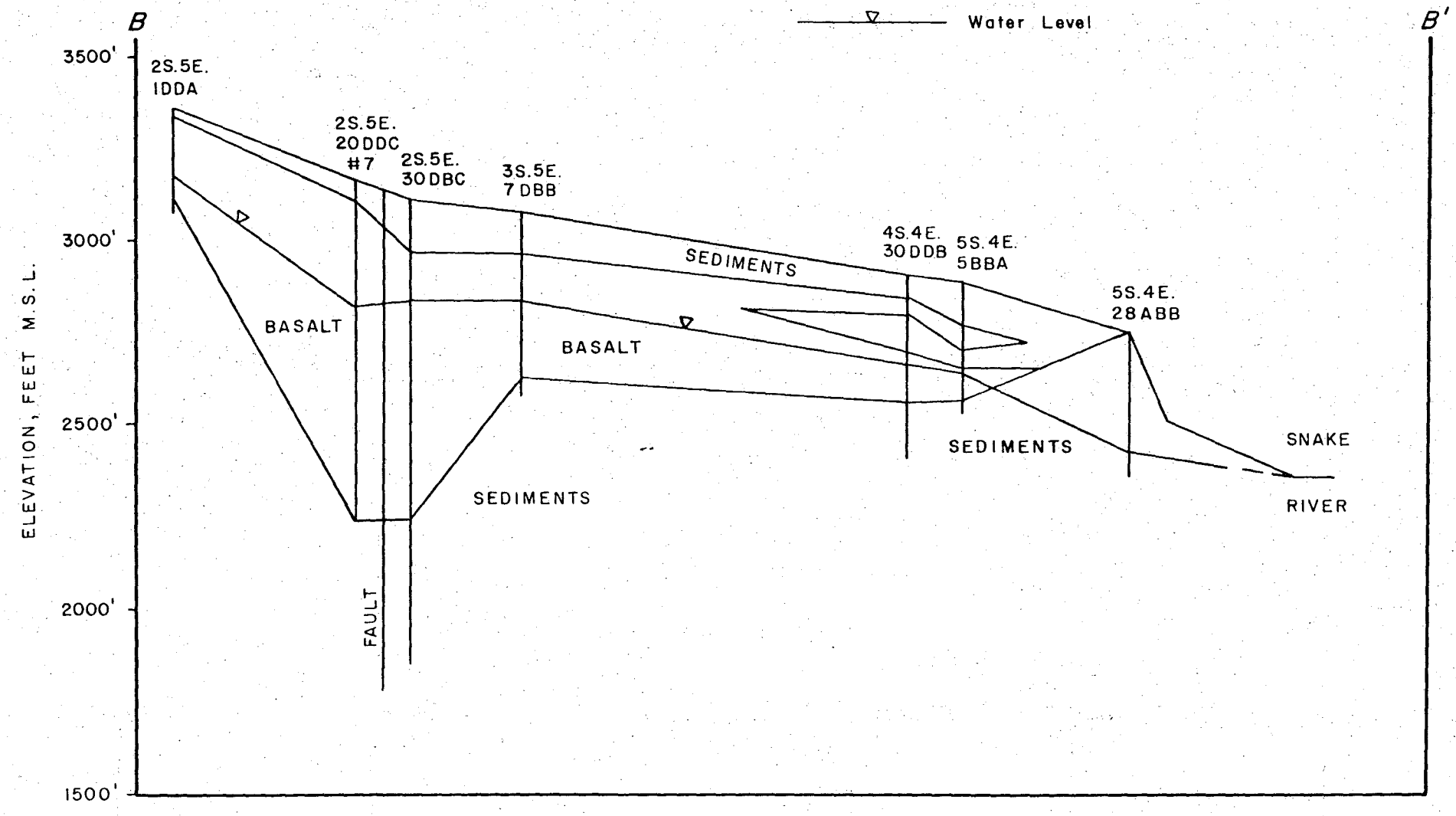

Figure 4B. Cross Section B

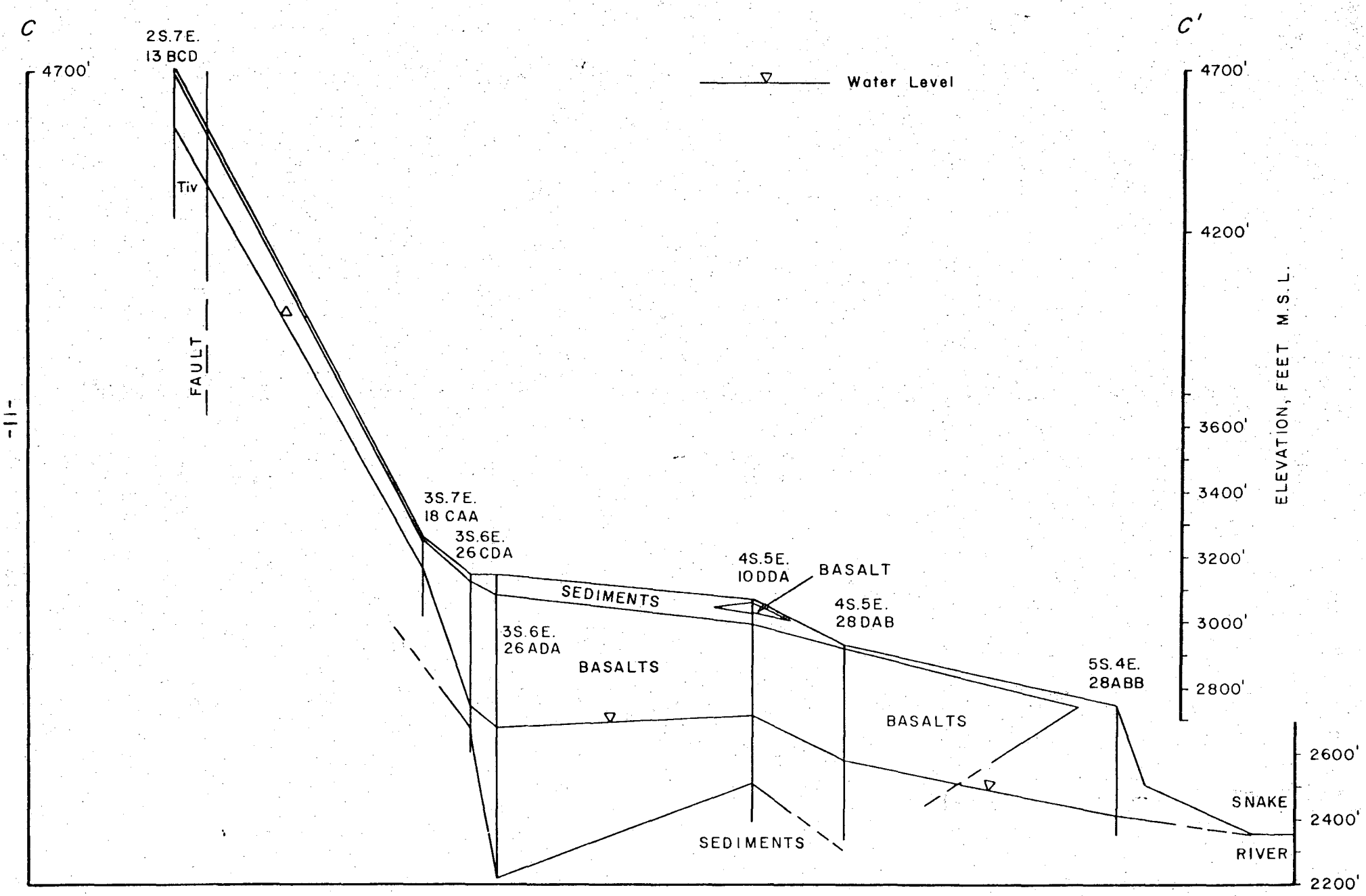

Figure 4C. Cross Section C

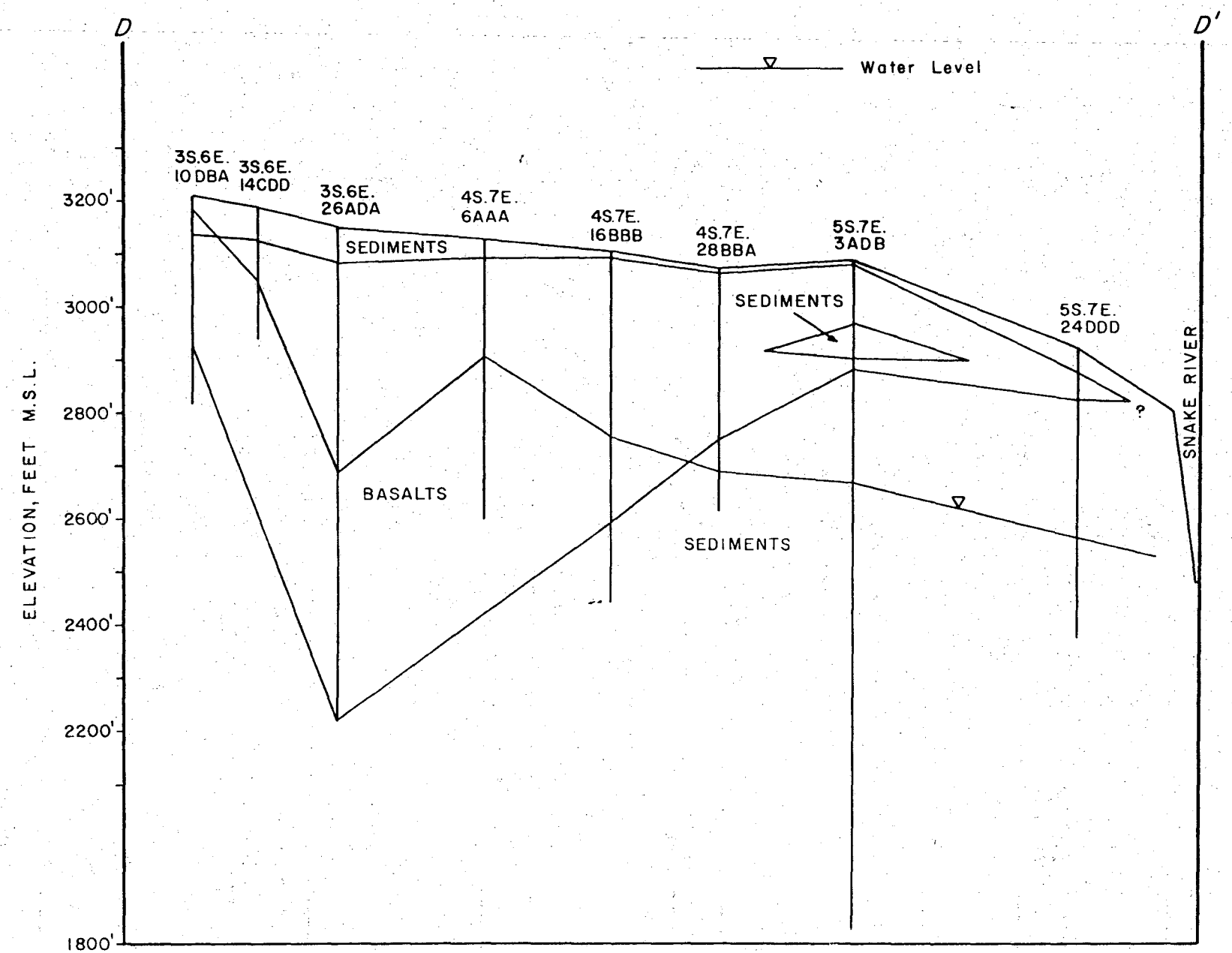

Figure 4D. Cross Section D

thickness of the Glenns Ferry Formation is 2,000 feet with 300 to 1100 feet of basalt above it.

Aquifer Description

In addition to the possible aquifer below the Glenns Ferry Formation, there are two main aquifers in the Mountain Home study area: 1) a shallow, perched system beneath Mountain Home and 2) a deeper, regional system. The perched system underlies approximately 38,000 acres as mapped by Young (1977) (Figure 5). For the most part, ground water in the perched system is in the clay, silt, sand, and gravel layers of the Quaternary Alluvium. Basalts of the Snake River Group and basalts and fan deposits of the Bruneau Formation beneath the alluvium also contain ground water from the perched system. Depth to