Selected Hydrologic Data from Fortymile Wash in the Yucca Mountain Area, Nevada, Water Year 1992

by Charles S. Savard

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CONVERSION FACTORS AND VERTICAL DATUM

Multiply	By	To obtain
kilometer (km)	0.6214	mile (mi)
meter (m)	3.281	foot (ft)
millimeter (mm)	0.03937	inch (in.)
centimeter (cm)	0.3937	inch (in.)

Degree Celsius (°C) may be converted to degree Fahrenheit (°F) by using the following equation:

$$°F = 9/5\ (°C) + 32.$$

Sea level: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)—a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

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Abstract

Precipitation totals of 245 and 210 mm were measured at UE-29 UZN #91 and UE-29 UZN #92 respectively, during the 1992 water year, October 1, 1991 to September 30, 1992. Approximately ninety percent of the precipitation fell during the period December 27 to April 2. Localized streamflow was generated in the Fortymile Wash drainage basin during the February 12–15, 1992 and March 31, 1992 precipitation, and infiltrated into the streambed materials. The streamflow went across the UE-29 UZN #91 neutron-access borehole location and within several meters of the UE-29 UZN #92 location. Neutron logging in these boreholes showed increases in the volumetric water content of the unsaturated alluvium and indicated streamflow infiltrated to a depth of approximately 5 meters. The volumetric water content in the upper 5 meters then gradually decreased during the remaining part of the water year. Ground-water levels rose over one meter in wells UE-29 a#1 and UE-29 a#2, and one-half meter in neutron-access borehole UE-29 UZN #91 following the streamflows. Water level declines of 0.5 meter in UE-29 a#1 and rises of 0.2 meter in UE-29 a#2 and 0.1 meter in UE-29 UZN #91 coincided with a June 29, 1992 earthquake at the Little Skull Mountain, located approximately 27 kilometers southeast of the wells.

INTRODUCTION

The Yucca Mountain area currently is being evaluated by the U.S. Department of Energy for its suitability to store high-level nuclear waste in a mined, underground repository (U.S. Department of Energy, 1988). Hydrologic data are being collected by the U.S. Geological Survey throughout a 150-square kilometer study area about 150 km northwest of Las Vegas in southern Nevada (fig. 1) for site characterization studies. Ongoing hydrologic studies are investigating atmospheric precipitation, streamflow, movement of water through the unsaturated zone, movement of water through the saturated zone, and paleohydrology.

The Fortymile Wash recharge study involves some components of each of these studies. Fortymile Wash is an ephemeral stream near Yucca Mountain with tributaries draining the east side of Yucca Mountain and then forming a distributary system in the Amargosa Desert. Data collected during the study will be used to determine the amount of ground-water recharge from Fortymile Wash to the ground-water flow system which has been proposed by Czarnecki and Waddell (1984), Claassen (1985), White and Chuma (1987), and Benson and Klieforth (1989). Understanding the ground-water flow system is important because it is a possible mechanism for radionuclide migration from the potential repository to the accessible environment, and is necessary for an evaluation of the environmental issues involved with siting the potential repository.

Purpose and Scope

The purpose of this report is to present selected hydrologic data for the 1992 Water Year (WY), which is October 1, 1991 to September 30, 1992. Precipitation totals and preliminary neutron logging results from two sites (UE-29 UZN #91 and UE-29 UZN #92), miscellaneous streamflow observations, and depth-to-ground-water data from three sites (UE-29 a#1, UE-29 a#2, and UE-29 UZN #91) are presented in this report. These data are considered important to understanding recharge processes to the ground-water system in Fortymile Wash. The neutron logging results are considered preliminary since a final calibration equation to convert neutron counts to volumetric water content has not been developed. However, a preliminary equation used to compute volumetric water content was considered adequate to show qualitative differences in the neutron-logging profiles.

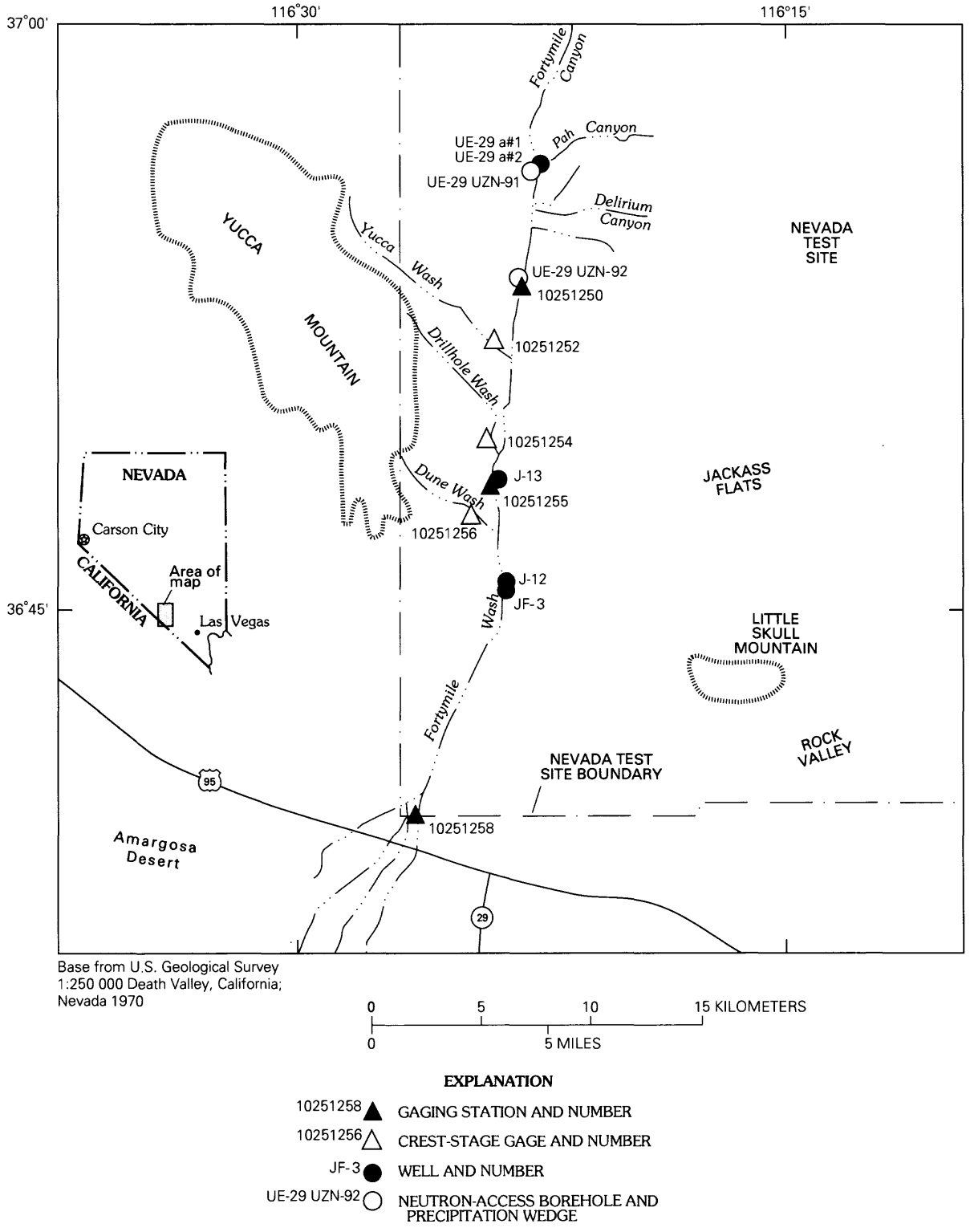

Figure 1. Location of gaging stations, crest-stage gages, neutron-access boreholes, and wells.

Previous Work

The U.S. Geological Survey has been investigating the hydrology of the Yucca Mountain area since the 1960's as part of other Nevada Test Site studies (Moore, 1961 & 1962; Thordarson and others, 1967; Young, 1972; and Winograd and Thordarson, 1975). Waddell (1982, 1984), Robison (1984), Waddell and others (1984), Robison and others (1988), Gemmel (1990), O'Brien (1991), and Luckey and others (1993) presented ground-water level data for wells in the Fortymile Wash and Yucca Mountain area. Squires and Young (1984) and Pabst and others (1993) investigated streamflow in Fortymile Wash. Huber (1988) investigated the geomorphic evolution of Fortymile Wash.

Acknowledgments

Numerous personnel helped in the collection, compilation, and quality assurance of the data included in this report. Those making notable specific contributions were: Dale Ambos for compiling the precipitation data; Lorraine Flint, Joe Gonzales, and David Hudson for compiling the neutron logging data; and Alan Flint for providing the preliminary neutron-logging calibration equation.

PRECIPITATION DATA

Nonrecording precipitation wedges were mounted on posts near the neutron-access borehole locations, UE-29 UZN #91 and UE-29 UZN #92 (fig. 1), during the 1992 WY. Differences between successive readings were used to determine the total amount of precipitation that fell in the intervening period (table 1). Oil was added to the wedges to prevent evaporation of the precipitation between readings. During the winter, antifreeze was added so snowfall would melt, and to keep the precipitation from freezing.

The total precipitation measured for the 1992 WY was 245 mm at UE-29 UZN #91 and 210 mm at UE-29 UZN #92. December 27, 1991 to April 2, 1992 was the wettest period of the water year when a series of storms in the Fortymile Wash drainage basin accounted for 89 percent of the total annual precipitation measured at the UE-29 UZN #91 site and 94 percent measured at the UE-29 UZN #92 site (fig. 2).

STREAMFLOW DATA

Streamflow data were collected from a network of three continuous recording gaging stations and three crest-stage gages in the lower Fortymile Wash drainage basin. Locations of the gages are shown in fig. 1 and described in table 2. Miscellaneous streamflow observations, such as velocity estimates and high-water marks, and the distances the streamflow traveled were made during and after the periods of streamflow, February 12–15 and March 31, 1992. Peak flow and mean daily discharge data at the gaging stations and crest-stage gages are contained in a separate report series (Pabst and others, 1993 and Kane and others, in press). This section of the report documents miscellaneous streamflow observations and evidence from field reconnaissance for the distances the streamflow traveled.

Yucca Wash had streamflow events on February 12 and 14. The February 12 event was observed near peak flow. A subsequent visit to the wash found evidence of the February 14 streamflow event. The February 14 event had a lower peak discharge than the February 12 event based on deposits and wash lines left by the two streamflow events. Recently deposited gravel and seed lines along the channel indicated streamflow reached the main Fortymile Wash channels approximately 450 m below the crest-stage gage. The streamflow traveled approximately 30 to 40 m down the main Fortymile Wash channel before completely infiltrating into the streambed sediments.

Delirium Canyon tributary and the two unnamed tributaries just to the north and the south had streamflow events on February 12. Recent sand and gravel deposits indicated streamflow in the three tributaries reached the main Fortymile Wash channel. No evidence of streamflow in Fortymile Wash was observed upstream of the confluence of Fortymile Wash and the northernmost tributary. Recent deposits of sand and gravel, seed lines, and wash lines indicated the Fortymile Wash streamflow event traveled past the Fortymile Wash at Narrows gaging station and continued to flow downstream for a distance of approximately 2.5 km. All of the measured streamflow at the Fortymile Wash at the Narrows gage infiltrated into the streambed materials. The lateral extent of the streamflow in Fortymile Wash was approximately 3 to 5 m away from the neutron-access borehole UE-29 UZN #92 just upstream of the Narrows gage.

Streamflow velocity was estimated at 2 to 3 meters per second for a reach in the Delirium Canyon tributary approximately 20 meters above the road crossing at 1520 hours on February 12. During a subsequent visit on February 13, the channel reach where

Table 1. Precipitation totals for the UE-29 UZN #91 and UE-29 UZN #92 sites

[NR, gage not read]

Period		UE-29 UZN #91 precipitation gage totals		UE-29 UZN #92 precipitation gage totals	
Begin date	End date	(inches)	(mm)	(inches)	(mm)
Oct. 1, 1991	Oct. 28, 1991	0.25	6	0.09	2
Oct. 28, 1991	Nov. 15, 1991	0.01	0	0.00	0
Nov. 15, 1991	Dec. 10, 1991	0.13	3	0.10	3
Dec. 10, 1991	Dec. 27, 1991	0.08	2	NR	NR
Dec. 27, 1991	Jan. 7, 1992	1.73	44	1.81*	46*
Jan. 7, 1992	Feb. 10, 1992	0.80	20	0.95	24
Feb. 10, 1992	Feb. 14, 1992	NR	NR	1.70	43
Feb. 14, 1992	Feb. 19, 1992	2.65**	67**	0.40	10
Feb. 19, 1992	Mar. 4, 1992	0.64	16	0.73	19
Mar. 4, 1992	Mar. 9, 1992	0.18	5	0.17	4
Mar. 9, 1992	Mar. 23, 1992	1.08	27	0.95	24
Mar. 23, 1992	Mar. 30, 1992	0.70	18	0.50	13
Mar. 30, 1992	Apr. 2, 1992	0.79	20	0.55	14
Apr. 2, 1992	May 13, 1992	0.12	3	0.02	1
May 13, 1992	Jul. 8, 1992	0.02	1	0.02	1
Jul. 8, 1992	Jul. 16, 1992	0.17	4	0.04	1
Aug. 16, 1992	Aug. 3, 1992	0.29	7	0.05	1
Aug. 3, 1992	Aug. 17, 1992	0.00	0	0.20	5
Aug. 17, 1992	Sep. 30, 1992	0.00	0	0.00	0
	1992 WY Total	9.64	243	8.28	211

*For the period Dec. 10, 1991 - Jan. 7, 1992.

**For the period Feb. 10, 1992 - Feb. 19, 1992.

velocity estimates were made was found to be filled with gravel deposited from the streamflow event. Comparison of photographs taken at the reach during (fig. 3) and after (fig. 4) the streamflow event, indicate the top of the gravel fill on February 13 was higher than the water surface was on February 12 during the streamflow event.

On February 13, Delirium Canyon tributary discharge was estimated at approximately 0.03 cubic meters per second in the channel 100 to 125 m upstream of the road crossing. The streamflow completely infiltrated into the streambed sediments rapidly and did not travel as far as the road crossing. It is unknown if this streamflow was part of the February 12 event and still in recession or a separate event.

Recent sand and gravel deposits and wash lines indicated Pah Canyon tributary to Fortymile Wash had a streamflow event during the period February 12 to 18. The streamflow went into Fortymile Wash and downstream past the UE-29 UZN #91 location. The neutron-access borehole was located within the wetted channel. Sand and gravel deposits became smaller in lateral extent going downstream from Pah Canyon tributary, through the confluence of Pah Canyon tributary and Fortymile Wash, and past the neutron-access borehole location. This indicated the active channel was decreasing and streamflow was infiltrating into the streambed sediments. Some water came down Fortymile Wash from above Pah Canyon, but the majority of the water came down Pah Canyon tributary.

