POTENTIAL HAZARDS FROM FLOOD IN PART OF THE CHALONE CREEK AND BEAR VALLEY DRAINAGE BASINS, PINNACLES NATIONAL MONUMENT, CALIFORNIA

By Robert W. Meyer

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Conversion Factors

Multiply	By	To obtain
foot (ft)	0.3048	meter
cubic foot per second (ft^3/s)	0.02832	cubic meter per second
inch (in.)	25.40	millimeter
mile (mi)	1.609	kilometer
square mile (mi^2)	2.590	square kilometer

Vertical Datum

In this report, elevations are referenced to an arbitrary local datum represented by National Park Service benchmarks KL-1, KL-2, and KL-3 along Old Pinnacles Campground Road and State Highway 146.

POTENTIAL HAZARDS FROM FLOOD IN PART OF THE CHALONE CREEK AND BEAR VALLEY DRAINAGE BASINS, PINNACLES NATIONAL MONUMENT, CALIFORNIA

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Abstract

Areas of Chalone Creek and Bear Valley drainage basins in Pinnacles National Monument, California, are subject to frontal storms that can cause major flooding from November to April in areas designated for public use. To enhance visitor safety and to protect cultural and natural resources, the U.S. Geological Survey in cooperation with the National Park Service studied flood-hazard potentials within the boundaries of the Pinnacles National Monument. This study area extends from about a quarter of a mile north of Chalone Creek Campground to the mouth of Bear Valley and from the east monument entrance to Chalone Creek.

Historical data of precipitation and flood-flow within the monument area are sparse to nonexistent, therefore, U.S. Soil Conservation Service unit-hydrograph procedures were used to determine the magnitude of a 100-year flood. Because of a lack of specific storm-rainfall data, a simulated storm was applied to the basins using a digital-computer model developed by the Soil Conservation Service. A graphical relation was used to define the regionally based maximum flood for Chalone Creek and Bear Valley. Water-surface elevations and inundation areas were determined using a conventional step-backwater program. Flood-zone boundaries were derived from the computed water-surface elevations.

The 100-year flood plain for both streams would be inundated at all points by the regional maximum flood. Most of the buildings and proposed building sites in the monument area are above the elevation of the 100-year flood, except the proposed building sites near the horse corral and the east monument entrance. The 100-year flood may cause reverse flow through a 12-inch culvert embedded in the embankment of Old Pinnacles Campground Road in the center of Chalone Creek Campground. The likelihood of this occurring is dependant upon the amount of aggradation that occurs upstream; therefore, the campground area also is considered to be within the 100-year flood zone.

INTRODUCTION

Pinnacles National Monument in California is a scenic area used for public recreation. Over the years, a monument headquarters, campgrounds, and picnic areas were built to accommodate increased visitor use. From November to April the area is subject to frontal storms that can cause major flooding in areas designated for public use. To enhance visitor safety and protect cultural and natural resources, the U.S. Geological Survey in 1985, in cooperation with the National Park Service, Water Resources Division, Western Regional Office, studied the flood-hazard potential in the Chalone Creek and Bear Valley drainage basins within the boundaries of the Pinnacles National Monument.

The flood-hazard potential in the basins was evaluated from about a quarter of a mile north of Chalone Creek Campground to the mouth of Bear Valley and from the eastern monument boundary to Chalone Creek. Sites of specific interest were (1) Chalone Creek Campground and picnic areas, (2) horse corral area (site of proposed improvement), (3) the bridge spanning Chalone Creek, and (4) other proposed building sites (fig. 1).

Streamflow records and peak-discharge data were not available for Chalone Creek and Bear Valley drainage basins, so flood frequency and magnitude were estimated using standard U.S. Soil Conservation Service unit-hydrograph procedures. Because of the lack of specific storm-rainfall data, a storm was simulated over the basins using a digital-computer model, TR-20, developed by the U.S. Soil

Conservation Service. Possible inundated areas and water-surface elevation profiles for the 100-year and maximum flood (Q_{me}) for Chalone Creek and Bear Valley drainage basins were computed using a