water in the shallow system can be less than 10 feet but varies considerably along the limits of the perched system as the water moves vertically down to the regional system.

Recharge to the perched system occurs from both Rattlesnake and Canyon Creeks as well as seepage from Mountain Home Reservoir and the canals and laterals that distribute the water. It has been estimated by the Mountain Home Irrigation District that it takes a diversion to the reservoir of approximately 28 cfs to maintain the reservoir at full stage with no releases (Charles Cook, personal communication).

Natural discharge from the perched system occurs mainly as downward percolation to the regional system and as spring flow at Rattlesnake Spring near the Snake River Canyon rim.

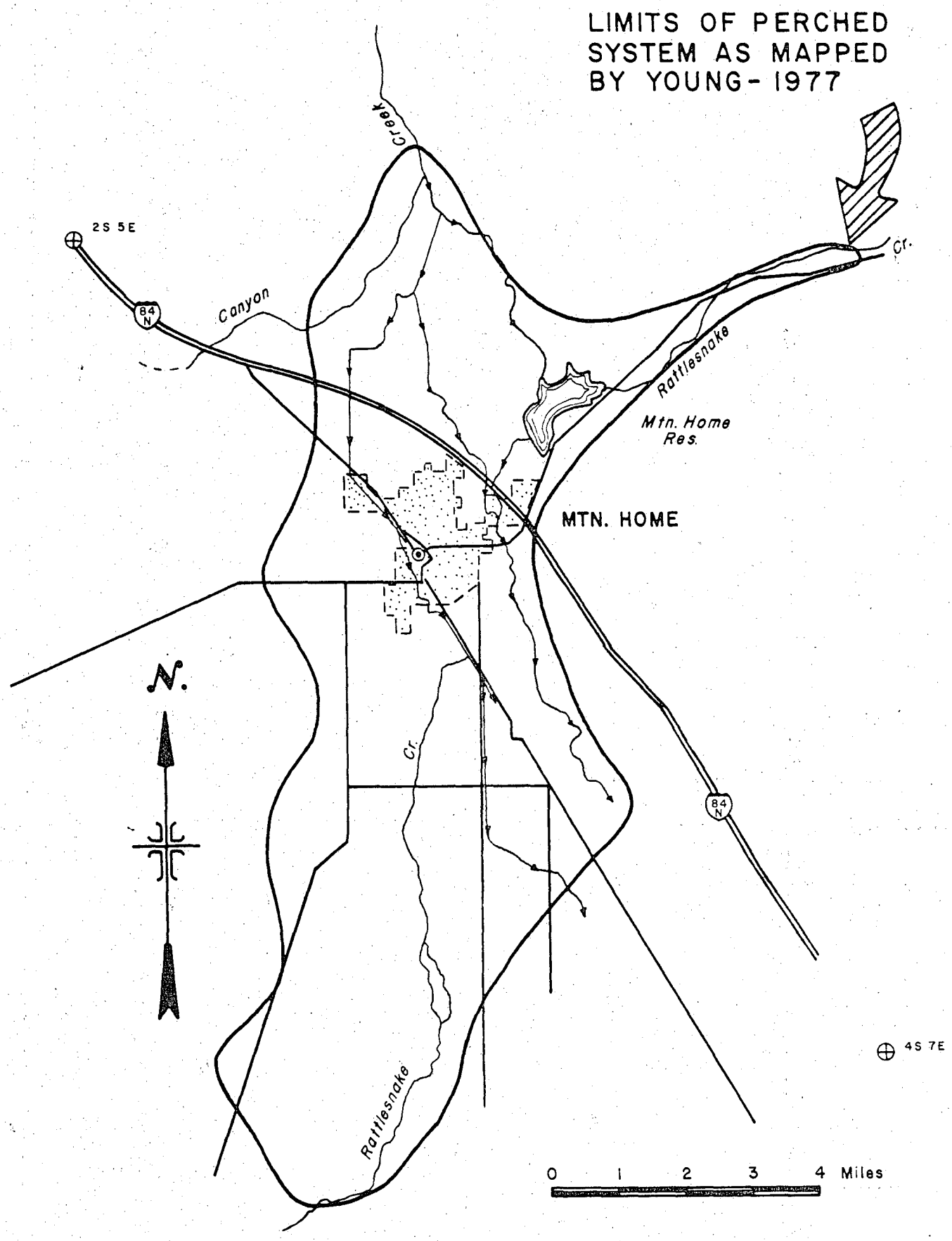

Figure 5. Location of Perched Aquifer

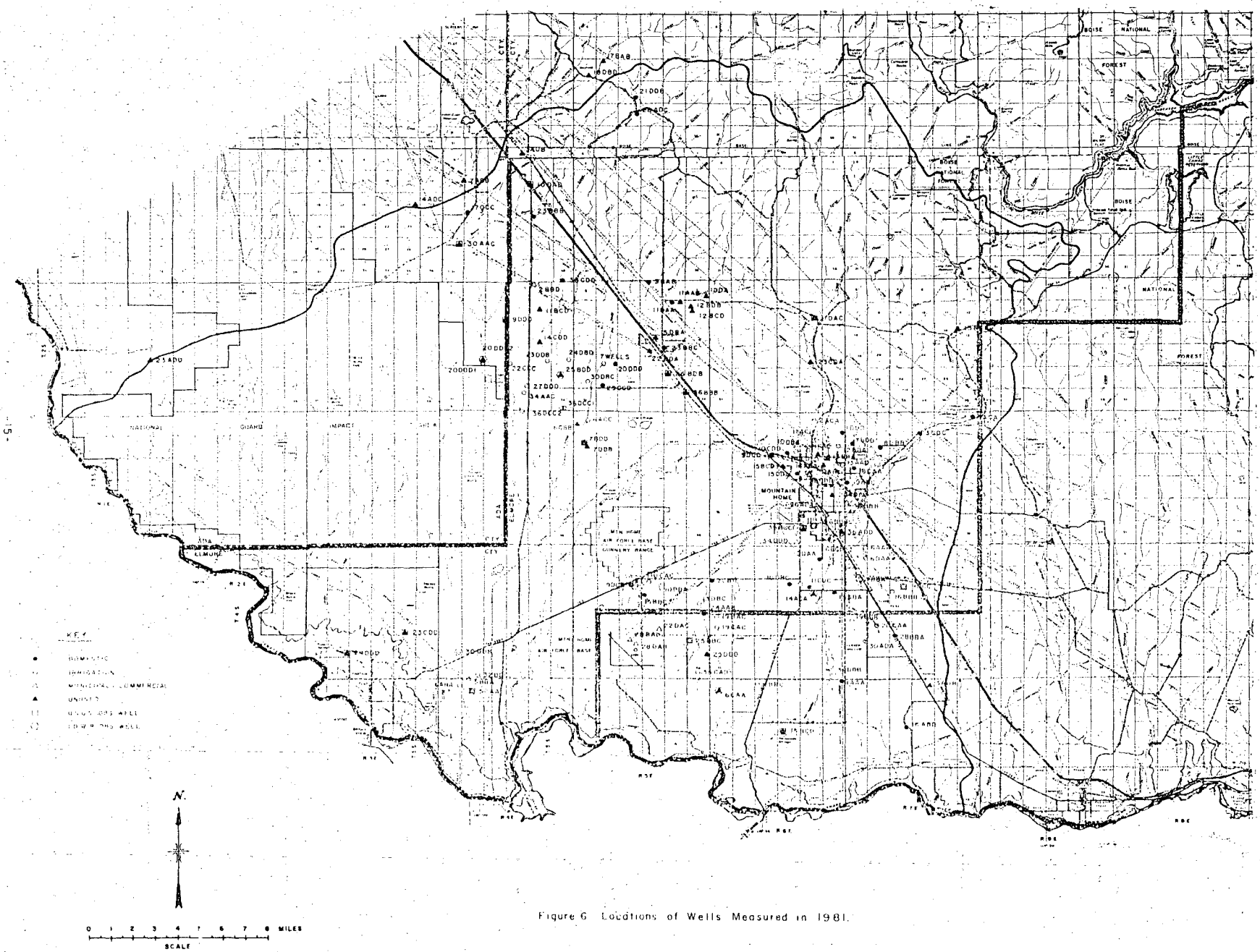

Figure 6 Locations of Wells Measured in 1981.