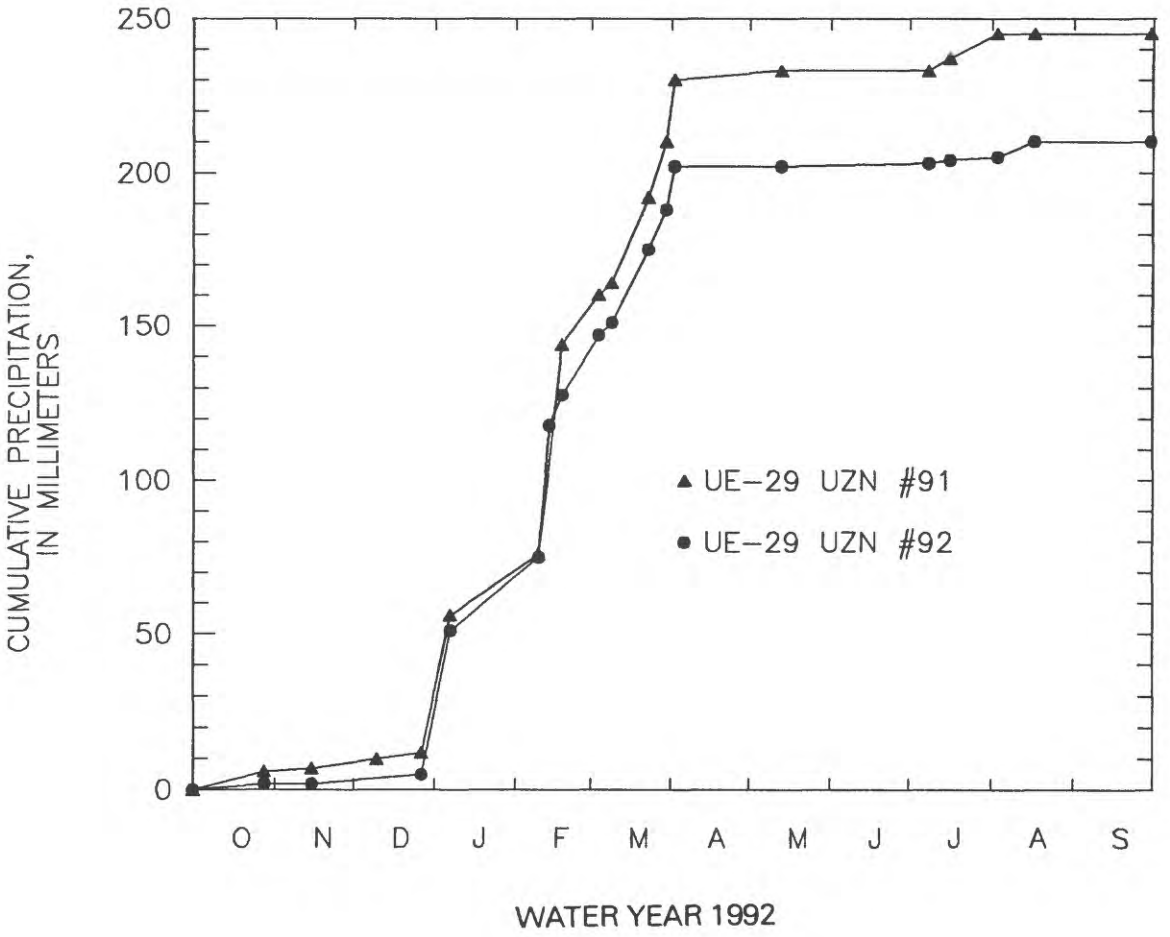

Figure 2. Cumulative precipitation at UE-29 UZN #91 and UE-29 UZN #92.

Table 2. Gaging station and crest-stage gage locations

[G, continuous recording gaging station; C, crest-stage gage]

Station number	Station name	Location		Gage type	Drainage area (mi^2)
		Latitude	Longitude		
10251250	Fortymile Wash at Narrows, Nevada Test Site, Nevada	36°53'13"	116°22'50"	G	258
10251252	Yucca Wash near mouth, Nevada Test Site, Nevada	36°51'58"	116°23'38"	C	17.0
10251254	Drillhole Wash at mouth, Nevada Test Site, Nevada	36°49'13"	116°23'52"	C	16.3
10251255	Fortymile Wash near Well J-13, Nevada Test Site, Nevada	36°48'27"	116°24'01"	G	304
10251256	Dune Wash near Busted Butte, Nevada Test Site, Nevada	36°47'35"	116°24'29"	C	6.77
10251258	Fortymile Wash near Amargosa Valley, Nevada Test Site, Nevada	36°40'18"	116°26'03"	G	316

Figure 3. Delirium Canyon tributary velocity section on February 12, 1992.

Figure 4. Delirum Canyon tributary velocity section on February 13, 1992.

The gravel deposits made it impossible to determine the wetted cross-sectional areas during the streamflow.

On March 31, evidence of a second streamflow event was found in Delirium Canyon and Pah Canyon tributaries to Fortymile Wash. At Delirium Canyon, a temporary road repair had been partially washed away and comparison between photographs taken on February 13 (fig. 4) and March 31 (fig. 5) showed deposition of gravel in the channel indicating a streamflow event had occurred. At UE-29 UZN #91, reworking of sediment deposits and the breaching of a small, kicked-up flow dam indicated another streamflow event had traveled down Pah Canyon tributary and into Fortymile Wash. No other evidence from streamflow events were found in the lower Fortymile Wash drainage basin on March 31.

No streamflow was recorded at the two most southern gaging stations, Fortymile Wash near Well J-13 and Fortymile Wash near Amargosa Valley, during the 1992 WY. Also, no streamflow was recorded at the crest-stage gages, Drillhole Wash at mouth, and Dune Wash near Busted Butte.

Drainage areas for the gaging stations and crest-stage gages are listed in table 2. Field observations during and after the 1992 WY streamflow events indicate that not all of the drainage basin upstream of a gage contributes streamflow. For example, the streamflow measured at Fortymile Wash at Narrows gage on February 12 was the result of streamflow produced only in the Delirium Canyon area, a small portion of the 668 square km drainage basin. As a result, relations between streamflow and total upstream drainage area are difficult to establish. Establishing the contributing area during precipitation-streamflow events, rather than just the drainage area, will be important for future Fortymile Wash studies.

UNSATURATED ZONE WATER-CONTENT PROFILES

The water content of the unsaturated zone was monitored by neutron logging at UE-29 UZN #91 and UE-29 UZN #92. Both boreholes are located in the main Fortymile Wash channel. UE-29 UZN #91 was drilled to a depth of 28.6 m, and UE-29 UZN #92 to 36.6 m (table 3). Only the water content of the alluvium and colluvium was monitored in UE-29 UZN #91 because the contact with the underlying volcanic bedrock is 20.2 m below the measurement point (M.P. Chornack, U.S. Geological Survey, oral com-

Figure 5. Delirium Canyon tributary velocity section on March 31, 1992.

Table 3. Well and neutron-access borehole locations

Name	Site ID	Location		Depth of open interval below land surface	
		Latitude	Longitude	Top (meters)	Bottom (meters)
UE-29 a#1	365629116222601	36°56'29"	116°22'26"	10.7	65.5
UE-29 a#2	365629116222602	36°56'29"	116°22'26"	86.9	213
				247	421
UE-29 UZN #91	365624116222901	36°56'24"	116°22'29"	27.1	28.6
UE-29 UZN #92	365324226225101	36°53'14"	116°22'51"	32.0	36.6
J-13	364829116234001	36°48'28"	116°23'40"	304	424
				820	1,010
J-12	364554116232401	36°45'54"	116°23'24"	265	347
JF-3	364528116232201	36°45'28"	116°23'22"	224	347

mun., 1993) and below the water table. The alluvium and colluvium contact with the underlying volcanic bedrock is 18.3 m below the measurement point in UE-29 UZN #92, so the vertical water-content profiles represent conditions in the alluvium, colluvium, and the volcanic bedrock to a depth of 19.4 m.

The hand-held neutron logging meter outputs the number of counts, which are proportional to the water content of the surrounding geologic medium (Gardner, 1986). The neutron logging meter has a resolution range less than one meter, thus the moisture contents derived from the neutron logging only represent a small portion of the Fortymile Wash drainage basin. Repeated measurements over the same intervals and depths allows for qualitative comparison of changes in moisture content. A preliminary calibration equation for the neutron meter provides a quantitative measure of the differences between measurements. The preliminary equation (A.L. Flint, U.S. Geological Survey, oral commun., 1993) used to convert the neutron counts to volumetric water content is,

$$VWC=(4.8639\times10^{-9}\times C^{2})+(1.3463\times10^{-5}\times C)-0.01386$$

where,

VWC is volumetric water content in cm^3/cm^3, and

C is the neutron count output from the meter after the 16 second counting interval.

The neutron logging meter was hand lowered down the neutron-access borehole with a depth-marked cable allowing vertical profiles of the water content to be made throughout the year (tables 4 and 5). Neutron counts were recorded every tenth of a meter from the land surface to five meters below the measurement point, after which counts were taken every three tenths of a meter. Both measurement points for the neutron-access boreholes are seven tenths of a meter above the land surface. Readings at UE-29 UZN #91 were stopped at 16.1 m to prevent the neutron tool from becoming immersed in the ground water and damaging the tool. Readings at UE-29 UZN #92 were stopped at 19.4 m depth. Both neutron holes were logged on the same day except for February 15, 1992, when road conditions from the recent streamflow made the road to UE-29 UZN #91 impassable. Readings at 16.1 m on May 7, 1992 for UE-29 UZN #91 and 17.6 m on October 29, 1992 for UE-29 UZN #92 were not recorded due to operator error.

At UE-29 UZN #91, there were no major differences from October 29 to January 28 in the vertical volumetric water-content profiles except for a slight increase from 0.7 to 1.0 m depth (fig. 6). After the February 12 streamflow event, the February 21 profile increased in water content from 0.7 to 5.0 m (fig. 7). From February 21 to March 11, the profile decreased in water content from 0.7 to 4.8 m and increased from 4.9 to 5.3 m (fig. 8). From March 11 to May 7, the profile decreased in water content from 0.7 to 4.8 m and increased from 4.9 to 5.6 m (fig. 9). From May 7 to August 26, the profile decreased in water content from 0.7 to 5.6 m (fig. 10). All profiles throughout the 1992 WY did not show any appreciable differences below 5.9 m.

At UE-29 UZN #92, there were no major differences from October 29 to January 28 in the vertical volumetric water-content profiles except for a slight increase from 0.7 to 1.2 m depth (fig. 11). After the February 12 streamflow event, the February 15 profile increased from 0.7 to 5.3 m (fig. 12). From February

Table 4. Preliminary computed volumetric water content from neutron logging in UE-29 UZN #91

[m, meter; cm^3, cubic centimeters; measurement point is top of casing after cap is removed]

Depth below measurement point (m)	Computed volumetric water content (cm^3/cm^3)						
	Oct. 29, 1991	Dec. 3, 1991	Jan. 28, 1992	Feb. 21, 1992	Feb. 25, 1992	Mar. 6, 1992	Mar. 11, 1992
0.7	0.140	0.153	0.190	0.220	0.221	0.218	0.220
0.8	0.083	0.085	0.115	0.134	0.139	0.141	0.130
0.9	0.066	0.067	0.092	0.125	0.124	0.132	0.128
1.0	0.065	0.066	0.084	0.132	0.124	0.136	0.128
1.1	0.062	0.066	0.074	0.123	0.124	0.129	0.130
1.2	0.071	0.068	0.068	0.133	0.127	0.136	0.129
1.3	0.073	0.079	0.079	0.147	0.141	0.144	0.135
1.4	0.083	0.082	0.084	0.157	0.162	0.159	0.156
1.5	0.088	0.084	0.091	0.180	0.159	0.162	0.158
1.6	0.086	0.085	0.081	0.157	0.156	0.151	0.150
1.7	0.085	0.081	0.083	0.144	0.140	0.136	0.132
1.8	0.083	0.086	0.084	0.152	0.150	0.146	0.144
1.9	0.091	0.091	0.088	0.153	0.153	0.144	0.149
2.0	0.088	0.080	0.082	0.151	0.151	0.142	0.143
2.1	0.082	0.085	0.079	0.155	0.148	0.153	0.151
2.2	0.073	0.073	0.073	0.156	0.154	0.141	0.141
2.3	0.074	0.071	0.075	0.144	0.140	0.142	0.145
2.4	0.074	0.075	0.074	0.170	0.170	0.169	0.163
2.5	0.067	0.068	0.074	0.181	0.181	0.165	0.164
2.6	0.063	0.058	0.059	0.161	0.155	0.153	0.153
2.7	0.051	0.056	0.053	0.125	0.122	0.116	0.112
2.8	0.056	0.059	0.060	0.126	0.125	0.114	0.120
2.9	0.066	0.064	0.066	0.142	0.139	0.134	0.128
3.0	0.059	0.059	0.064	0.157	0.148	0.138	0.144
3.1	0.055	0.051	0.055	0.153	0.135	0.134	0.136
3.2	0.046	0.044	0.046	0.146	0.136	0.148	0.132
3.3	0.040	0.043	0.041	0.165	0.158	0.149	0.146
3.4	0.037	0.042	0.041	0.160	0.158	0.155	0.156
3.5	0.035	0.033	0.037	0.151	0.156	0.145	0.148
3.6	0.034	0.032	0.033	0.130	0.125	0.132	0.129
3.7	0.036	0.035	0.037	0.124	0.118	0.115	0.116
3.8	0.045	0.044	0.045	0.133	0.127	0.123	0.121
3 9	0.053	0.057	0.060	0.161	0.155	0.140	0.143
4.0	0.069	0.066	0.069	0.223	0.207	0.204	0.198

Table 4. Preliminary computed volumetric water content from neutron logging in UE-29 UZN #91 --Continued