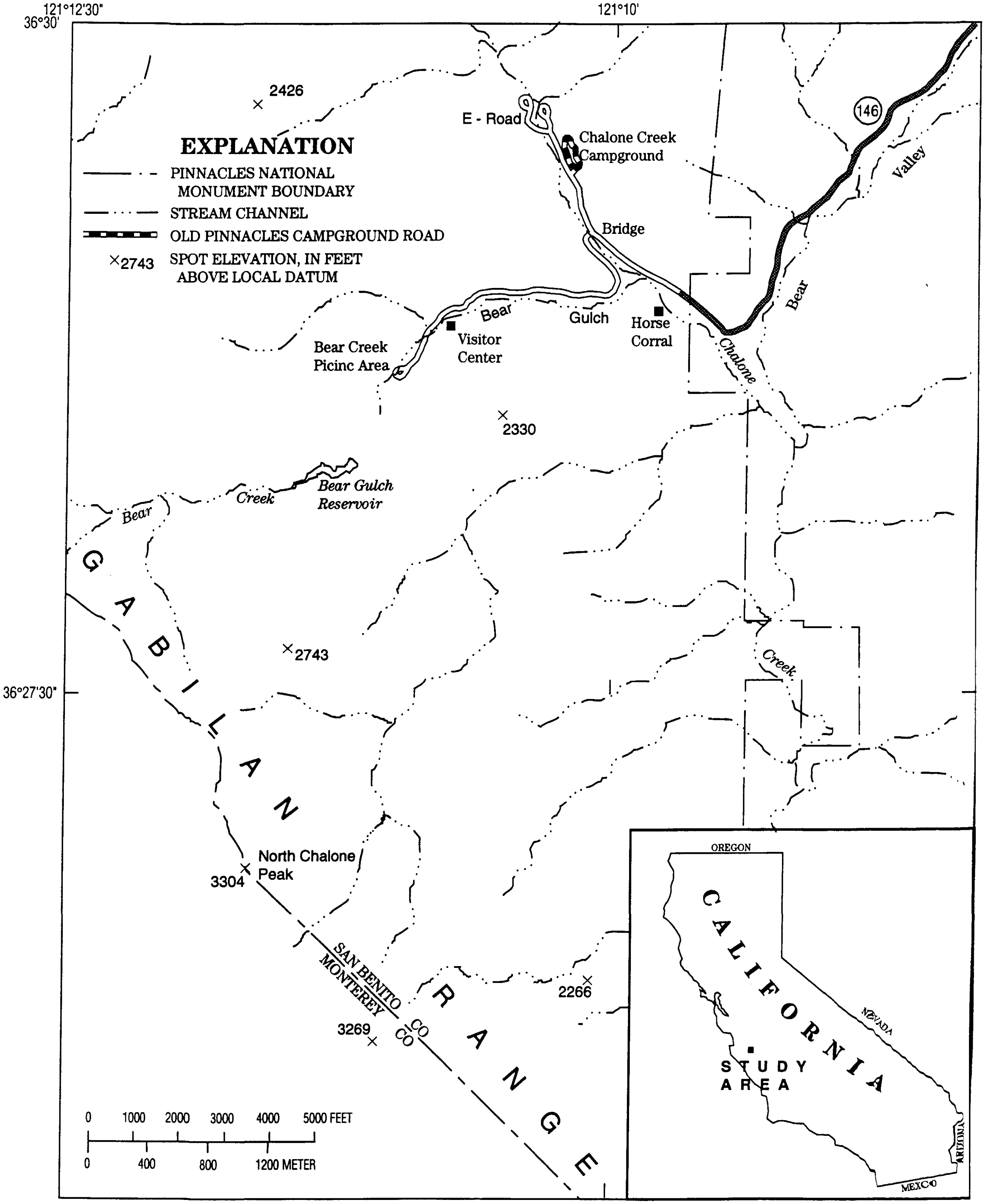

Figure 1. Location of Pinnacles National Monument and Chalone Creek and Bear Valley.

conventional step-backwater program. Flood-zone boundaries were derived from the computed water-surface elevations (pl. 1).

DESCRIPTION OF DRAINAGE BASINS

Pinnacles National Monument includes about 23 mi^2 in west-central California. The monument is in the Gabilan Range, a part of the Coast Ranges (fig. 1). The terrain is steep and rugged. The geohydrologic units described by Akers (1967) are subdivided into three main groups: (1) granitic and metamorphic rocks, (2) volcanic rocks, and (3) sedimentary rocks. Most of the Pinnacles National Monument area is underlain by volcanic rocks, except the western and southeastern areas of the monument, which are underlain principally by granitic rocks.

The locations of surveyed cross sections in the Pinnacles National Monument area are shown in figure 2. Estimated flood elevations are shown in figures 7 and 8 (at back of report). Elevations in the Chalone Creek drainage basin range from 906 ft above sea level at cross section 1 on Chalone Creek to 3,304 ft at North Chalone Peak. Elevations of the Chalone Creek channel bed range from 906 ft at cross section 1 to 1,036 ft at cross section 26 upstream from Chalone Creek Campground. Bear Valley channel-bed elevations range from 906 ft at cross section 1 to 996 ft at cross section 16*A* (fig. 2).