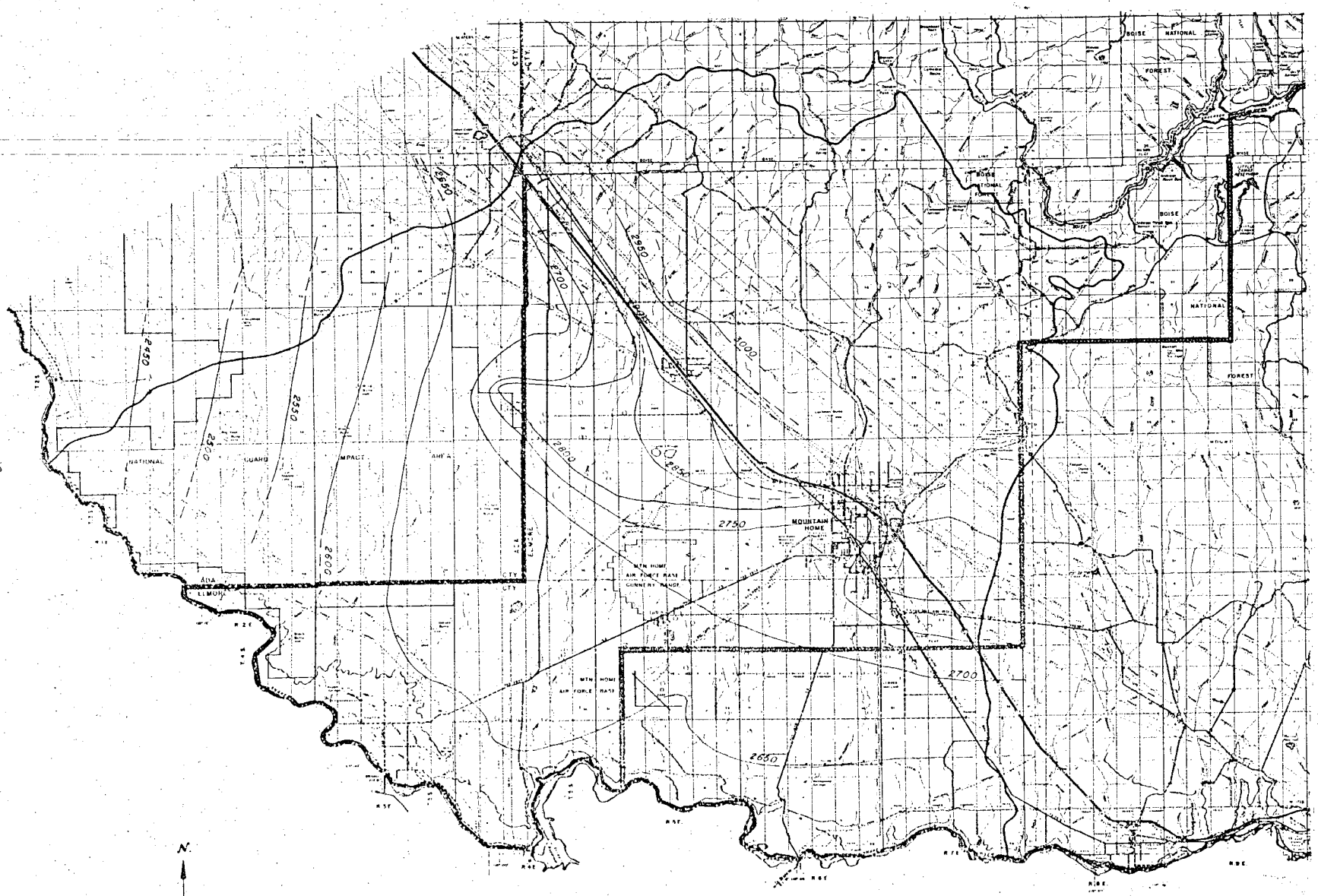

Figure 7. Water Levels of the Regional Aquifer in Fall of 1976.

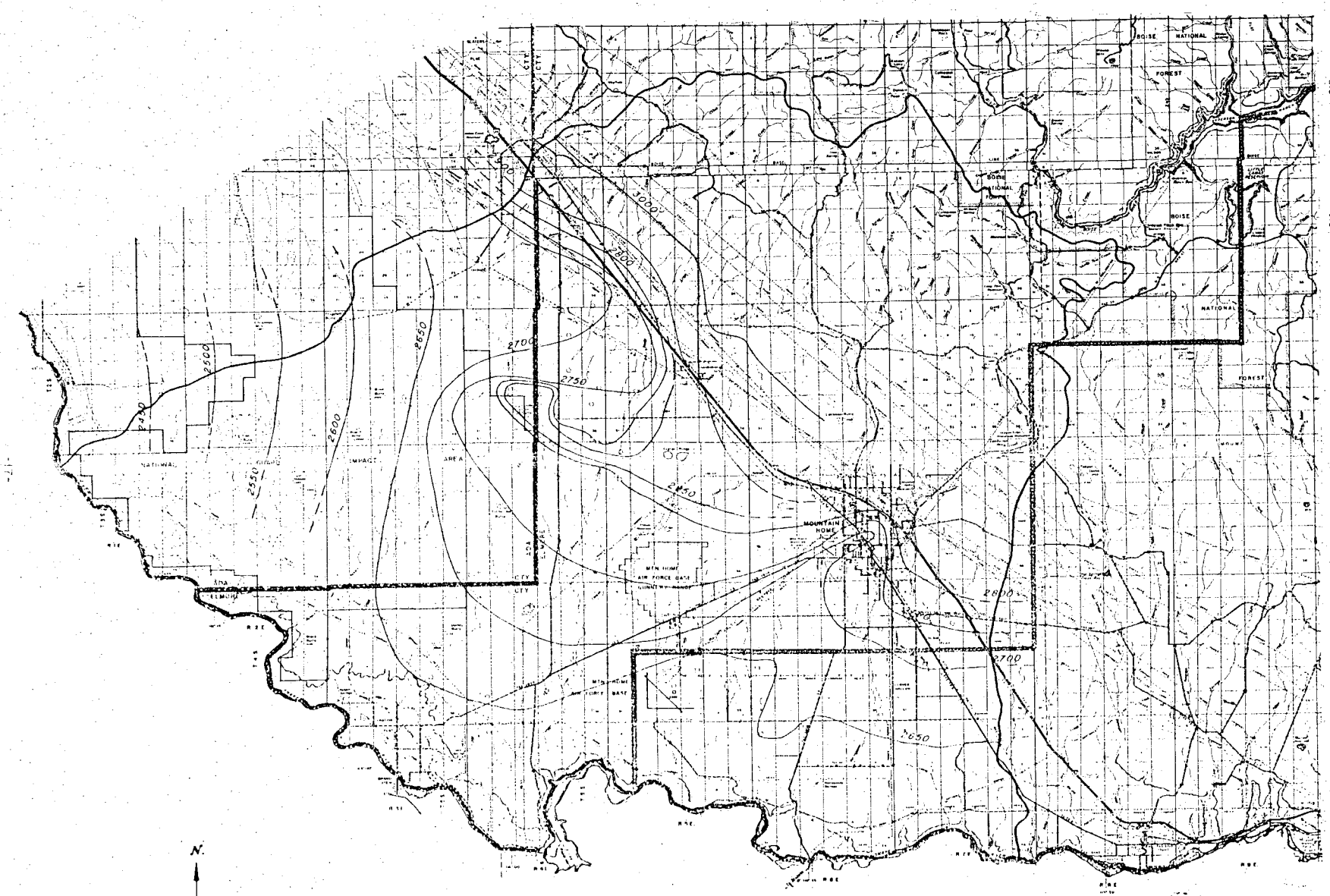

Figure 8. Water Levels of the Regional Aquifer in Fall of 1981.

The amount of flow from the spring is not known. There has been some development of the perched system as a domestic supply and for small irrigation uses (less than 40 acres).

The deeper, regional aquifer supplies ground water to the large irrigation wells and municipal wells for Mountain Home and the Air Force base. The major rock types are basalts of the Bruneau Formation, Idaho Group and poorly consolidated detrital material and minor basalt flows of the Glenns Ferry Formation, Idaho Group. Well yields from the basalts (Bruneau Formation) range from 10 to 3500 gpm. The range of the well yields for the Glenns Ferry Formation is three to 350 gpm. The Bruneau Formation thins rapidly towards the east where the Glenns Ferry Formation becomes the major source of ground water.

Recharge to the regional system occurs as downward percolation of precipitation that falls on the mountains, losses from intermittent stream flows, and from downward percolation from the perched system. Some of the precipitation falling on areas having little soil cover probably also reaches the aquifer.

Discharge from the regional system occurs as spring flow, underflow to the Snake River, and pumpage. Young (1977) estimated that 3000 acre-ft/yr are discharged through four springs in the Snake River Canyon; one of the springs is west of the study area. Pumpage for irrigation is the largest discharge from the regional aquifer system.

Data Collection

Ground water level data collected by the U.S. Geological Survey for the 1976-77 study, in addition to the observation well data, were supplemented by a mass measurement in the fall of 1981. The locations of wells measured in 1981 are shown in Figure 6. In addition to the mass measurement, several wells were measured periodically to help determine the amount and location of recharge.

A staff gage was installed on Canyon Creek above the bridge on Foothill Road (T.2S. R.6E. Sec. 11). Measurements of Canyon Creek at the old U.S. Highway 30 bridge were made to determine channel loss between Foothill Road and the highway.