Depth below measurement point (m)	Computed volumetric water content (cm^3/cm^3)						
	Oct. 29, 1991	Dec. 3, 1991	Jan. 28, 1992	Feb. 21, 1992	Feb. 25, 1992	Mar. 6, 1992	Mar. 11, 1992
4.1	0.075	0.071	0.071	0.216	0.209	0.203	0.203
4.2	0.075	0.076	0.076	0.183	0.172	0.165	0.163
4.3	0.074	0.077	0.075	0.158	0.151	0.148	0.144
4.4	0.070	0.073	0.073	0.153	0.146	0.137	0.137
4.5	0.081	0.083	0.083	0.170	0.169	0.160	0.156
4.6	0.088	0.087	0.085	0.161	0.154	0.155	0.143
4.7	0.084	0.089	0.088	0.156	0.150	0.149	0.151
4.8	0.088	0.085	0.092	0.158	0.151	0.151	0.148
4.9	0.087	0.087	0.092	0.152	0.156	0.144	0.151
5.0	0.087	0.092	0.087	0.134	0.148	0.146	0.144
5.3	0.093	0.088	0.092	0.091	0.101	0.115	0.126
5.6	0.085	0.092	0.093	0.095	0.088	0.096	0.094
5.9	0.089	0.088	0.097	0.090	0.090	0.088	0.089
6.2	0.085	0.083	0.082	0.077	0.087	0.082	0.086
6.5	0.080	0.074	0.075	0.075	0.073	0.074	0.074
6.8	0.071	0.065	0.075	0.073	0.072	0.072	0.071
7.1	0.067	0.068	0.068	0.075	0.070	0.070	0.063
7.4	0.070	0.070	0.066	0.073	0.070	0.067	0.069
7.7	0.066	0.068	0.066	0.067	0.066	0.065	0.065
8.0	0.076	0.071	0.076	0.078	0.075	0.075	0.075
8.3	0.077	0.071	0.073	0.070	0.071	0.069	0.068
8.6	0.067	0.066	0.067	0.074	0.066	0.071	0.069
8.9	0.089	0.081	0.089	0.091	0.092	0.089	0.087
9.2	0.082	0.083	0.089	0.084	0.085	0.085	0.084
9.5	0.087	0.084	0.081	0.081	0.084	0.083	0.086
9.8	0.108	0.107	0.114	0.114	0.113	0.122	0.117
10.1	0.084	0.087	0.090	0.088	0.089	0.085	0.088
10.4	0.098	0.106	0.105	0.104	0.098	0.097	0.099
10.7	0.114	0.110	0.110	0.119	0.117	0.121	0.111
11.0	0.089	0.101	0.100	0.103	0.104	0.105	0.104
11.3	0.095	0.089	0.097	0.098	0.096	0.099	0.098
11.6	0.103	0.103	0.095	0.102	0.099	0.102	0.103
11.9	0.150	0.158	0.148	0.155	0.155	0.156	0.156
12.2	0.128	0.127	0.130	0.127	0.131	0.131	0.132
12.5	0.169	0.168	0.167	0.170	0.160	0.171	0.169

Table 4. Preliminary computed volumetric water content from neutron logging in UE-29 UZN #91 --Continued

Depth below measurement point (m)	Computed volumetric water content (cm^3/cm^3)						
	Oct. 29, 1991	Dec. 3, 1991	Jan. 28, 1992	Feb. 21, 1992	Feb. 25, 1992	Mar. 6, 1992	Mar. 11, 1992
12.8	0.171	0.168	0.165	0.167	0.160	0.161	0.161
13.1	0.149	0.146	0.145	0.150	0.148	0.142	0.143
13.4	0.139	0.149	0.145	0.141	0.138	0.133	0.146
13.7	0.146	0.149	0.147	0.147	0.150	0.139	0.143
14.0	0.130	0.126	0.127	0.125	0.127	0.127	0.123
14.3	0.103	0.103	0.101	0.102	0.103	0.097	0.099
14.6	0.086	0.088	0.087	0.094	0.088	0.089	0.090
14.9	0.159	0.159	0.153	0.160	0.156	0.152	0.155
15.2	0.180	0.188	0.184	0.188	0.187	0.184	0.181
15.5	0.176	0.184	0.183	0.174	0.177	0.181	0.184
15.8	0.168	0.166	0.163	0.164	0.166	0.174	0.173
16.1	0.171	0.168	0.166	0.170	0.178	0.160	0.173

Depth below measurement point (m)	Computed volumetric water content (cm^3/cm^3)					
	Apr. 2, 1992	Apr. 8, 1992	May 7, 1992	June 22, 1992	Juiy 27, 1992	Aug. 26, 1992
0.7	0.231	0.206	0.182	0.123	0.108	0.122
0.8	0.140	0.138	0.096	0.079	0.079	0.072
0.9	0.134	0.126	0.093	0.072	0.069	0.066
1.0	0.142	0.128	0.096	0.072	0.069	0.070
1.1	0.141	0.122	0.101	0.072	0.069	0.069
1.2	0.135	0.130	0.113	0.076	0.070	0.074
1.3	0.153	0.139	0.126	0.090	0.087	0.081
1.4	0.171	0.165	0.148	0.098	0.093	0.088
1.5	0.176	0.178	0.147	0.117	0.101	0.094
1.6	0.171	0.157	0.144	0.119	0.100	0.099
1.7	0.153	0.144	0.137	0.110	0.096	0.092
1.8	0.163	0.144	0.139	0.121	0.111	0.096
1.9	0.159	0.154	0.137	0.123	0.114	0.108
2.0	0.165	0.155	0.146	0.130	0.118	0.107
2.1	0.167	0.159	0.144	0.141	0.120	0.108
2.2	0.161	0.156	0.135	0.133	0.118	0.101
2.3	0.146	0.149	0.142	0.137	0.113	0.109
2.4	0.173	0.174	0.159	0.141	0.131	0.108
2.5	0.185	0.179	0.171	0.134	0.118	0.100

Table 4. Preliminary computed volumetric water content from neutron logging in UE-29 UZN #91 --Continued

Depth below measurement point (m)	Computed volumetric water content (cm^3/cm^3)					
	Apr. 2, 1992	Apr. 8, 1992	May 7, 1992	June 22, 1992	July 27, 1992	Aug. 26, 1992
2.6	0.162	0.153	0.129	0.124	0.099	0.085
2.7	0.127	0.122	0.112	0.098	0.084	0.072
2.8	0.121	0.127	0.115	0.097	0.090	0.079
2.9	0.136	0.142	0.121	0.112	0.097	0.093
3.0	0.141	0.153	0.136	0.117	0.106	0.100
3.1	0.143	0.143	0.138	0.128	0.116	0.104
3.2	0.142	0.143	0.138	0.129	0.115	0.106
3.3	0.149	0.158	0.158	0.135	0.128	0.114
3.4	0.156	0.157	0.155	0.145	0.133	0.121
3.5	0.150	0.152	0.149	0.142	0.117	0.111
3.6	0.133	0.135	0.129	0.116	0.109	0.099
3.7	0.113	0.121	0.111	0.097	0.091	0.083
3.8	0.117	0.131	0.124	0.100	0.084	0.081
3.9	0.141	0.157	0.147	0.127	0.090	0.078
4.0	0.184	0.209	0.196	0.153	0.104	0.084
4.1	0.189	0.197	0.197	0.152	0.107	0.090
4.2	0.160	0.174	0.158	0.135	0.111	0.093
4.3	0.135	0.143	0.148	0.117	0.112	0.093
4.4	0.134	0.136	0.137	0.123	0.113	0.094
4.5	0.155	0.157	0.157	0.142	0.111	0.103
4.6	0.148	0.143	0.149	0.133	0.117	0.102
4.7	0.143	0.139	0.146	0.131	0.112	0.103
4.8	0.141	0.135	0.149	0.132	0.109	0.104
4.9	0.142	0.140	0.153	0.128	0.112	0.104
5.0	0.150	0.136	0.151	0.130	0.106	0.099
5.3	0.137	0.130	0.141	0.134	0.104	0.094
5.6	0.102	0.105	0.124	0.127	0.110	0.095
5.9	0.098	0.090	0.087	0.097	0.098	0.091
6.2	0.086	0.078	0.083	0.082	0.076	0.082
6.5	0.076	0.077	0.077	0.078	0.079	0.076
6.8	0.069	0.069	0.071	0.072	0.068	0.070
7.1	0.065	0.069	0.069	0.069	0.068	0.070
7.4	0.067	0.074	0.068	0.066	0.065	0.066
7.7	0.068	0.066	0.062	0.062	0.065	0.063
8.0	0.078	0.077	0.075	0.075	0.080	0.076

Table 4. Preliminary computed volumetric water content from neutron logging in UE-29 UZN #91 --Continued

Depth below measurement point (m)	Computed volumetric water content (cm^3/cm^3)					
	Apr. 2, 1992	Apr. 8, 1992	May 7, 1992	June 22, 1992	July 27, 1992	Aug. 26, 1992
8.3	0.070	0.071	0.074	0.067	0.071	0.067
8.6	0.072	0.074	0.073	0.074	0.071	0.068
8.9	0.091	0.085	0.088	0.088	0.091	0.090
9.2	0.086	0.084	0.092	0.085	0.081	0.083
9.5	0.089	0.085	0.084	0.089	0.092	0.086
9.8	0.124	0.121	0.119	0.120	0.118	0.117
10.1	0.087	0.093	0.087	0.089	0.084	0.091
10.4	0.099	0.100	0.101	0.096	0.097	0.096
10.7	0.122	0.118	0.120	0.114	0.123	0.121
11.0	0.103	0.098	0.106	0.102	0.094	0.100
11.3	0.091	0.097	0.096	0.097	0.094	0.097
11.6	0.102	0.107	0.108	0.101	0.100	0.103
11.9	0.153	0.156	0.158	0.156	0.153	0.156
12.2	0.126	0.125	0.129	0.117	0.126	0.134
12.5	0.175	0.184	0.163	0.160	0.177	0.177
12.8	0.161	0.166	0.158	0.166	0.159	0.156
13.1	0.148	0.147	0.138	0.145	0.146	0.154
13.4	0.142	0.140	0.136	0.142	0.126	0.125
13.7	0.142	0.138	0.150	0.139	0.144	0.144
14.0	0.135	0.131	0.128	0.131	0.121	0.123
14.3	0.099	0.098	0.100	0.103	0.093	0.100
14.6	0.086	0.094	0.095	0.086	0.091	0.087
14.9	0.158	0.145	0.152	0.150	0.165	0.150
15.2	0.177	0.191	0.180	0.180	0.183	0.183
15.5	0.178	0.179	0.179	0.179	0.180	0.180
15.8	0.171	0.167	0.163	0.171	0.170	0.173
16.1	0.170	0.168	-	0.179	0.167	0.168

Table 5. Preliminary computed volumetric water content from neutron logging in UE-29 UZN #92

[m, meter; cm^3, cubic centimeters; measurement point is top of casing after cap is removed]

Depth below measurement point (m)	Computed volumetric water content (cm^3/cm^3)						
	Oct. 29, 1991	Dec. 3, 1991	Jan. 28, 1992	Feb. 15, 1992	Feb. 21, 1992	Feb. 25, 1992	Mar. 6, 1992
0.7	0.067	0.057	0.114	0.141	0.133	0.129	0.139
0.8	0.066	0.066	0.100	0.119	0.125	0.120	0.117
0.9	0.068	0.066	0.094	0.120	0.119	0.118	0.121
1.0	0.062	0.067	0.084	0.124	0.118	0.116	0.120
1.1	0.076	0.071	0.082	0.137	0.126	0.127	0.127
1.2	0.074	0.076	0.082	0.148	0.135	0.142	0.145
1.3	0.080	0.080	0.079	0.147	0.149	0.138	0.140
1.4	0.078	0.082	0.081	0.152	0.147	0.146	0.147
1.5	0.072	0.072	0.073	0.139	0.145	0.137	0.143
1.6	0.070	0.062	0.066	0.121	0.133	0.125	0.123
1.7	0.063	0.066	0.069	0.105	0.117	0.118	0.111
1.8	0.071	0.074	0.073	0.123	0.123	0.120	0.116
1.9	0.079	0.085	0.082	0.138	0.141	0.139	0.140
2.0	0.083	0.086	0.086	0.132	0.137	0.139	0.141
2.1	0.090	0.092	0.093	0.151	0.147	0.150	0.143
2.2	0.108	0.101	0.103	0.171	0.165	0.168	0.167
2.3	0.106	0.108	0.100	0.178	0.175	0.185	0.171
2.4	0.109	0.108	0.107	0.175	0.178	0.188	0.178
2.5	0.113	0.112	0.110	0.185	0.178	0.184	0.186
2.6	0.118	0.117	0.117	0.197	0.194	0.197	0.189
2.7	0.121	0.129	0.122	0.203	0.205	0.201	0.197
2.8	0.127	0.127	0.128	0.207	0.212	0.196	0.199
2.9	0.120	0.117	0.122	0.186	0.179	0.182	0.183
3.0	0.110	0.102	0.110	0.181	0.184	0.174	0.181
3.1	0.112	0.104	0.107	0.181	0.183	0.170	0.173
3.2	0.105	0.105	0.108	0.184	0.179	0.184	0.176
3.3	0.102	0.104	0.104	0.178	0.171	0.167	0.167
3.4	0.092	0.097	0.103	0.165	0.156	0.161	0.160
3.5	0.096	0.095	0.093	0.147	0.144	0.157	0.151
3.6	0.082	0.084	0.081	0.125	0.128	0.130	0.130
3.7	0.082	0.084	0.086	0.129	0.134	0.139	0.133
3.8	0.082	0.085	0.085	0.140	0.137	0.135	0.133
3.9	0.081	0.088	0.083	0.134	0.134	0.130	0.133
4.0	0.088	0.091	0.085	0.140	0.135	0.135	0.139

Table 5. Preliminary computed volumetric water content from neutron logging in UE-29 UZN #92 --Continued

Depth below measurement point (m)	Computed volumetric water content (cm^3/cm^3)						
	Oct. 29, 1991	Dec. 3, 1991	Jan. 28, 1992	Feb. 15, 1992	Feb. 21, 1992	Feb. 25, 1992	Mar. 6, 1992
4.1	0.092	0.091	0.090	0.134	0.136	0.136	0.136
4.2	0.086	0.090	0.090	0.139	0.137	0.139	0.137
4.3	0.090	0.092	0.094	0.141	0.139	0.134	0.138
4.4	0.096	0.091	0.095	0.153	0.142	0.135	0.135
4.5	0.093	0.095	0.094	0.151	0.139	0.139	0.150
4.6	0.094	0.099	0.099	0.145	0.134	0.137	0.140
4.7	0.097	0.093	0.103	0.140	0.139	0.138	0.133
4.8	0.094	0.095	0.099	0.130	0.132	0.135	0.131
4.9	0.089	0.089	0.094	0.120	0.130	0.126	0.121
5.0	0.095	0.096	0.102	0.122	0.127	0.123	0.123
5.3	0.077	0.081	0.078	0.088	0.087	0.090	0.091
5.6	0.106	0.112	0.112	0.114	0.114	0.110	0.113
5.9	0.127	0.129	0.122	0.120	0.126	0.120	0.119
6.2	0.126	0.128	0.122	0.126	0.116	0.124	0.129
6.5	0.119	0.126	0.117	0.112	0.122	0.121	0.121
6.8	0.108	0.108	0.106	0.107	0.106	0.099	0.104
7.1	0.112	0.115	0.117	0.119	0.123	0.118	0.120
7.4	0.125	0.131	0.130	0.132	0.130	0.132	0.122
7.7	0.129	0.124	0.118	0.132	0.124	0.127	0.130
8.0	0.128	0.128	0.122	0.124	0.125	0.123	0.128
8.3	0.135	0.136	0.138	0.129	0.135	0.138	0.137
8.6	0.126	0.115	0.123	0.119	0.127	0.116	0.113
8.9	0.113	0.114	0.117	0.117	0.111	0.112	0.107
9.2	0.104	0.123	0.116	0.110	0.117	0.112	0.110
9.5	0.119	0.123	0.123	0.121	0.121	0.126	0.125
9.8	0.117	0.117	0.116	0.112	0.116	0.118	0.113
10.1	0.108	0.110	0.108	0.103	0.108	0.113	0.103
10.4	0.114	0.123	0.120	0.123	0.116	0.120	0.118
10.7	0.142	0.143	0.142	0.138	0.142	0.136	0.139
11.0	0.120	0.116	0.118	0.114	0.117	0.118	0.127
11.3	0.101	0.102	0.107	0.106	0.109	0.104	0.106
11.6	0.124	0.127	0.125	0.120	0.130	0.128	0.128
11.9	0.132	0.135	0.133	0.132	0.137	0.134	0.131
12.2	0.114	0.113	0.118	0.109	0.119	0.108	0.116
12.5	0.104	0.105	0.101	0.102	0.103	0.098	0.101