Direction of Ground Water Flow

Contour maps of the regional ground water system for the fall of 1976 and 1981 are shown in Figures 7 and 8. The direction of ground water flow is perpendicular to the contour lines. In general, the direction of flow is towards the southwest with a southern component in the southeast and a western component in the northwest. Low permeability along the apparent east-west trending fault through Cleft limits the flow toward the north. The ground water elevation is 70 to 165 feet higher on the south side of the fault. Due to a greater number of wells in the Cinder Cone Butte area now than in 1976, the effects of the fault are more readily visible.

The direction of flow in the perched ground water system is towards the southwest (Figures 9 and 10). Note the change

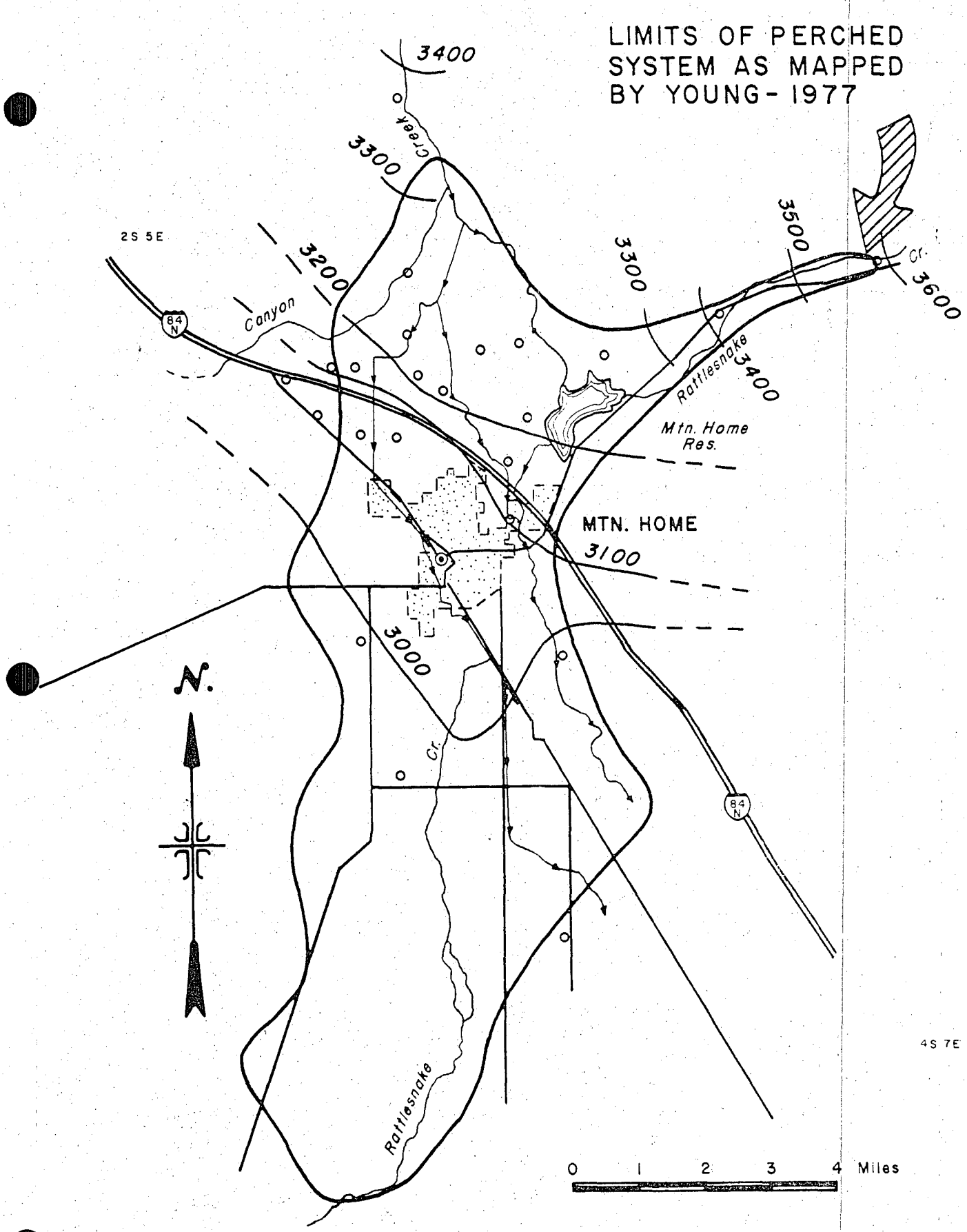

Figure 9. Water Levels of the Perched Aquifer, 1976.

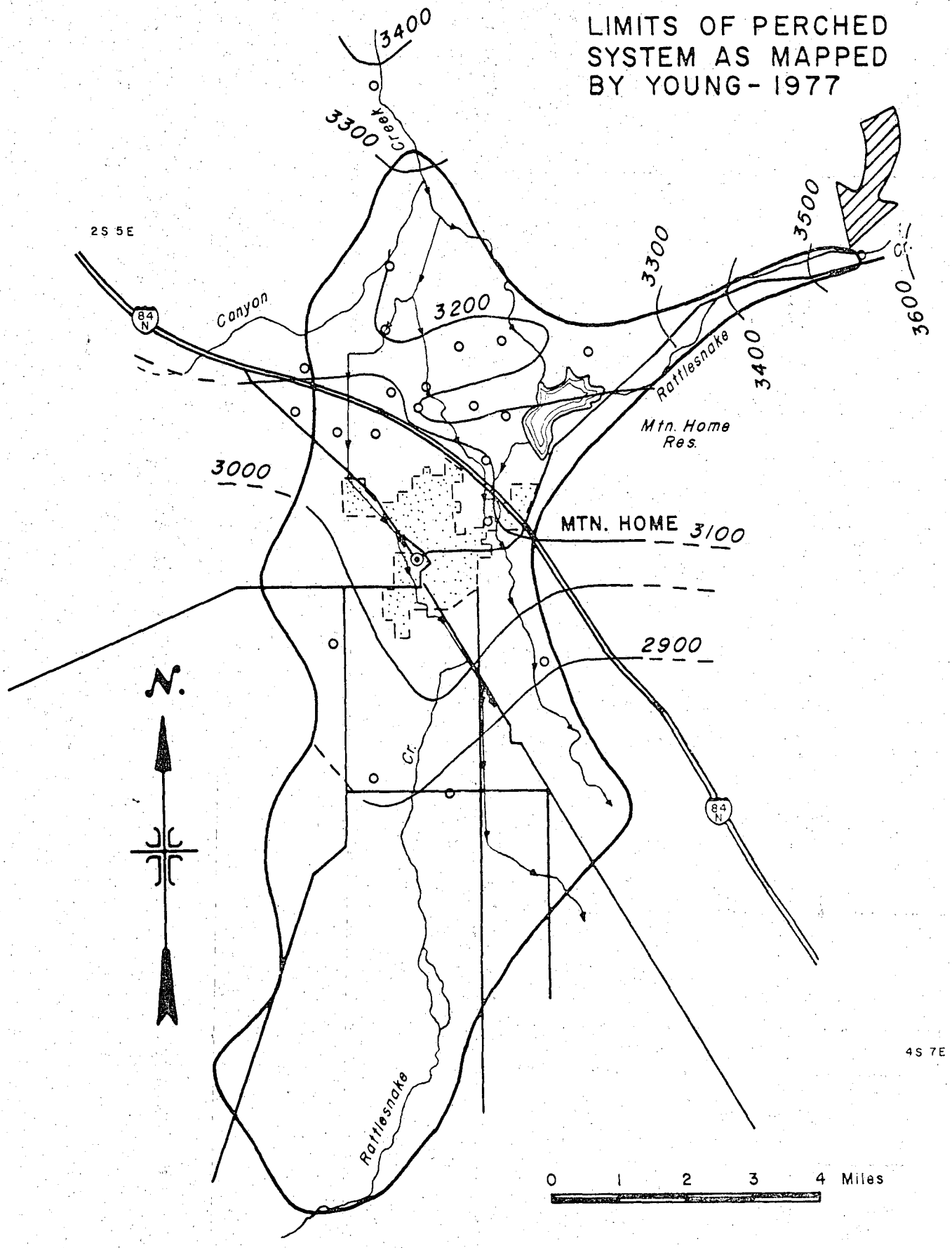

Figure 10. Water Levels of the Perched Aquifer, 1981.

in the 3200 foot contour between 1976 and 1981. This change is in response to development of the perched system as a domestic supply of water.

Water Level Fluctuations

In general, a ground water system can be considered in equilibrium when discharge from, recharge to, and the volume in storage remain constant. When development occurs, the equilibrium is changed. The direction of the change depends on the type of development; if surface water irrigation is started, more water is made available for recharge and water levels rise. But if pumpage from the ground water system occurs, water is taken from storage and water levels will decline. Natural discharge from the system may increase in response to recharge and may decrease with pumpage. When development reaches the new level, the system will reach a new equilibrium or steady state condition. Water level fluctuations provide an indication of how the ground water system is reacting to changes in recharge, discharge, and pumping.

There are 15 observation wells of the USGS - IDWR network in the study area. Two other observation wells have been discontinued. Twelve wells have long term records (1967 to present) while records for the five remaining wells began in 1976. Depth to water ranges from less than three feet (perched system) to over 487 feet (regional system). Locations of these wells are shown in Figure 6 and the hydrographs are plotted in Figures 11 through 17.

Four of the wells do not show signs of decline. Two (T.1S. R.4E, Sec. 10DAD1 and T.4S. R.3E. Sec. 29DD1) are stable (Figures 12 and 15). One (Figure 11) has risen from 488 feet in 1967 to 482 feet in 1981 (T.1S. R.4E. Sec. 30AAC1), while the fourth (Figure 13) took several years to recover from test pumping in 1973 (T.2S. R.6E. Sec. 11DAC1).

Declines in the remaining observation wells have varied from less than one foot to over 35 feet. The ground water level in well T.2S. R.4E. Sec. 9DDD2 rose seven feet from 1960 through 1977 (Figure 11). The upward trend then reversed and the water level has declined to the 1960 level over the last five years. Well T.2S. R.5E. Sec. 26BDB1, located northwest of Mountain Home, has declined one-half foot since 1976 (Figure 12). An upward trend in well T.2S. R.5E. Sec. 36 BBB1 reversed during the winter of 1977 and declined almost two feet by September 1981 (Figure 12). The hydrograph of domestic well T.3S. R.5E. Sec. 7BDD1 shows a steady decline from July through January (Figure 13). The water level rises only slightly, if at all, during the spring. This indicates little or no recharge to the ground water system in this area. Well T.3S. R.6E. Sec. 13BBA1 is in the perched system north of Mountain Home and has declined over 30 feet since 1976 (Figure 14). The water level declines from March through September in response to pumpage in the area, and recovery in the well occurs during the winter. A shallow well used as a domestic source of water in the late 1960's shows a similar trend to the previous well (T.3S. R.6E.

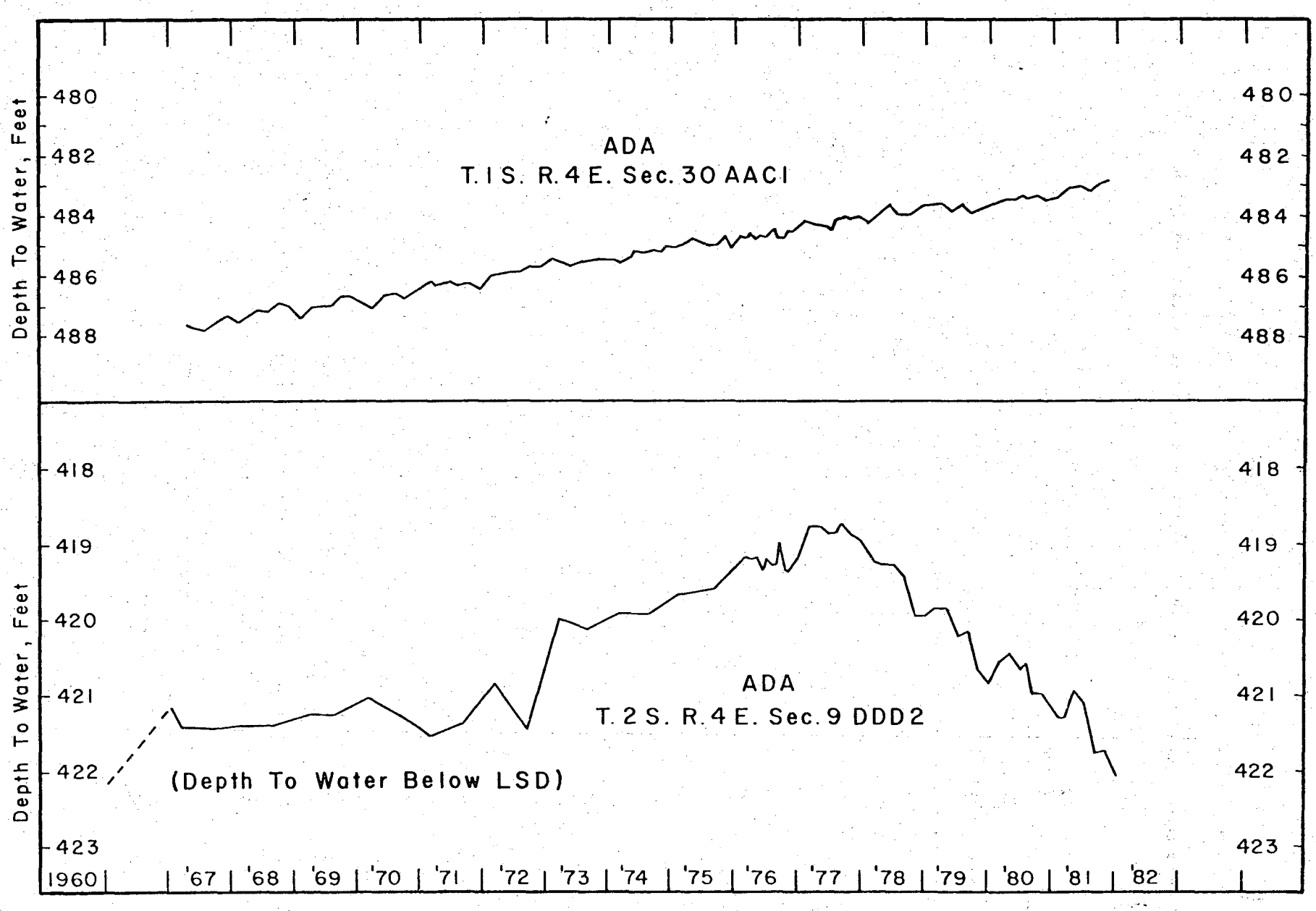

Figure 11. Hydrographs of Wells on the Mountain Home Plateau.

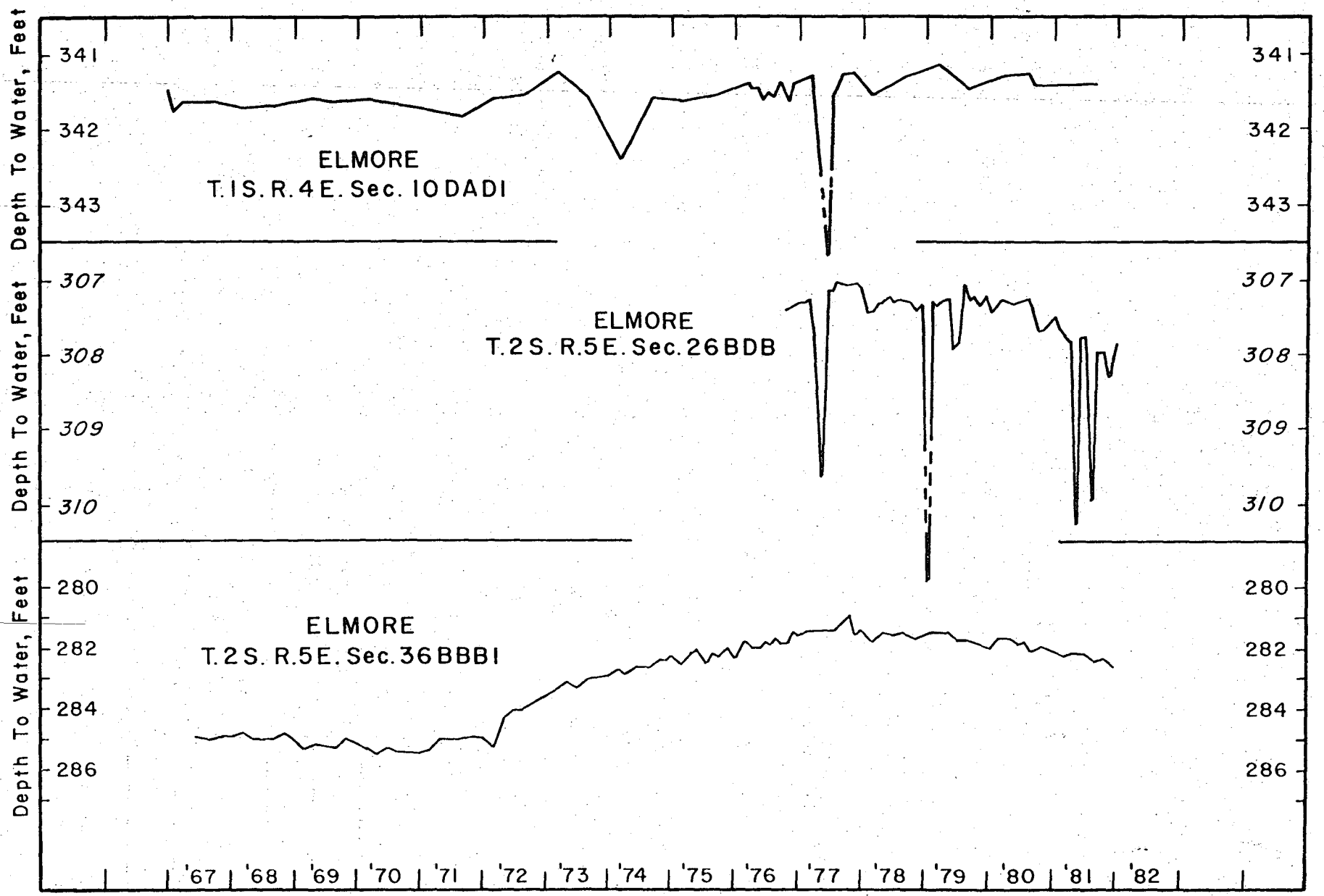

Figure 12. Hydrographs of Wells on the Mountain Home Plateau.