Table 5. Preliminary computed volumetric water content from neutron logging in UE-29 UZN #92 --Continued

Depth below measurement point (m)	Computed volumetric water content (cm^3/cm^3)						
	Oct. 29, 1991	Dec. 3, 1991	Jan. 28, 1992	Feb. 15, 1992	Feb. 21, 1992	Feb. 25, 1992	Mar. 6, 1992
12.8	0.126	0.124	0.122	0.127	0.129	0.124	0.122
13.1	0.136	0.144	0.140	0.139	0.142	0.135	0.141
13.4	0.134	0.132	0.130	0.131	0.131	0.131	0.131
13.7	0.121	0.125	0.125	0.124	0.124	0.131	0.125
14.0	0.109	0.105	0.106	0.113	0.110	0.114	0.106
14.3	0.110	0.103	0.111	0.112	0.111	0.105	0.108
14.6	0.122	0.125	0.123	0.129	0.123	0.127	0.123
14.9	0.126	0.126	0.130	0.118	0.135	0.133	0.133
15.2	0.120	0.121	0.116	0.117	0.119	0.113	0.118
15.5	0.108	0.109	0.108	0.107	0.105	0.108	0.101
15.8	0.134	0.143	0.142	0.141	0.138	0.135	0.142
16.1	0.126	0.129	0.125	0.135	0.126	0.127	0.130
16.4	0.124	0.121	0.128	0.122	0.125	0.116	0.115
16.7	0.122	0.126	0.121	0.123	0.123	0.135	0.131
17.0	0.134	0.131	0.135	0.130	0.134	0.131	0.138
17.3	0.136	0.138	0.140	0.132	0.125	0.128	0.129
17.6	-	0.140	0.140	0.134	0.133	0.132	0.134
17.9	0.125	0.123	0.129	0.127	0.136	0.131	0.120
18.2	0.118	0.121	0.120	0.126	0.126	0.127	0.121
18.5	0.175	0.166	0.158	0.174	0.165	0.163	0.169
18.8	0.181	0.184	0.185	0.186	0.172	0.176	0.183
19.1	0.165	0.158	0.174	0.167	0.183	0.174	0.164
19.4	0.145	0.144	0.128	0.146	0.141	0.138	0.146

Depth below measurement point (m)	Computed volumetric water content (cm^3/cm^3)						
	Mar. 11, 1992	Apr. 2, 1992	Apr. 8, 1992	May 7, 1992	June 22, 1992	July 27, 1992	Aug. 26, 1992
0.7	0.143	0.146	0.128	0.087	0.058	0.053	0.052
0.8	0.120	0.129	0.106	0.068	0.062	0.063	0.058
0.9	0.115	0.122	0.112	0.070	0.066	0.065	0.068
1.0	0.113	0.117	0.111	0.079	0.069	0.069	0.065
1.1	0.123	0.126	0.123	0.090	0.075	0.074	0.068
1.2	0.141	0.147	0.143	0.112	0.087	0.080	0.081
1.3	0.146	0.157	0.157	0.126	0.088	0.080	0.083
1.4	0.147	0.157	0.143	0.129	0.089	0.083	0.083

Table 5. Preliminary computed volumetric water content from neutron logging in UE-29 UZN #92 --Continued

Depth below measurement point (m)	Computed volumetric water content (cm^3/cm^3)						
	Mar. 11, 1992	Apr. 2, 1992	Apr. 8, 1992	May 7, 1992	June 22, 1992	July 27, 1992	Aug. 26, 1992
1.5	0.142	0.151	0.144	0.123	0.085	0.077	0.079
1.6	0.127	0.140	0.130	0.100	0.078	0.073	0.073
1.7	0.120	0.124	0.123	0.106	0.085	0.071	0.077
1.8	0.122	0.133	0.124	0.114	0.090	0.079	0.075
1.9	0.143	0.152	0.148	0.128	0.107	0.097	0.089
2.0	0.140	0.148	0.133	0.133	0.107	0.093	0.093
2.1	0.152	0.160	0.155	0.150	0.121	0.104	0.097
2.2	0.170	0.169	0.177	0.164	0.128	0.115	0.110
2.3	0.176	0.189	0.187	0.174	0.141	0.118	0.114
2.4	0.171	0.196	0.185	0.173	0.156	0.132	0.119
2.5	0.187	0.192	0.188	0.188	0.165	0.134	0.126
2.6	0.198	0.207	0.190	0.185	0.170	0.148	0.129
2.7	0.202	0.216	0.212	0.200	0.190	0.164	0.141
2.8	0.212	0.218	0.200	0.208	0.195	0.184	0.160
2.9	0.189	0.192	0.190	0.187	0.181	0.167	0.144
3.0	0.177	0.178	0.187	0.174	0.171	0.169	0.142
3.1	0.170	0.179	0.181	0.170	0.163	0.167	0.144
3.2	0.162	0.181	0.187	0.173	0.160	0.148	0.146
3.3	0.162	0.163	0.166	0.164	0.157	0.154	0.146
3.4	0.156	0.152	0.166	0.153	0.155	0.144	0.150
3.5	0.147	0.154	0.160	0.150	0.139	0.140	0.141
3.6	0.128	0.131	0.136	0.132	0.132	0.122	0.120
3.7	0.129	0.137	0.133	0.136	0.125	0.132	0.119
3.8	0.141	0.142	0.139	0.138	0.131	0.128	0.124
3.9	0.133	0.138	0.139	0.135	0.132	0.132	0.127
4.0	0.143	0.139	0.135	0.146	0.140	0.130	0.132
4.1	0.137	0.143	0.136	0.145	0.144	0.137	0.132
4.2	0.139	0.140	0.146	0.143	0.142	0.133	0.135
4.3	0.145	0.139	0.146	0.137	0.145	0.135	0.136
4.4	0.146	0.136	0.147	0.144	0.148	0.142	0.142
4.5	0.140	0.144	0.158	0.146	0.140	0.148	0.133
4.6	0.141	0.149	0.146	0.140	0.150	0.134	0.143
4.7	0.142	0.151	0.158	0.148	0.144	0.147	0.138
4.8	0.131	0.139	0.139	0.145	0.142	0.135	0.128
4.9	0.120	0.126	0.133	0.135	0.134	0.130	0.121
5.0	0.130	0.139	0.133	0.143	0.137	0.136	0.133

Table 5. Preliminary computed volumetric water content from neutron logging in UE-29 UZN #92 --Continued

Depth below measurement point (m)	Computed volumetric water content (cm^3/cm^3)						
	Mar. 11, 1992	Apr. 2, 1992	Apr. 8, 1992	May 7, 1992	June 22, 1992	July 27, 1992	Aug. 26, 1992
5.3	0.092	0.113	0.120	0.123	0.115	0.112	0.103
5.6	0.115	0.120	0.125	0.120	0.126	0.128	0.123
5.9	0.121	0.129	0.127	0.127	0.138	0.128	0.138
6.2	0.126	0.125	0.117	0.118	0.130	0.136	0.135
6.5	0.118	0.119	0.127	0.120	0.123	0.120	0.119
6.8	0.112	0.111	0.105	0.114	0.108	0.105	0.111
7.1	0.116	0.122	0.126	0.121	0.118	0.121	0.120
7.4	0.134	0.129	0.131	0.130	0.137	0.127	0.127
7.7	0.119	0.123	0.123	0.121	0.125	0.126	0.126
8.0	0.121	0.124	0.123	0.124	0.127	0.118	0.123
8.3	0.135	0.136	0.136	0.131	0.132	0.137	0.128
8.6	0.123	0.123	0.118	0.120	0.116	0.122	0.120
8.9	0.110	0.114	0.105	0.109	0.115	0.110	0.108
9.2	0.113	0.116	0.110	0.117	0.123	0.109	0.115
9.5	0.114	0.120	0.117	0.116	0.121	0.123	0.119
9.8	0.116	0.113	0.113	0.114	0.110	0.117	0.118
10.1	0.109	0.109	0.108	0.106	0.108	0.104	0.106
10.4	0.119	0.117	0.126	0.123	0.121	0.121	0.129
10.7	0.136	0.136	0.140	0.133	0.139	0.139	0.141
11.0	0.113	0.119	0.113	0.122	0.125	0.117	0.111
11.3	0.104	0.104	0.104	0.102	0.105	0.104	0.101
11.6	0.126	0.125	0.128	0.129	0.125	0.123	0.129
11.9	0.142	0.137	0.130	0.139	0.129	0.131	0.130
12.2	0.114	0.119	0.113	0.115	0.108	0.117	0.107
12.5	0.106	0.104	0.109	0.103	0.107	0.106	0.102
12.8	0.123	0.126	0.121	0.122	0.125	0.129	0.139
13.1	0.141	0.140	0.145	0.147	0.146	0.143	0.147
13.4	0.130	0.129	0.126	0.132	0.136	0.140	0.132
13.7	0.125	0.118	0.119	0.129	0.124	0.121	0.118
14.0	0.114	0.113	0.111	0.115	0.115	0.116	0.110
14.3	0.114	0.106	0.111	0.109	0.109	0.104	0.111
14.6	0.121	0.129	0.122	0.129	0.124	0.135	0.128
14.9	0.136	0.129	0.128	0.129	0.129	0.122	0.129
15.2	0.119	0.108	0.120	0.113	0.120	0.111	0.114
15.5	0.102	0.102	0.108	0.106	0.105	0.109	0.105

Table 5. Preliminary computed volumetric water content from neutron logging in UE-29 UZN #92 --Continued

Depth below measurement point (m)	Computed volumetric water content (cm^3/cm^3)						
	Mar. 11, 1992	Apr. 2, 1992	Apr. 8, 1992	May 7, 1992	June 22, 1992	July 27, 1992	Aug. 26, 1992
15.8	0.136	0.142	0.142	0.142	0.143	0.142	0.140
16.1	0.126	0.126	0.122	0.119	0.127	0.121	0.124
16.4	0.121	0.118	0.119	0.130	0.124	0.125	0.129
16.7	0.125	0.122	0.125	0.128	0.130	0.131	0.127
17.0	0.135	0.141	0.133	0.139	0.131	0.133	0.128
17.3	0.132	0.130	0.132	0.134	0.132	0.131	0.131
17.6	0.135	0.131	0.138	0.132	0.132	0.132	0.126
17.9	0.133	0.127	0.128	0.124	0.124	0.121	0.120
18.2	0.121	0.128	0.116	0.123	0.120	0.117	0.118
18.5	0.169	0.167	0.171	0.168	0.169	0.173	0.177
18.8	0.184	0.182	0.196	0.175	0.172	0.183	0.186
19.1	0.170	0.170	0.169	0.166	0.174	0.158	0.153
19.4	0.128	0.141	0.143	0.131	0.137	0.136	0.132

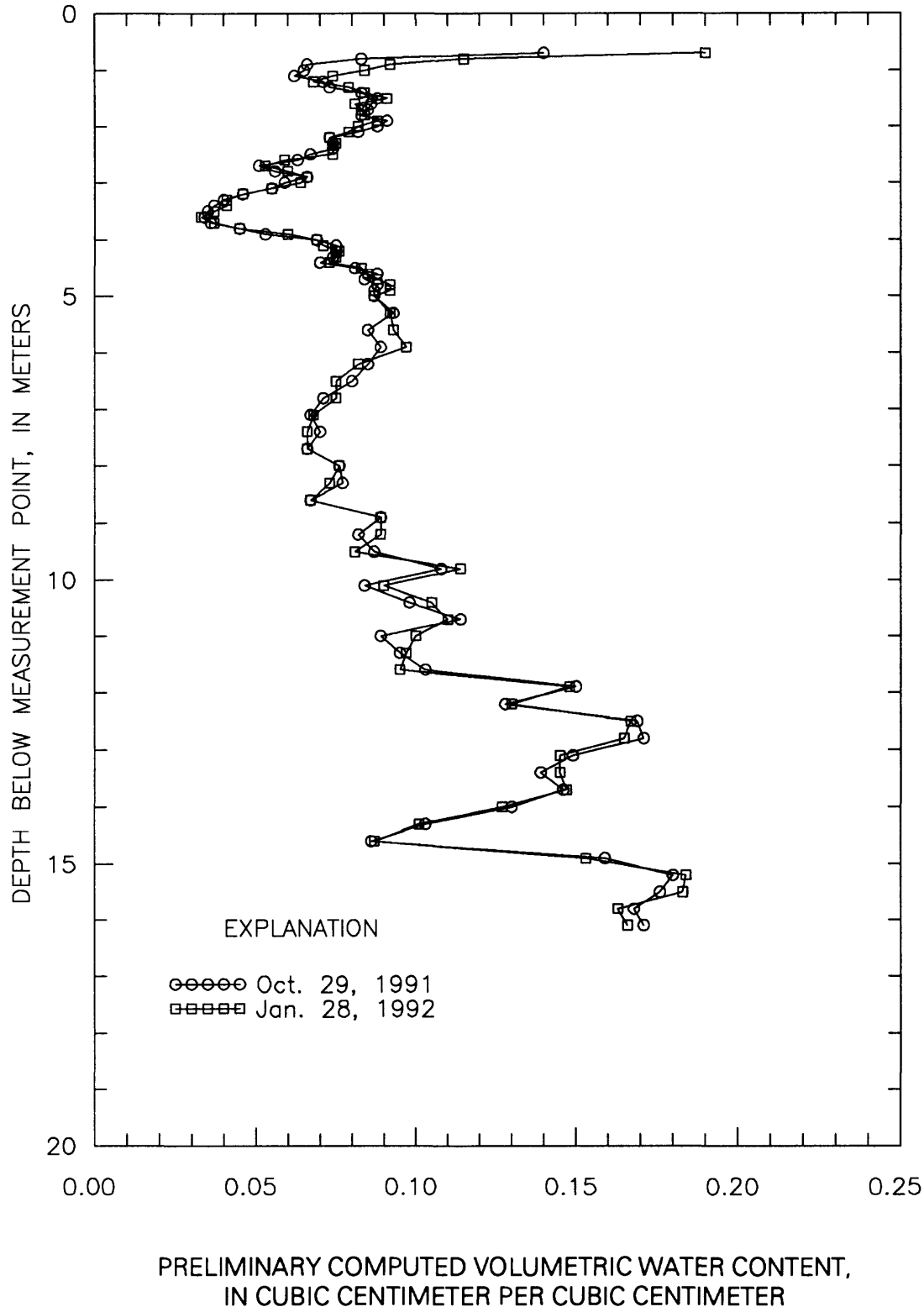

Figure 6. Preliminary computed volumetric water-content profiles for UE-29 UZN #91 for Oct. 29, 1991 and Jan. 28, 1992.

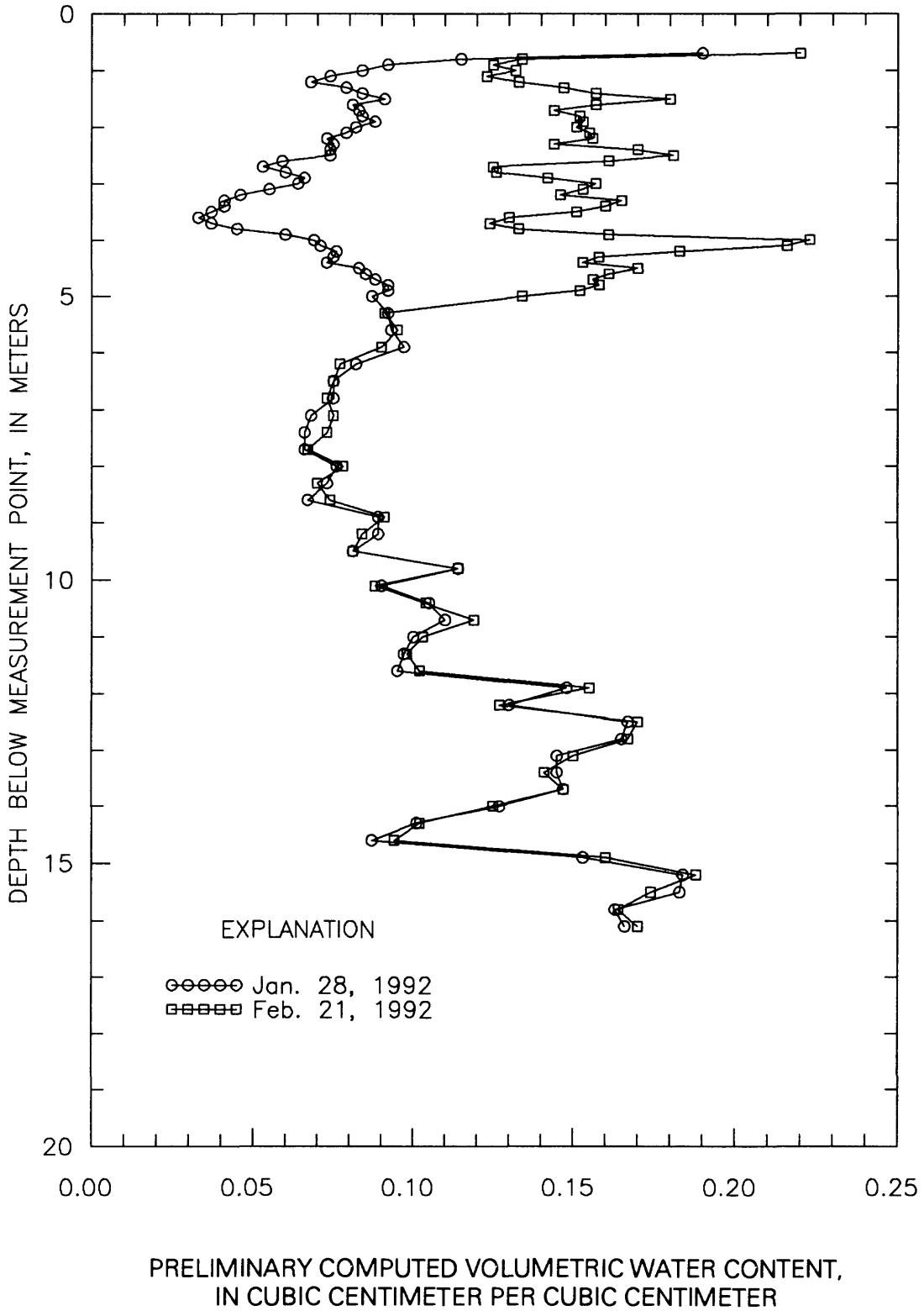

Figure 7. Preliminary computed volumetric water-content profiles for UE-29 UZN #91 for Jan. 28, 1992 and Feb. 21, 1992.

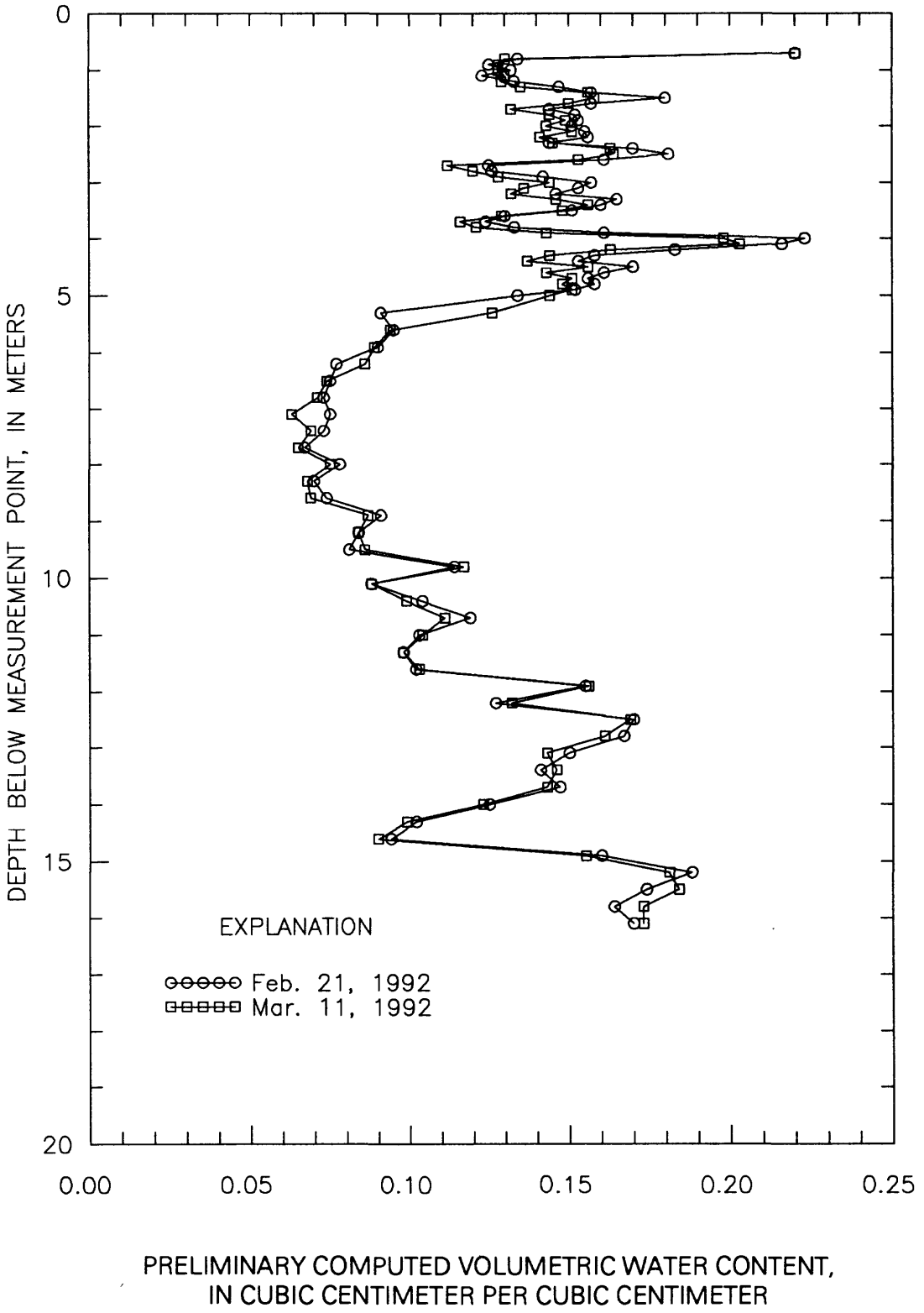

Figure 8. Preliminary computed volumetric water-content profiles for UE-29 UZN #91 for Feb. 21, 1992 and Mar. 11, 1992.

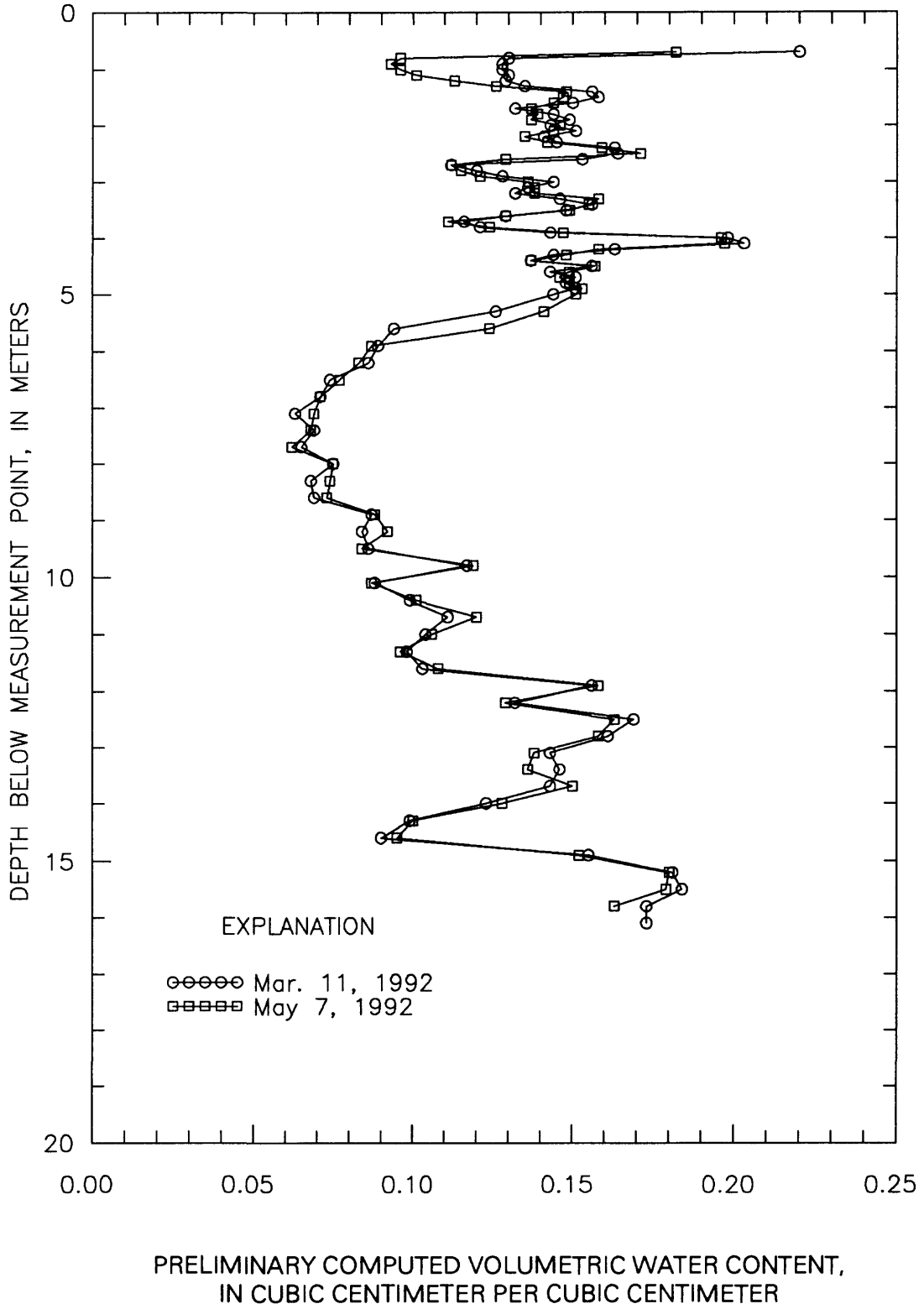

Figure 9. Preliminary computed volumetric water-content profiles for UE-29 UZN #91 for Mar. 11, 1992 and May 7, 1992.

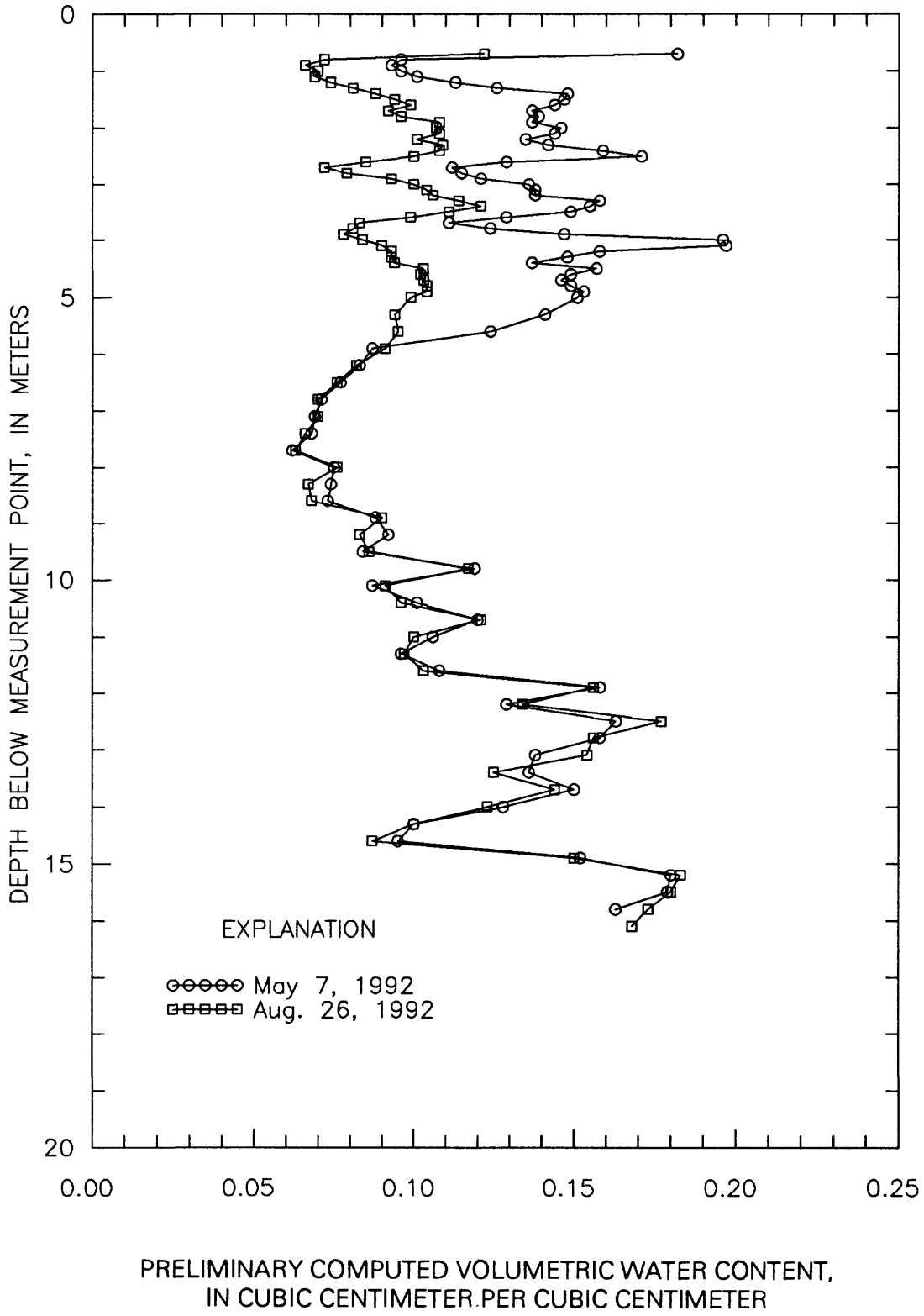

Figure 10. Preliminary computed volumetric water-content profiles for UE-29 UZN #91 for May 7, 1992 and Aug. 26, 1992.