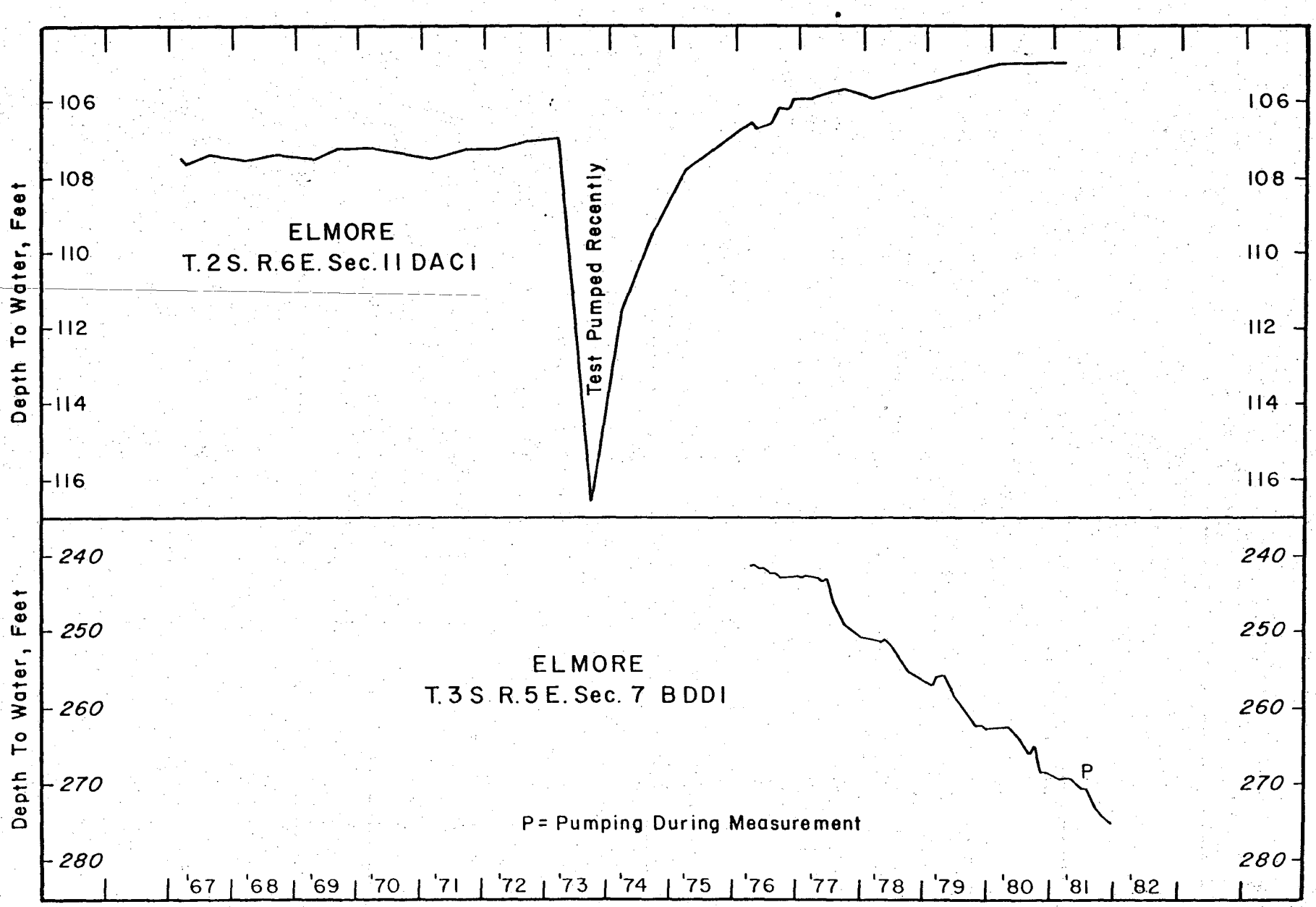

Figure 13. Hydrographs of Wells on the Mountain Home Plateau.

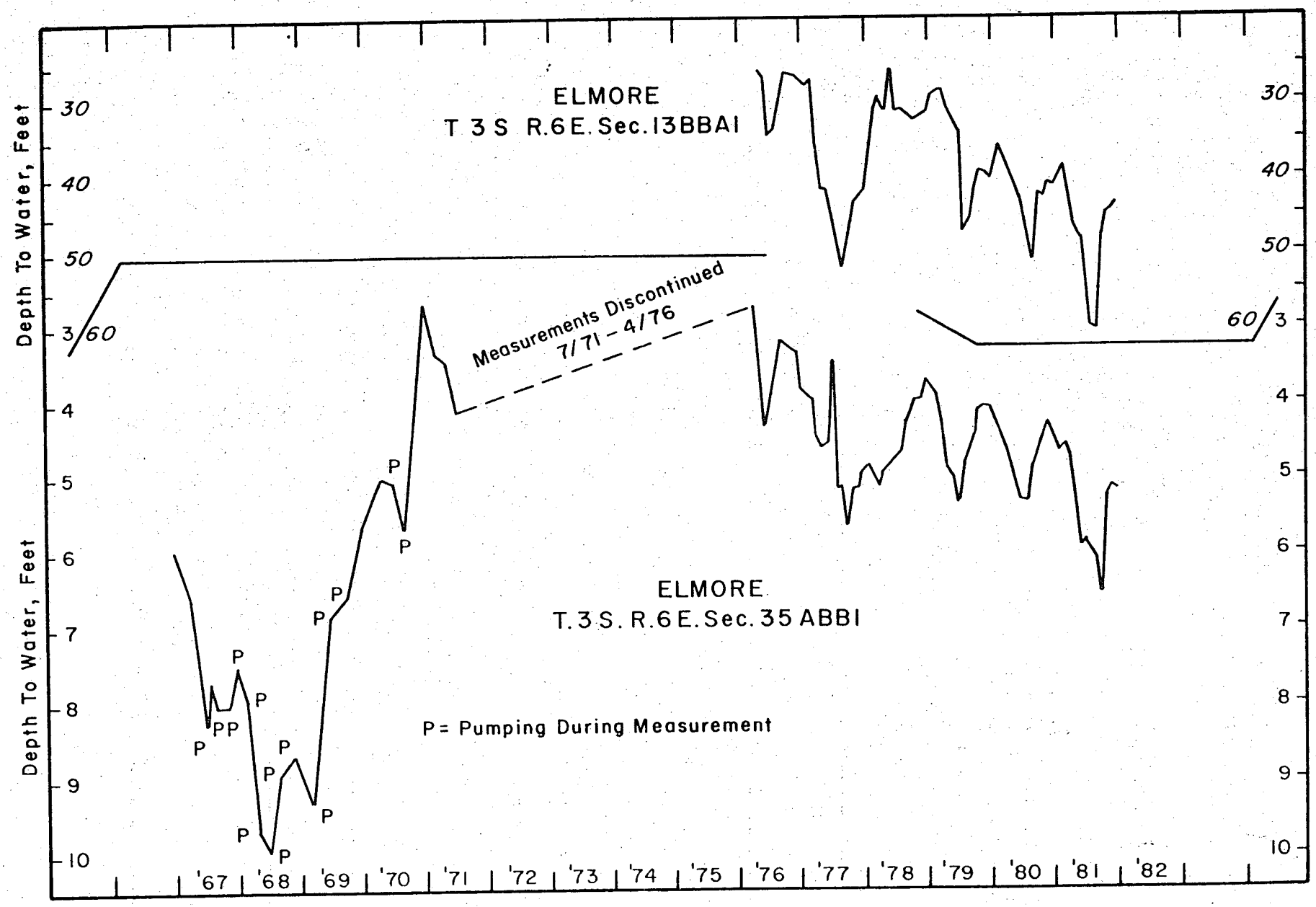

Figure 14. Hydrographs of Wells on the Mountain Home Plateau.

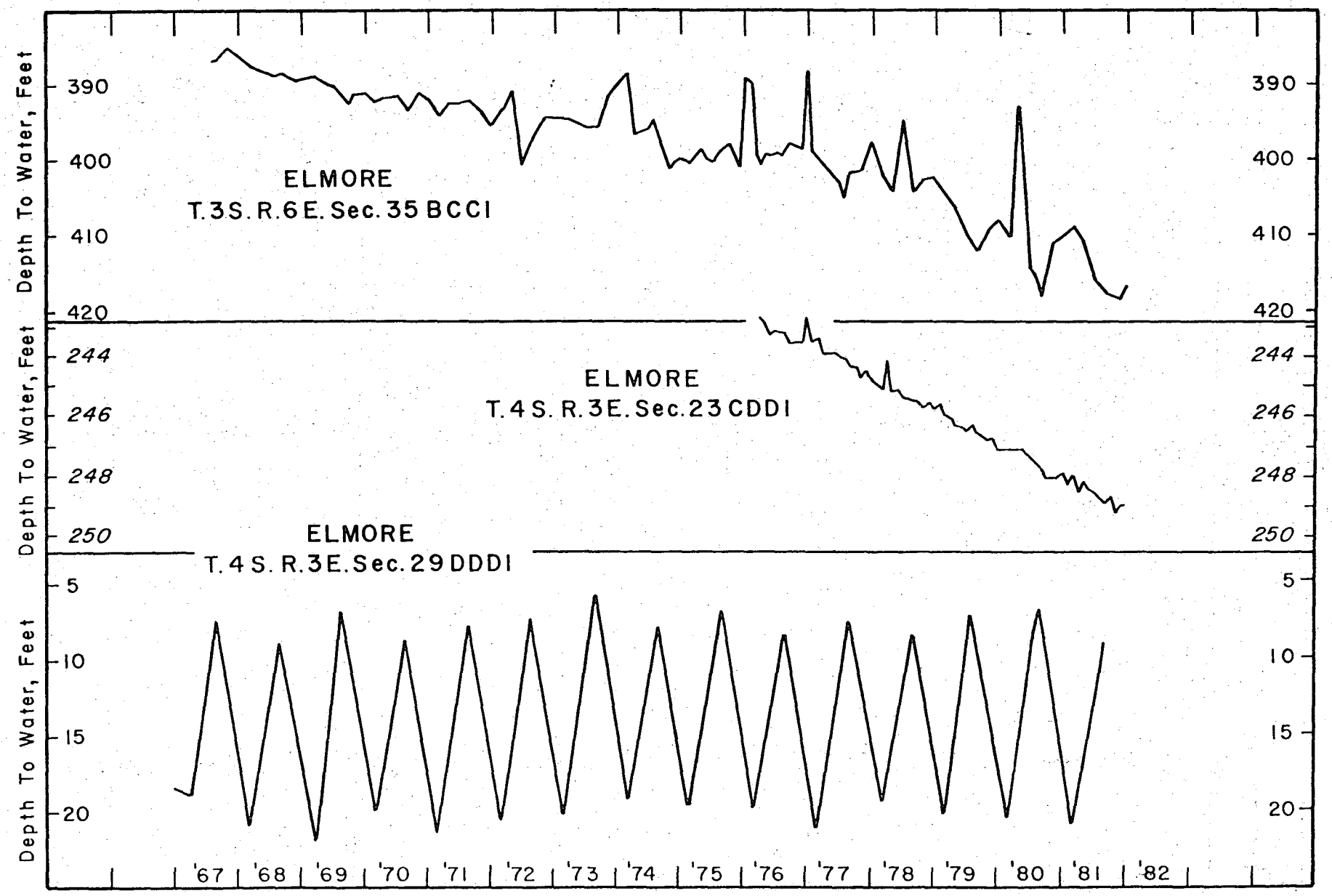

Figure 15. Hydrographs of Wells on the Mountain Home Plateau.