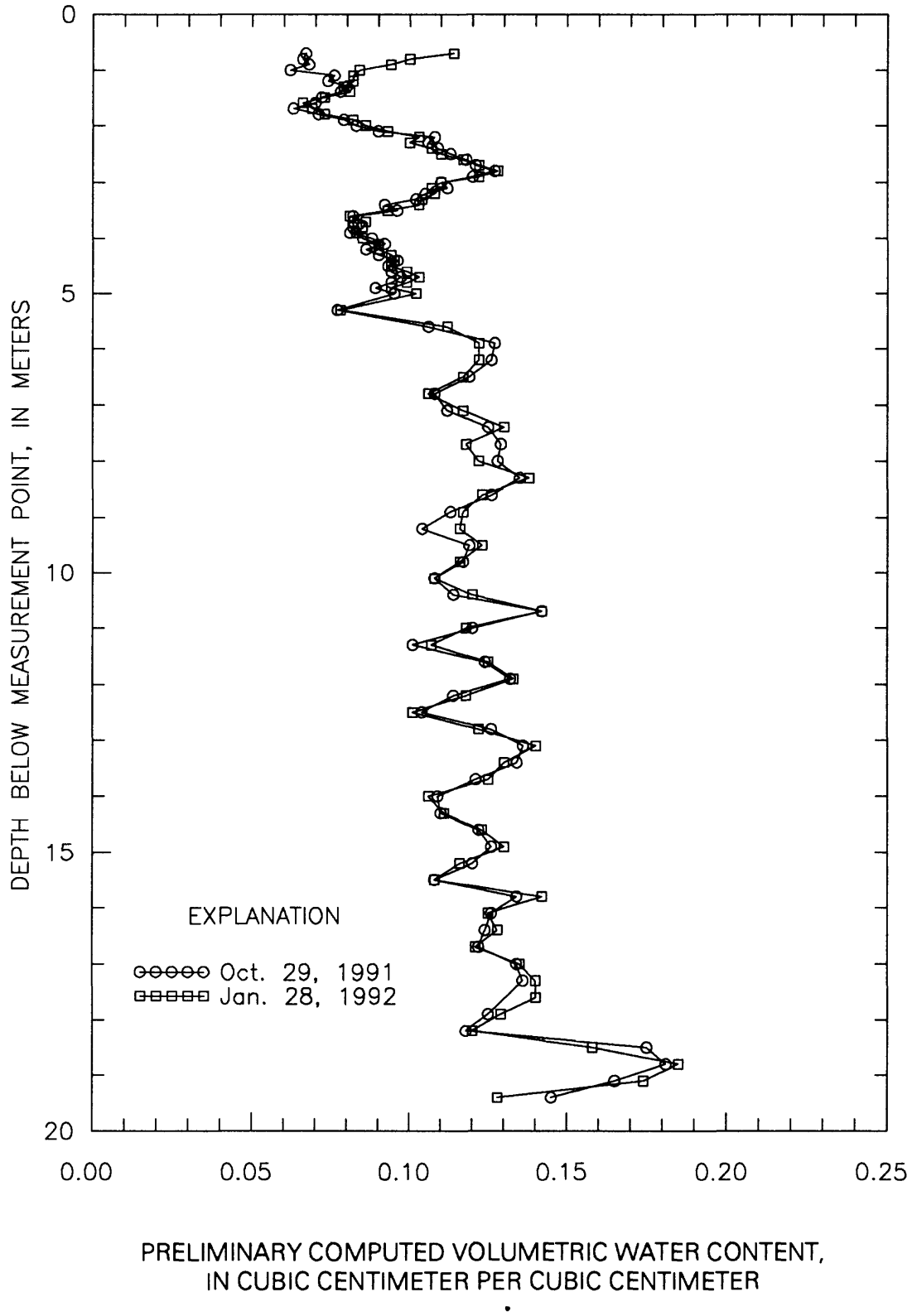

Figure 11. Preliminary computed volumetric water-content profiles for UE-29 UZN #92 for Oct. 29, 1991 and Jan. 28, 1992.

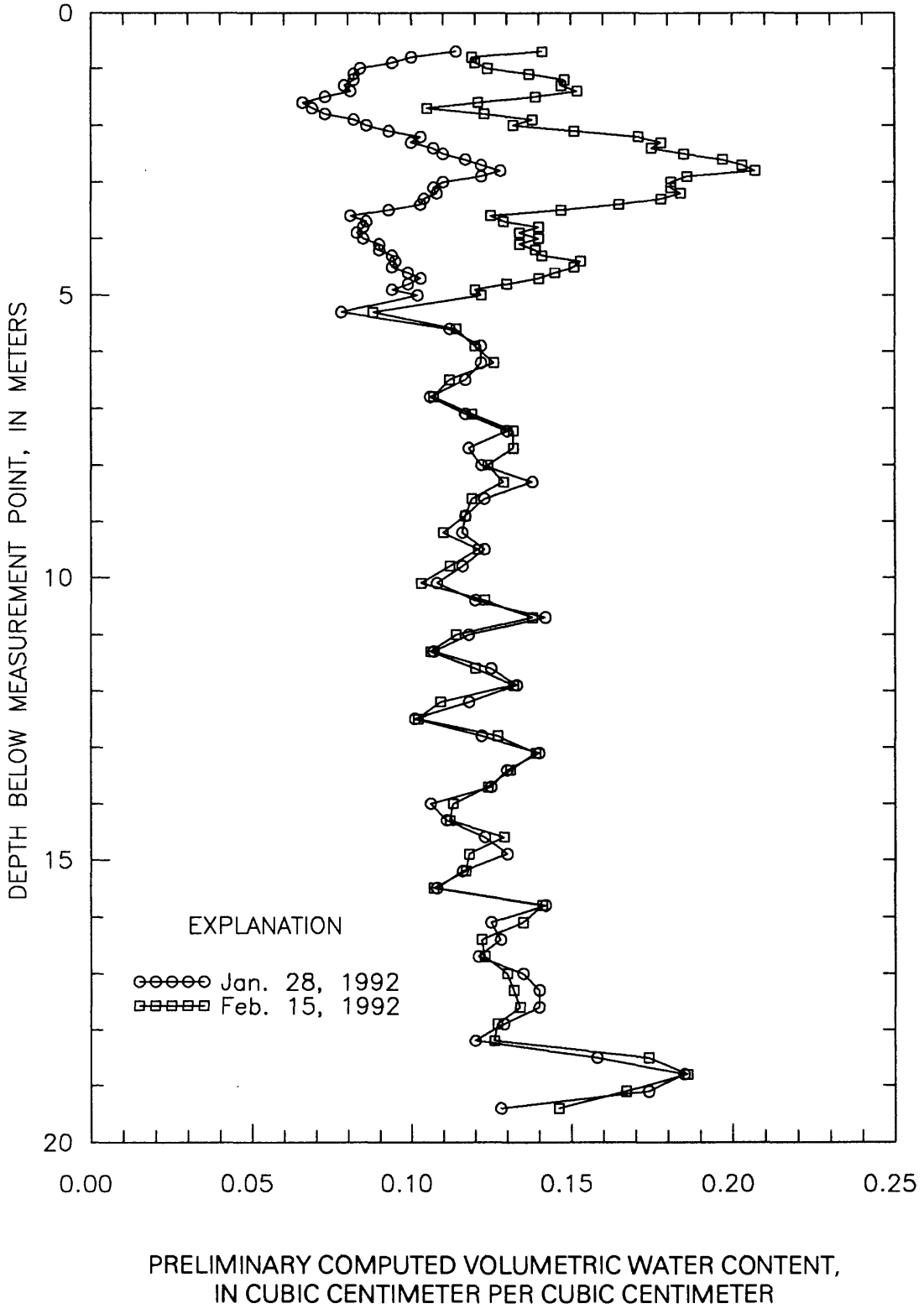

Figure 12. Preliminary computed volumetric water-content profiles for UE-29 UZN #92 for Jan. 28, 1992 and Feb. 15, 1992.

15 to March 11, the profile only had minor changes in the vertical water content (fig. 13). From March 11 to May 7, the profile decreased from 0.7 to 2.9 m and increased from 3.9 to 5.9 m (fig. 14). From May 7 to August 26, the profile decreased from 0.7 to 5.3 m (fig. 15). All profiles throughout the 1992 WY did not show any appreciable differences below 5.9 m.

DEPTH-TO-WATER DATA

Depth-to-water measurements were made in five wells, UE-29 a#1, UE-29 a#2, J-13, J-12, and JF-3, and one neutron-access borehole, UE-29 UZN #91, during the 1992 WY. These wells and the neutron-access borehole are either in or near Fortymile Wash. Depth-to-water measurements for J-12, J-13, and JF-3 were collected by other hydrologic studies in the Yucca Mountain Project and will not be reported in this report. JF-3 was drilled and completed during the 1992 WY. Water from aquifer testing in JF-3 was discharged during the WY into the Fortymile Wash channel near the well.

A measurement point was established at each well so successive depth-to-water measurements could be compared (table 6–8). The UE-29 a#1 measurement point is a scribed point on the top of the well cover, approximately 0.09 m above land surface. The UE-29 a#2 measurement point is a scribed point on the well cover, approximately 0.1 m above the land surface. The UE-29 UZN #91 measurement point is the top of the well casing with the cover removed, approximately 0.9 m above the land surface. The land surface around UE-29 UZN #91 is not stable due to erosion and deposition of stream sediments in the channel. Measurement point elevations are not known to an adequate accuracy so the depth-to-water measurements were not converted to an elevation with reference to mean sea level.

The measurements were made with a hand-held steel tape, an electric tape, or both. Both the steel tape and the electric tape use feet as a measurement scale. The steel tape measurements were made by lowering a chalked steel tape into the well and holding at a known depth on the tape. When the tape was removed from the well, the water cut was read. The water cut is the portion of the tape wetted by water in the well. Subtraction of the water cut from the hold is the depth to water for the well below the measurement point at the measurement time. The electric tape measurements were made by lowering the probe in the well until the contacts in the probe just touched the water. Depth to water could be read directly from markings on the electric tape. When both measurement techniques were used, the steel tape was the method used to report the depth-to-water measurement. Depth-to-water measurements were converted from feet to meters for reporting purposes.

Depth to water decreased after the February and March streamflow events in all three wells, indicating water levels rose. Water levels rose in UE-29 a#2 and UE-29 UZN #91 after the June 29 earthquake, but declined in UE-29 a#1. The measuring frequency was varied to document changes in the water levels (fig. 16–18). Water could be heard dripping in well UE-29 a#1 on April 2. Wells UE-29 a#1 and a#2 are only 10 m apart and have depth-to-water measurements that are generally 3 m different, with UE-29 a#1 having the smaller depth to water. This is because the wells are open to different intervals of the geologic strata. The depth to the open intervals of the wells are listed in table 3. Well UE-29 a#2 is open to the deepest interval of the three wells in the Pah Canyon area.

The highest water level in UE-29 a#1 was on April 16, when a depth to water of 25.46 m was measured. The lowest water level was on September 25 when a depth to water of 27.02 m was measured. The observed range in water level was 1.56 m for the water year. The highest water level measured in March was on March 2, nineteen days after the February 12 streamflow event. The highest water level measured in April was on April 16, sixteen days after the March 31 streamflow event. The water level declined 1.46 m during June 22 to 29, coinciding with the magnitude 5.6 earthquake at Little Skull Mountain on June 29, 27 km to the southwest.

The highest water level in UE-29 a#2 was on April 20 when a depth to water of 28.32 m was measured. The lowest water level was on January 13 when a depth to water of 29.33 m was measured. The observed range in water level was 1.01 m for the water year. The highest water level measured in March was on March 2, nineteen days after the February 12 streamflow event. The highest water level measured in April was on April 20, twenty days after the March 31 streamflow event. The water level rose 0.20 m during June 22 to 29, coinciding with the Little Skull Mountain earthquake on June 29.

The highest water levels in UE-29 UZN #91 were on April 30, July 1 and 2, when a depth to water of 16.93 m was measured. The lowest water level was on January 13, when a depth to water of 17.59 m was measured. The observed range in water level was 0.66 m for the water year. The highest water level measured in March was during the period March 16 to 30, thirty-three days after the February 12 streamflow event. The highest water level measured in April was on April 30, thirty days after the March 31 streamflow event. The water level rose 0.15 m during June 22 to

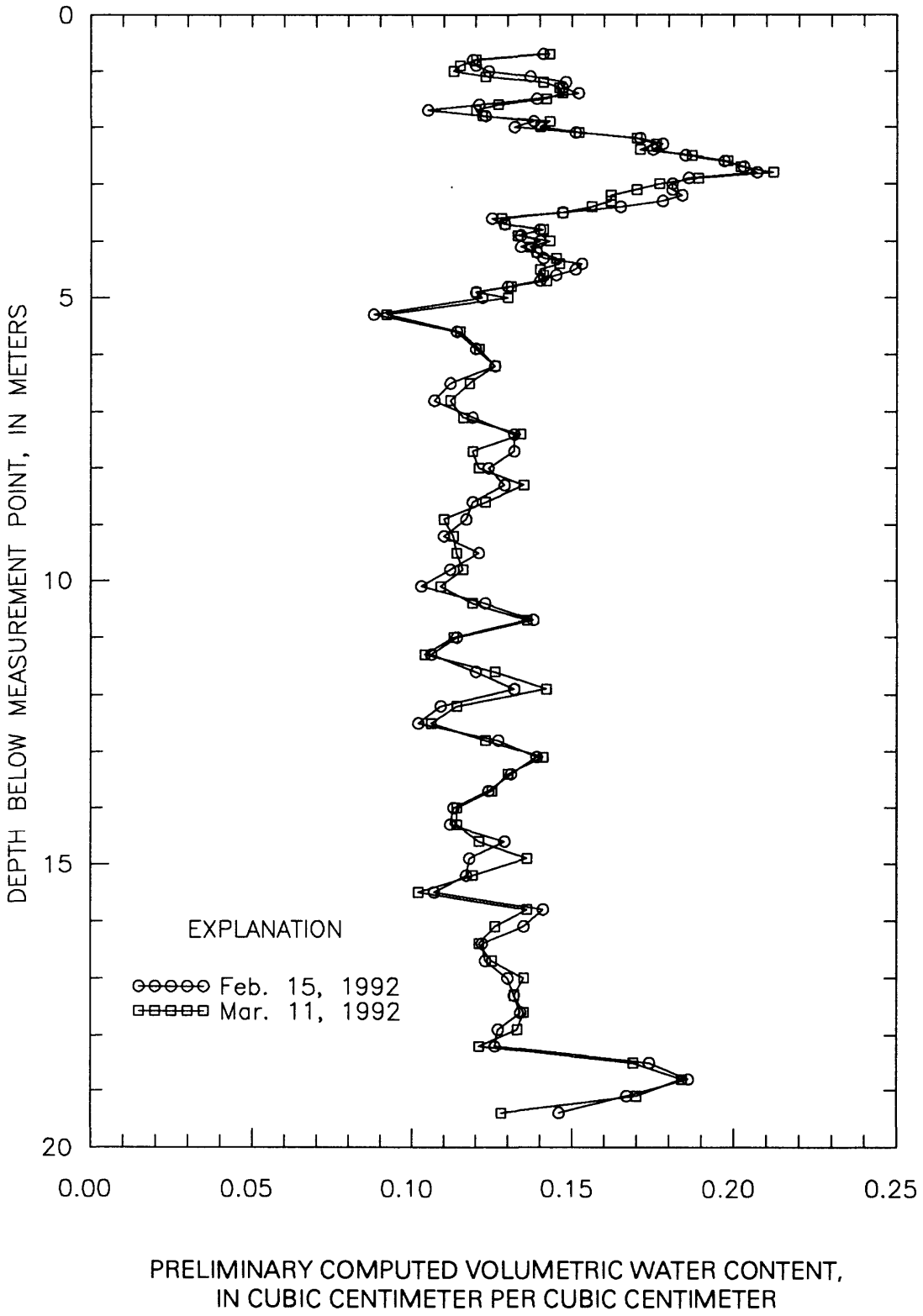

Figure 13. Preliminary computed volumetric water-content profiles for UE-29 UZN #92 for Feb. 15, 1992 and Mar. 11, 1992.

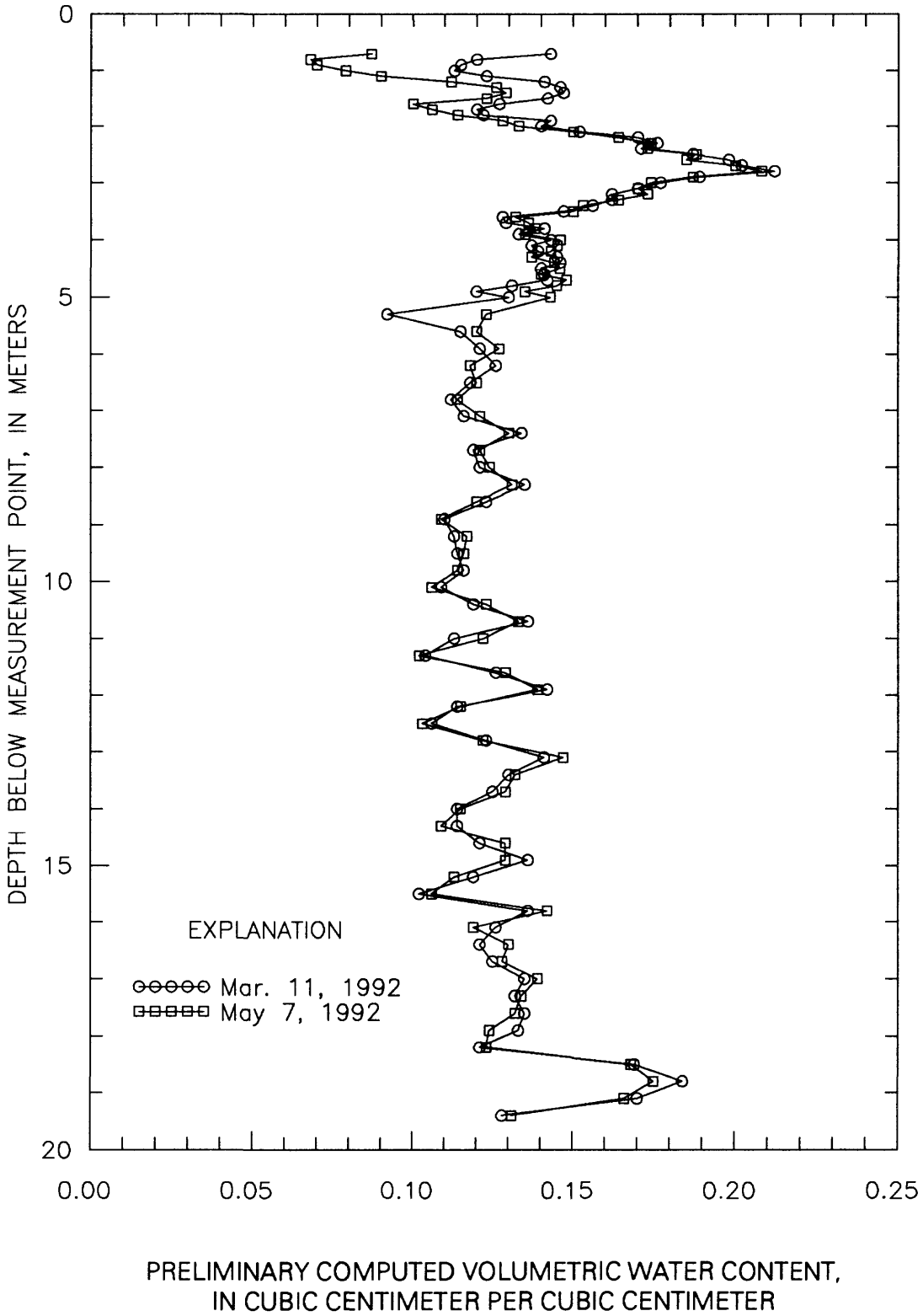

Figure 14. Preliminary computed volumetric water-content profiles for UE-29 UZN #92 for Mar. 11, 1992 and May 7, 1992.

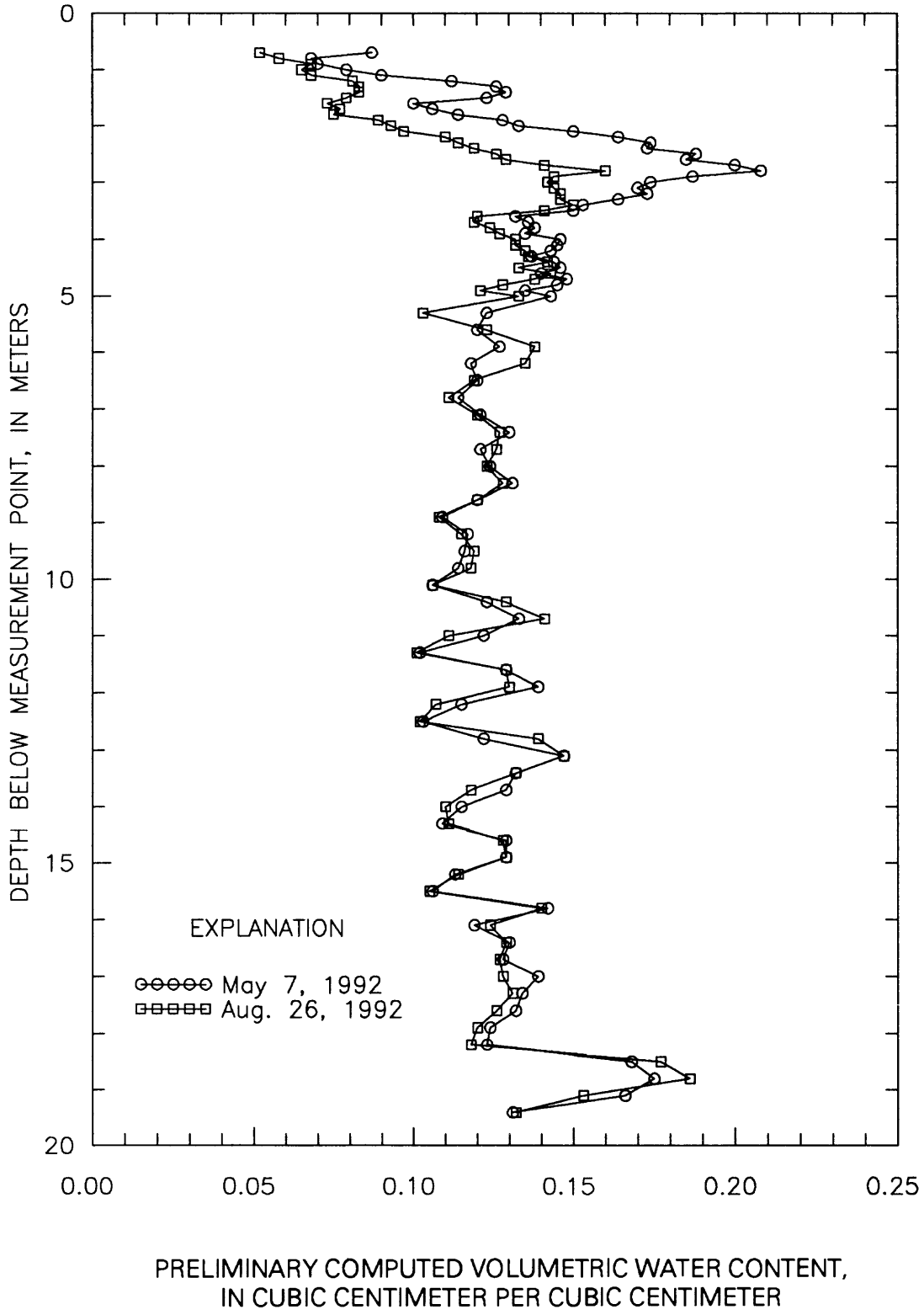

Figure 15. Preliminary computed volumetric water-content profiles for UE-29 UZN #92 for May 7, 1992 and Aug. 26, 1992.

Table 6. Depth-to-water measurements in UE-29 a#1

[m, meter; S, steel tape; E, electric tape]

Date	Time	Depth to water below measuring point (m)	Method	Date	Time	Depth to water below measuring point (m)	Method
Jan. 13, 1992	1128	26.81	S	May 29, 1992	1346	25.78	E
Feb. 25, 1992	1024	25.62	S	June 9, 1992	1447	25.87	E
Mar. 2, 1992	1345	25.58	E	June 15, 1992	1043	25.90	E
Mar. 4, 1992	1440	25.61	S	June 22, 1992	1119	25.94	E
Mar. 5, 1992	1308	25.63	E	June 29, 1992	1029	26.48	E
Mar. 6, 1992	1253	25.63	E	June 30, 1992	1020	26.50	E
Mar. 9, 1992	1045	25.67	E	July 1, 1992	1135	26.52	E
Mar. 11, 1992	1439	25.70	E	July 2, 1992	0942	26.55	E
Mar. 13, 1992	1033	25.73	E	July 6, 1992	0928	26.59	E
Mar. 16, 1992	1342	25.73	E	July 9, 1992	1004	26.64	E
Mar. 23, 1992	0947	25.83	E	July 13, 1992	0947	26.66	E
Mar. 30, 1992	1143	25.90	E	July 16, 1992	1131	26.67	E
Mar. 31, 1992	1026	25.88	E	July 27, 1992	1123	26.74	E
Apr. 2, 1992	1253	25.87	E	Aug. 3, 1992	1358	26.77	E
Apr. 8, 1992	1208	25.57	E	Aug. 10, 1992	1152	26.82	E
Apr. 16, 1992	1112	25.46	E	Aug. 17, 1992	1106	26.86	E
Apr. 20, 1992	1122	25.48	E	Aug. 26, 1992	1213	26.93	S
Apr. 23, 1992	1038	25.50	E	Sep. 9, 1992	1045	26.97	S
Apr. 27, 1992	1117	25.55	E	Sep. 15, 1992	0955	26.97	S
Apr. 30, 1992	1137	25.53	E	Sep. 25, 1992	1107	27.02	E
May 4, 1992	1310	25.59	E				
May 7, 1992	1159	25.62	E				
May 18, 1992	1050	25.74	E				
May 21, 1992	1115	25.74	E				
May 26, 1992	1146	25.75	E				

Table 7. Depth-to-water measurements in UE-29 a#2

[m, meter; S, steel tape; E, electric tape]

Date	Time	Depth to water below measuring point (m)	Method	Date	Time	Depth to water below measuring point (m)	Method
Jan. 13, 1992	1113	29.33	S	May 29, 1992	1343	28.50	E
Feb. 25, 1992	1005	28.67	S	June 9, 1992	1445	28.54	E
Mar. 2, 1992	1340	28.51	E	June 15, 1992	1040	28.59	E
Mar. 4, 1992	1434	28.52	S	June 22, 1992	1116	28.62	E
Mar. 5, 1992	1305	28.54	E	June 29, 1992	1027	28.42	E
Mar. 6, 1992	1250	28.55	E	June 30, 1992	1017	28.37	E
Mar. 9, 1992	1043	28.57	E	July 1, 1992	1133	28.39	E
Mar. 11, 1992	1437	28.56	E	July 2, 1992	0940	28.38	E
Mar. 13, 1992	1031	28.57	E	July 6, 1992	0926	28.41	E
Mar. 16, 1992	1340	28.54	E	July 9, 1992	1002	28.46	E
Mar. 23, 1992	0945	28.62	E	July 13, 1992	0936	28.47	E
Mar. 30, 1992	1140	28.64	E	July 16, 1992	1129	28.48	E
Mar. 31, 1992	1024	28.65	E	July 27, 1992	1121	28.57	E
Apr. 2, 1992	1250	28.61	E	Aug. 3, 1992	1355	28.55	E
Apr. 8, 1992	1204	28.41	E	Aug. 10, 1992	1150	28.63	E
Apr. 16, 1992	1110	28.34	E	Aug. 17, 1992	1100	28.65	E
Apr. 20, 1992	1120	28.32	E	Aug. 26, 1992	1206	28.72	S
Apr. 23, 1992	1035	28.35	E	Sep. 9, 1992	1036	28.75	S
Apr. 27, 1992	1114	28.36	E	Sep. 15, 1992	0950	28.74	S
Apr. 30, 1992	1135	28.35	E	Sep. 25, 1992	1104	28.83	E
May 4, 1992	1308	28.40	E				
May 7, 1992	1157	28.41	E				
May 18, 1992	1048	28.48	E				
May 21, 1992	1112	28.46	E				
May 26, 1992	1142	28.48	E				

Table 8. Depth-to-water measurements in UE-29 UZN #91

[m, meter; S, steel tape; E, electric tape]