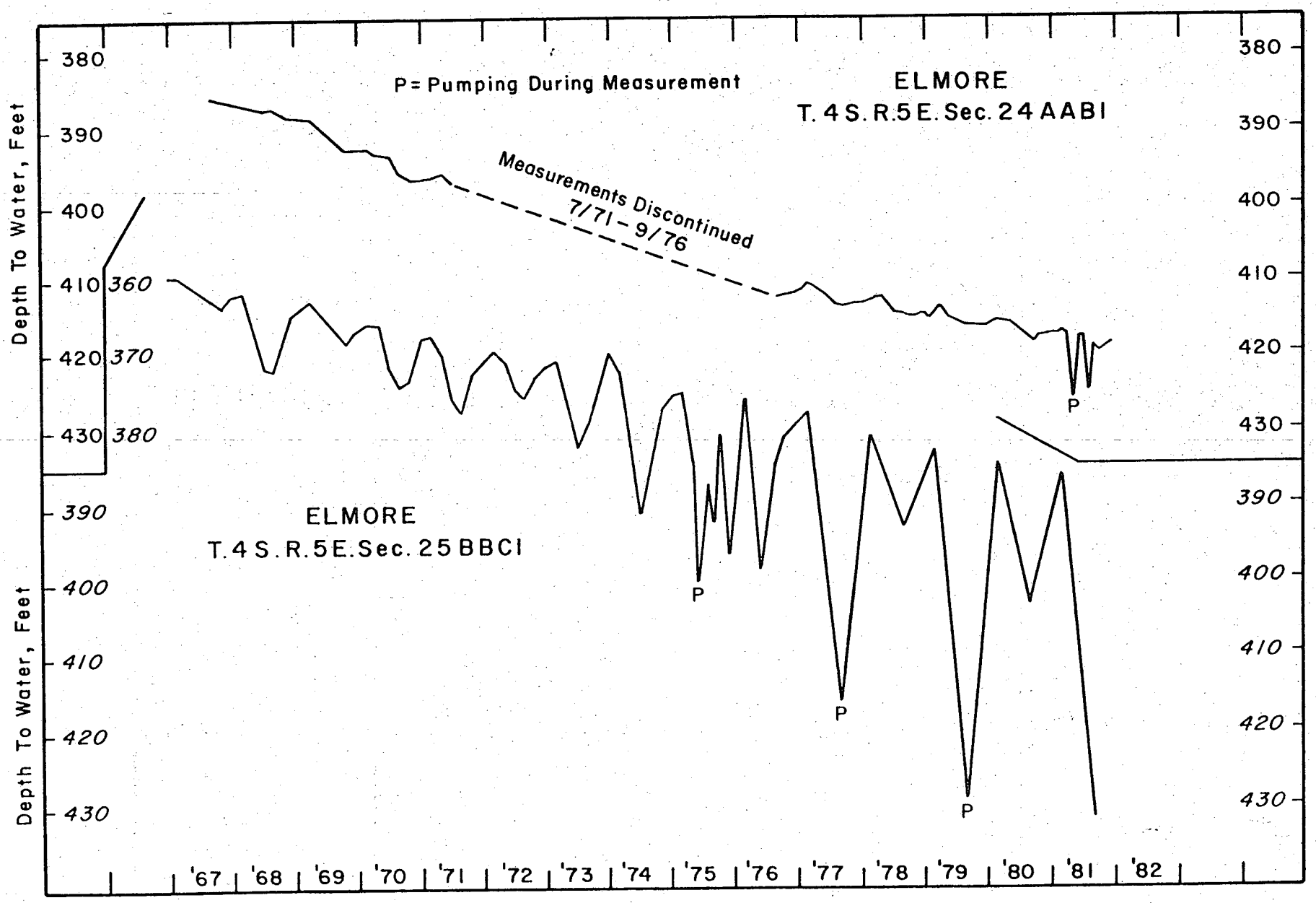

Figure 16. Hydrographs of Wells on the Mountain Home Plateau.

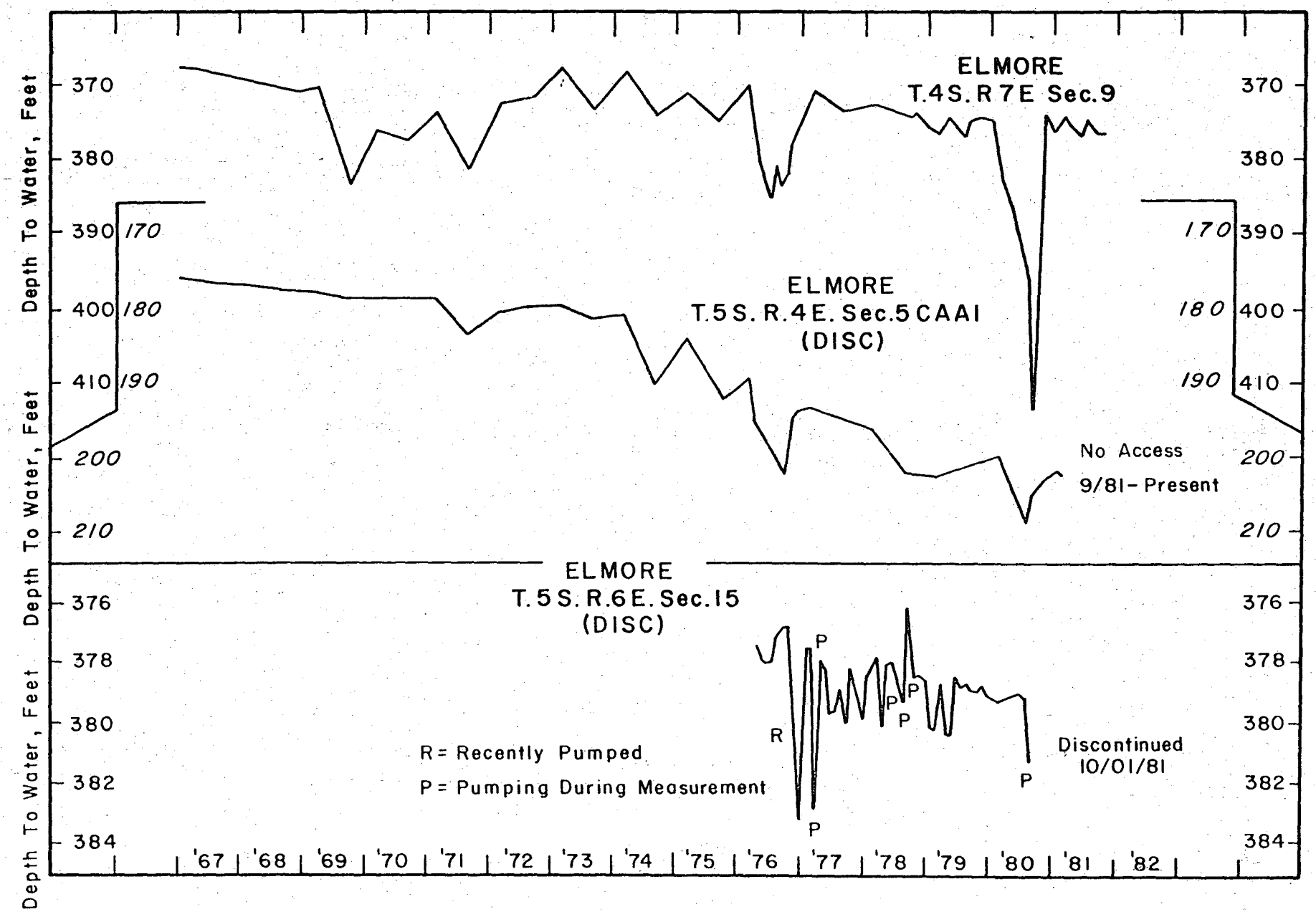

Figure 17. Hydrographs of Wells on the Mountain Home Plateau.

Sec. 35ABB1) (Figure 14). A second well in the section (Sec. 35BCC1), but in the regional system has declined 18 feet over the last five years and almost 31 feet since 1967 (Figure 15). Well T.4S. R.3E. Sec. 23CDD1 is located nine miles west of Mountain Home A.F.B. and over two miles from the nearest production well. The water level has declined over five feet since 1976 (Figure 15). The hydrograph shows a steady rate of decline with little or no recharge. Two observation wells east of the Mountain Home A.F.B. have shown a steady decline since 1967 (T.4S. R.5E. Sec. 24AAB1 and Sec. 25BBC1) (Figure 16). The water levels have declined 34 and 27 feet, respectively. The pumping level at well 25BBC1 in 1975 was approximately 400 feet below L.S.D. but by 1981, the pumping level was below 431 feet. Well T.4S. R.7E. Sec. 9DCC1 has declined almost nine feet since 1967 while well T.5S. R.4E. Sec. 5CAA1 over the same period of time declined 27 feet (Figure 17). Well T.5S. R.6E. Sec. 15BCD1 has declined four feet since 1976 (Figure 17).

Changes in the Ground Water Systems

The change in ground water levels over a 5 year period was contoured to show the areas and the amount of decline (Figure 18). The difference between the mass measurement data collected in the fall of 1976 (Young, 1977) and the mass measurement data collected in the fall of 1981 was used for the change map. Wells where data were collected from the spring of both years were also used for a larger number of data points. A large area south of Mountain Home declined

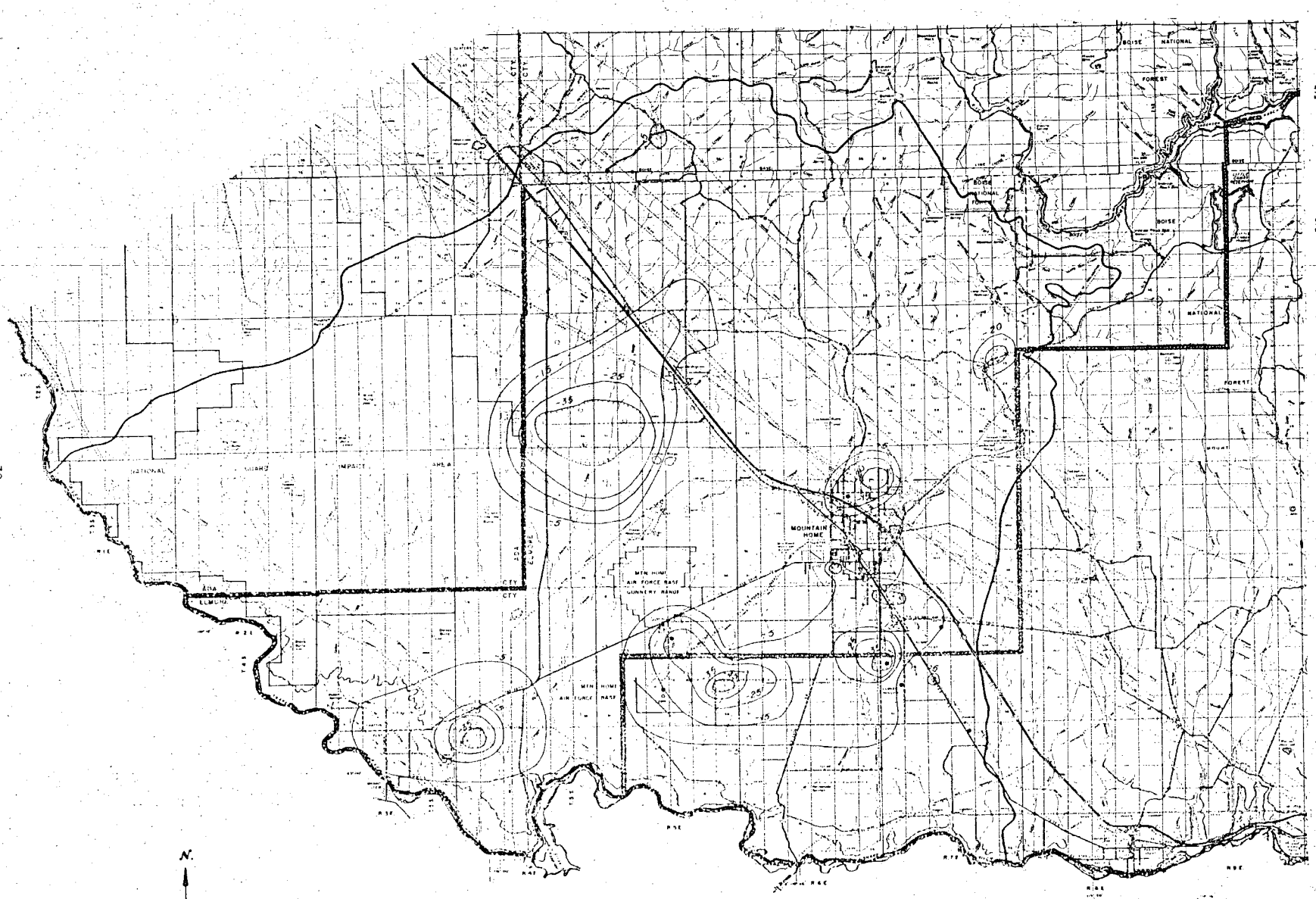

Figure 18. Change in Water Levels in the Regional Aquifer from 1976 to 1981 in Feet.

more than five feet, with two depressions of 35 and 40 feet inside the -5 foot contour. The second largest area of declines occurred in the Cinder Cone Butte C.G.W.A. with declines of more than 35 feet over a large portion of the area. Declines of more than 35 feet also occurred west of Mountain Home A.F.B. Small areas of decline appeared beneath Mountain Home (-20 feet) and northeast of the city (-15 feet). Declines in the regional system have occurred in areas where irrigation development has taken place.

Declines in the perched ground water system occurred mainly in the vicinity of Mountain Home where large domestic development has occurred (Figure 19). Declines varied in amounts from over 50 feet to no decline at all. Two small areas of decline of over five feet were located south and northeast of Mountain Home.

Declines in both the perched and regional ground water systems are due mainly to development of the resource, but lower amounts of precipitation in the mountains over the last several years have also played a part. Table 2 shows the annual precipitation and the departure from normal for precipitation stations located at Mountain Home, Anderson Dam, and Hill City. Precipitation at Mountain Home for the eight years of record shown was above average for all but one year and 14.35 inches above average for the period listed. Precipitation for the station at Anderson Dam was above average only three times over the same time period, but precipitation for the three wet years was almost equal to the lack of precipitation during the remaining five years. The station at Hill

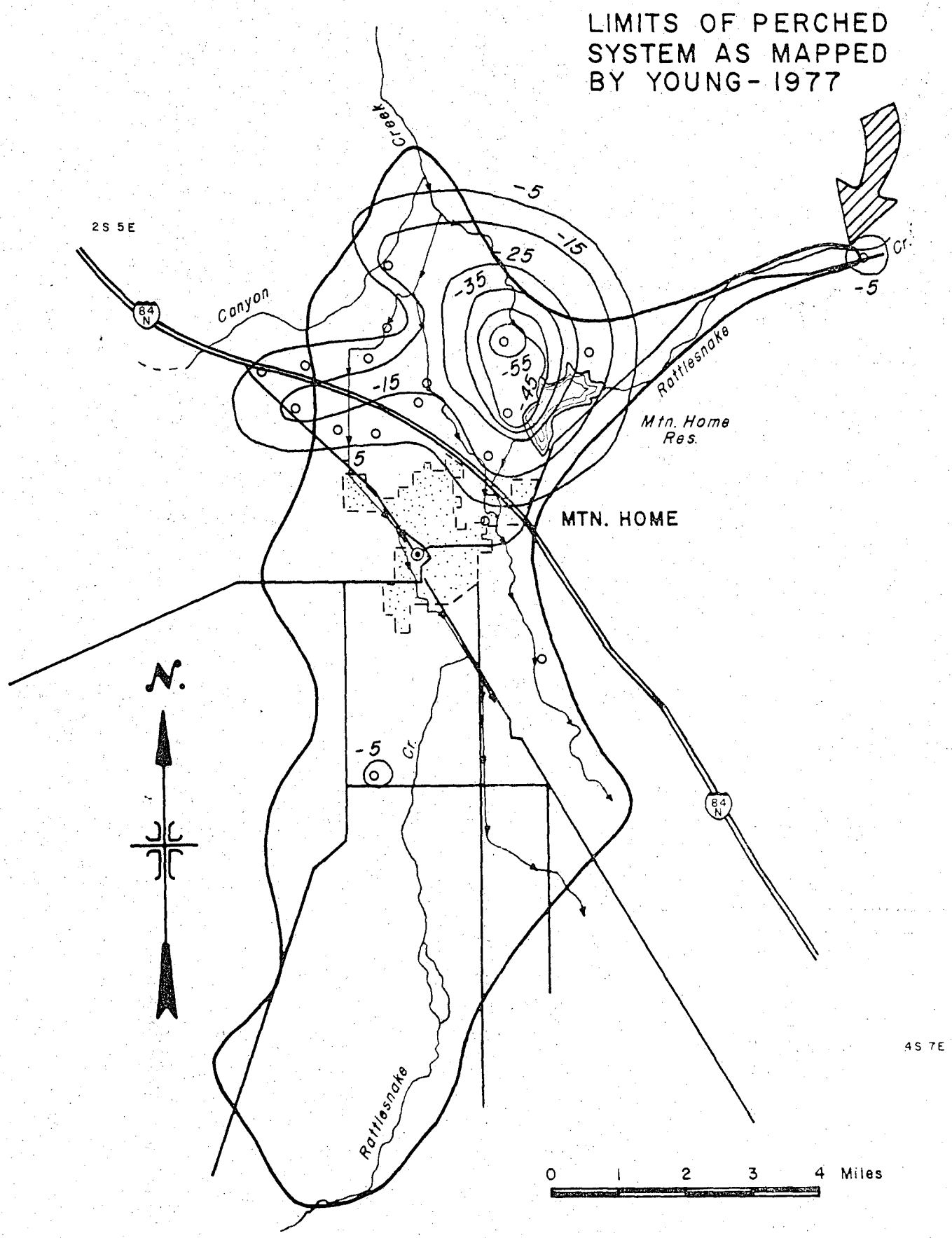

Figure 19. Change in Water Levels in the Perched Aquifer from 1976 to 1981 in Feet.

City was below average for all but one year and 19.21 inches below average for the period listed. Over the last eight years, precipitation was above average for the Mountain Home Plateau but was probably near or below average in the mountains above the plateau. This would lead to near or below average yield from Canyon Creek, Rattlesnake, and Ditto Creek basins. Below average precipitation would also affect the interbasin transfer of water from Little Camas Reservior.

Table 2. Annual Precipitation and Departure from Normal for Stations in Vicinity of Mountain Home Plateau in inches

	Mountain Home		Anderson Dam		Hill City	
Date	Annual Precip	Departure*	Annual Precip	Departure*	Annual Precip	Departure*
1981	12.03	+2.43	22.98	+3.09	17.45	+1.96
1980	10.30	+0.70	22.19	+2.30	13.60	-1.89
1979	19.20	-0.40	15.59	-4.30	10.90	-4.59
1978	12.24	+2.64	19.11	-0.78	13.82	-1.67
1977	9.83	+0.23	19.77	-0.12	12.73	-2.76
1976	12.91	+3.31	14.40	-5.49	9.99	-5.50
1975	13.40	+3.80	28.40	+8.51	14.61	-0.88
1974	11.24	+1.64	17.04	-2.85	11.95	-3.94

* Departure from average annual precipitation based on period 1941-1970.