Date	Time	Depth to water below measuring point (m)	Method	Date	Time	Depth to water below measuring point (m)	Method
Jan. 13, 1992	1149	17.59	S	May 18, 1992	1037	16.98	E
Jan. 28, 1992	1143	17.58	S	May 21, 1992	1102	16.98	S
Feb. 21, 1992	1245	17.31	S	May 26, 1992	1130	17.00	S
Feb. 25, 1992	1041	17.25	S	May 29, 1992	1329	17.00	S
Feb. 25, 1992	1455	17.22	S	June 9, 1992	1440	17.03	S
Mar. 2, 1992	1245	17.14	S	June 15, 1992	1028	17.05	S
Mar. 4, 1992	1418	17.12	S	June 22, 1992	1023	17.08	S
Mar. 5, 1992	1234	17.12	S	June 29, 1992	1020	17.00	S
Mar. 6, 1992	1151	17.11	S	June 30, 1992	1009	16.94	S
Mar. 9, 1992	1031	17.11	S	July 1, 1992	1126	16.93	S
Mar. 11, 1992	1348	17.10	S	July 2, 1992	0930	16.93	S
Mar. 13, 1992	1023	17.10	S	July 6, 1992	0919	16.95	S
Mar. 16, 1992	1330	17.09	S	July 9, 1992	0955	16.97	S
Mar. 23, 1992	0935	17.09	S	July 13, 1992	0920	16.99	S
Mar. 30, 1992	1130	17.09	S	July 16, 1992	1120	17.00	S
Mar. 31, 1992	1017	17.10	E	July 27, 1992	1030	17.05	S
Apr. 2, 1992	1135	17.09	S	Aug. 3, 1992	1343	17.07	S
Apr. 8, 1992	1111	17.02	S	Aug. 10, 1992	1139	17.10	S
Apr. 16, 1992	1100	16.96	S	Aug. 17, 1992	1050	17.12	S
Apr. 20, 1992	1111	16.94	S	Aug. 26, 1992	1045	17.15	S
Apr. 23, 1992	1024	16.94	S	Sep. 9, 1992	1024	17.18	S
Apr. 27, 1992	1104	16.94	S	Sep. 15, 1992	0939	17.20	S
Apr. 30, 1992	1125	16.93	S	Sep. 25, 1992	1052	17.22	S
May 4, 1992	1245	16.95	S				
May 7, 1992	1100	16.95	S				

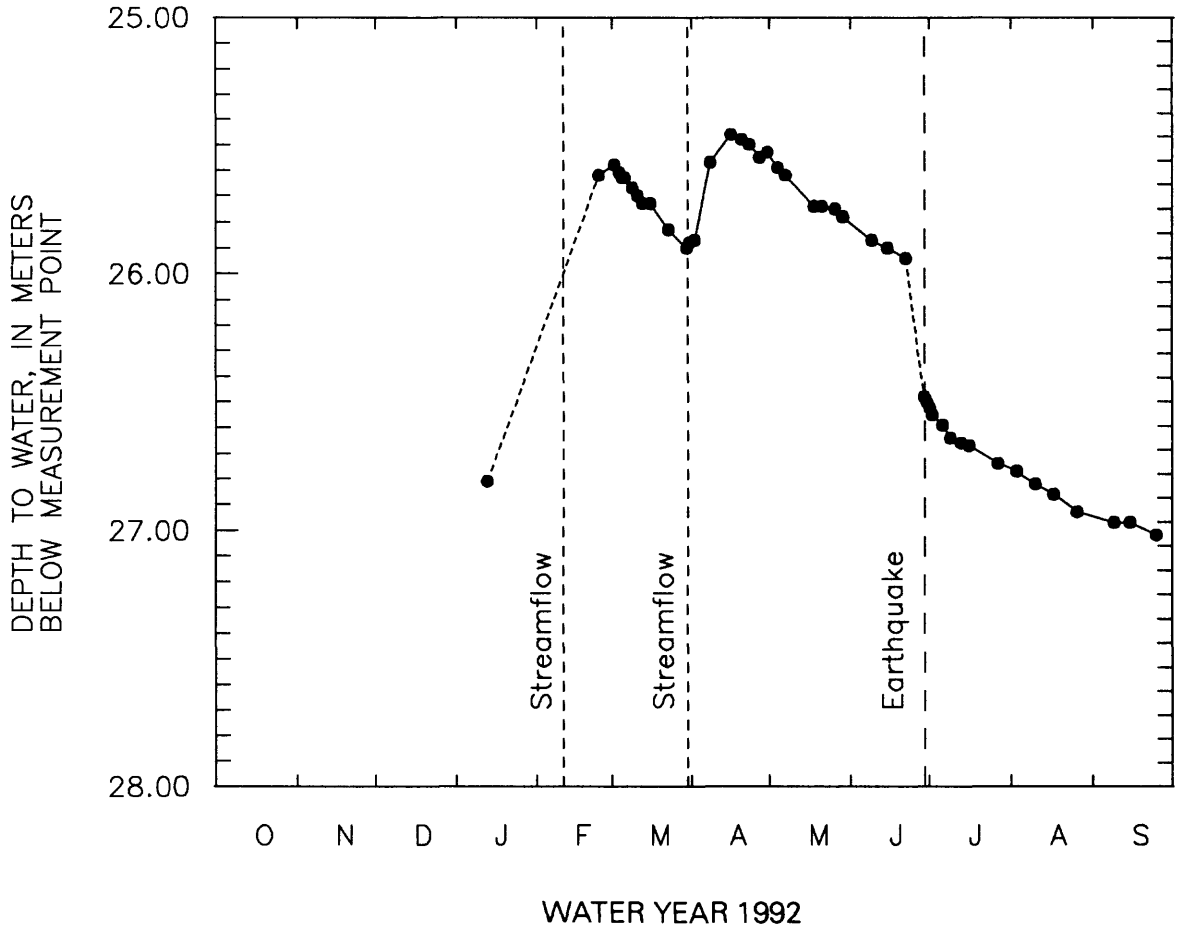

Figure 16. Depth-to-water measurements in UE-29 a#1.

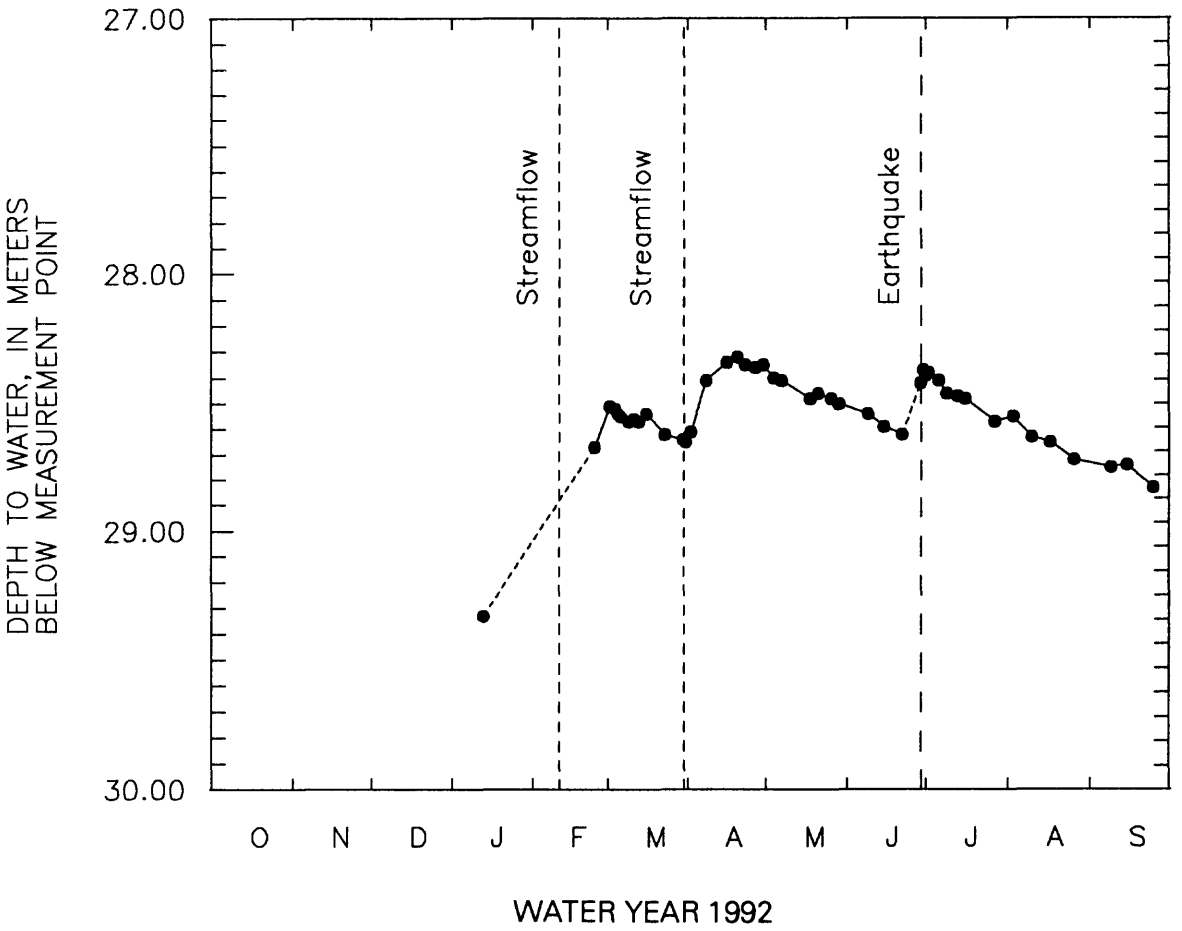

Figure 17. Depth-to-water measurements in UE-29 a#2.

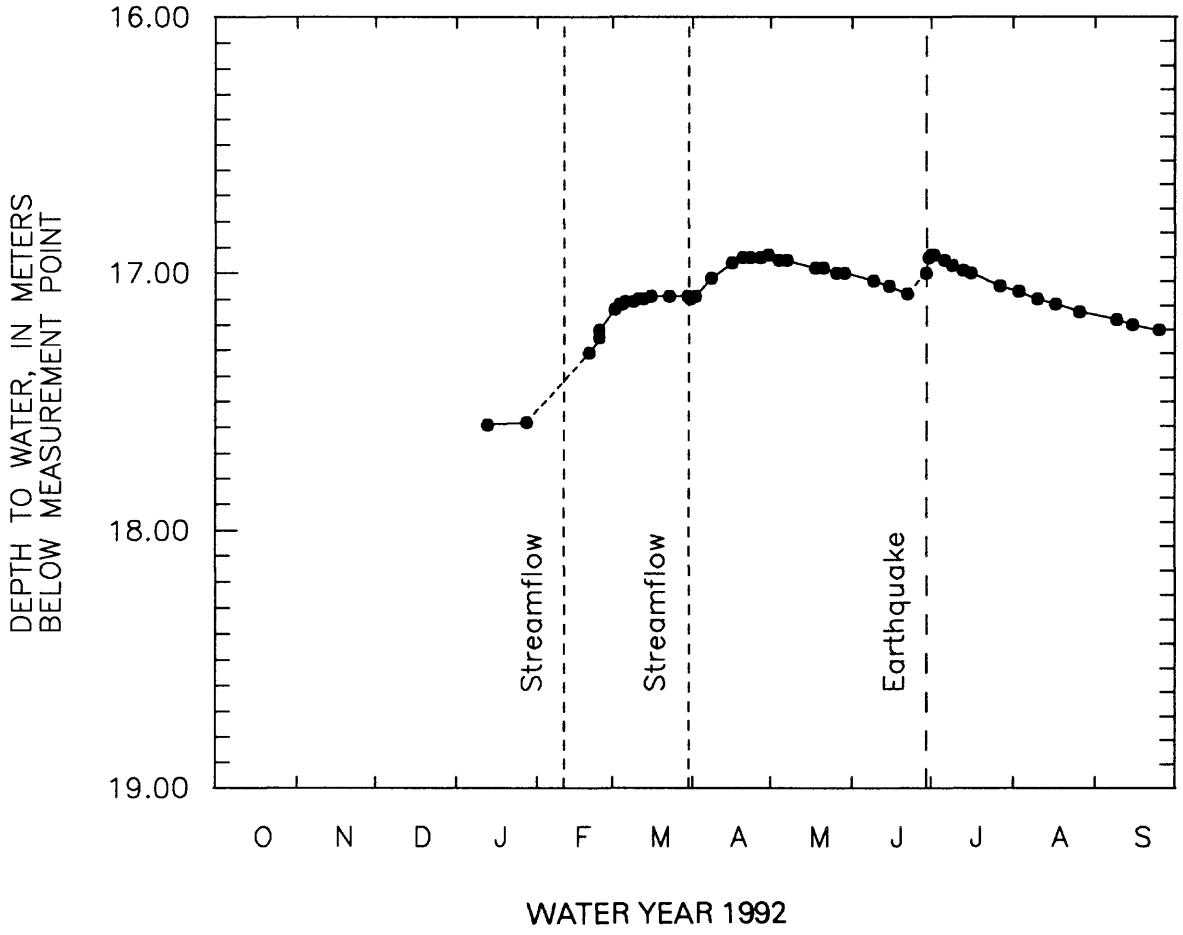

Figure 18. Depth-to-water measurements in UE-29 UZN #91.

July 1, coinciding with the Little Skull Mountain earthquake on June 29.

QUALITY ASSURANCE

Data in this report will be used in the evaluation of the suitability of the Yucca Mountain site for a potential high-level nuclear-waste repository. Confidence in the reliability of collection, processing, and reporting of the hydrologic data is necessary so the data may be used with confidence to assess the expected performance of the potential repository. A quality-assurance program has been implemented to support the reliability of the data. The precipitation data collected with the rain wedges reported in this report were not collected under a quality-assurance program. The neutron-logging and water-level data were all collected under a quality-assurance program.

The neutron-logging profiles and water-level measurements were obtained by methods described by formal technical procedures as required by the U.S. Geological Survey Yucca Mountain Project quality-assurance program. The technical procedures included tests and adjustments done during the measuring operation to ensure the equipment was operating properly and the expected precision and accuracy were attained. For example, the technical procedure to neutron log a borehole specified how to perform standardization tests, log the borehole, and process the data.

HYDROLOGIC SUMMARY

From October to late December 1991, there was a small amount of precipitation in the Fortymile Wash drainage basin. No streamflow was observed, and neutron logging indicated no precipitation was infiltrating. From late December until early April, 1992, precipitation occurred from a series of regional storms. Localized streamflow occurred in the Pah Canyon, Delirium Canyon, and Yucca Wash drainage basins of the Fortymile Wash drainage basin with some streamflow going into the main Fortymile Wash channel during February 12–14 and March 31. The streamflow infiltrated into the streambed sediments to a depth of 5 meters at two neutron-access borehole locations. The moisture from the streamflow events then redistributed when moisture contents in the upper 5 m of the boreholes decreased, and from 5.0 to 5.9 m increased. Ground-water levels rose at wells UE-29 a#1 and UE-29 a#2 and neutron-access borehole UE-29 UZN #91 after each streamflow event for approximately two weeks, and then began a steady decline.

From late April to September 1992, there were only small amounts of precipitation, and no streamflow was observed. The moisture in the vertical profiles continued to redistribute from April to May, when moisture contents in the upper 5 m of the borehole decreased, and from 5.0 to 5.9 m increased. From May to September, the moisture content of the entire vertical profiles decreased. Ground-water levels decreased from April to September, except for a shift coinciding with the June 29 earthquake at Little Skull Mountain.

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