PRECIPITATION

Annual precipitation within the Pinnacles National Monument area averages 14 in. Precipitation in the surrounding mountains is considerably higher than precipitation in the Chalone Creek-Bear Valley drainage area. Although most of the rainfall occurs during the winter months, high-intensity thunderstorms of short duration occasionally occur during

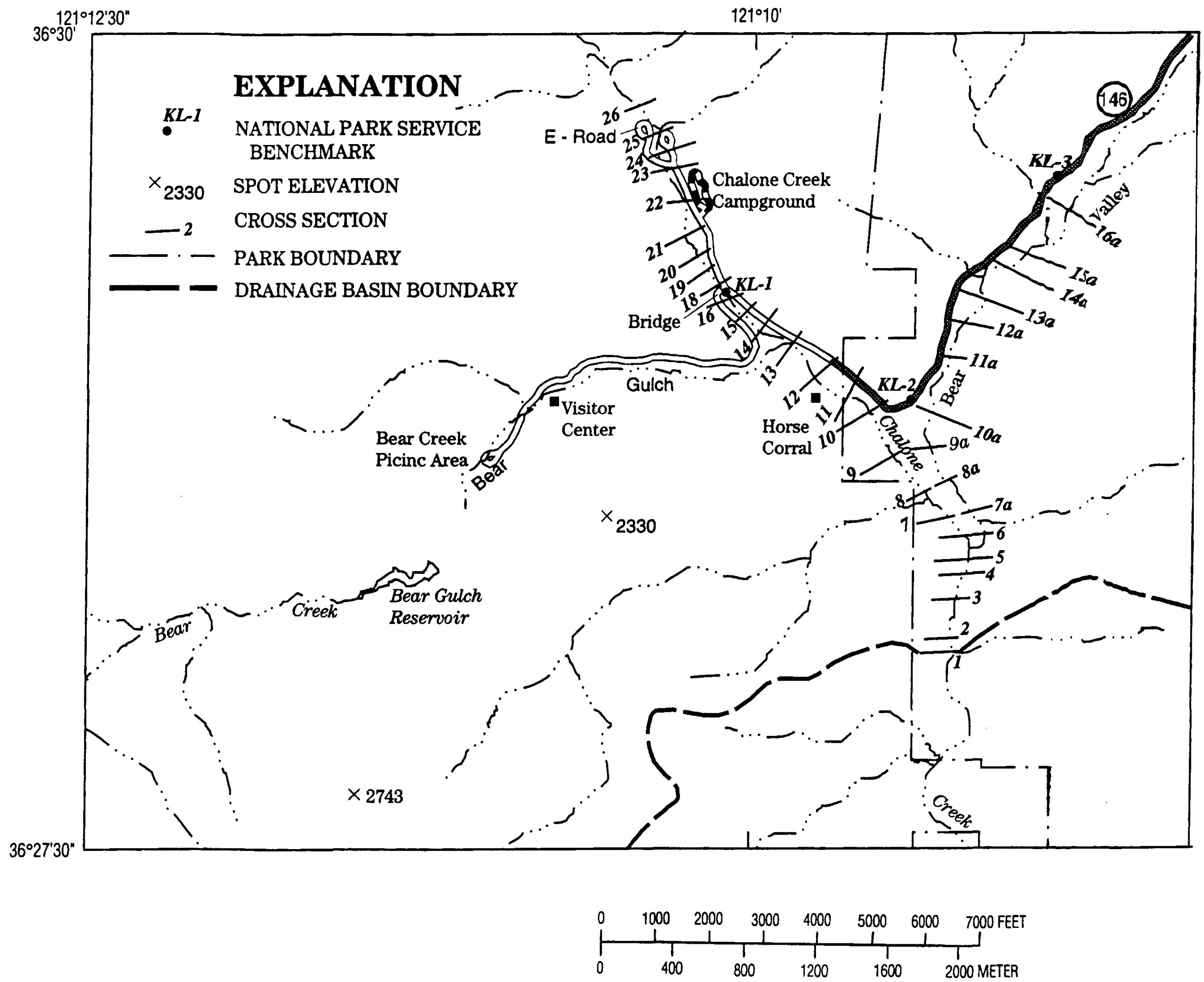

Figure 2. Location of surveyed cross sections along Chalone Creek and Bear Valley.

the summer months. There is little or no snowfall in the area. The average elevation for precipitation stations surrounding the monument area is about 1,100 ft above sea level. The data from these stations indicate that a 100-year storm in this area would produce about 4.8 to 5.0 in. of rainfall. Most of the monument area exceeds the average elevation of the precipitation stations; therefore, the precipitation data are assumed to be slightly low estimates of a 100-year, 24-hour rainfall. The National Oceanic and Atmospheric Administration atlas (Miller and others, 1973) indicates a 100-year rainfall between 5 and 7 in. within the monument boundary. An average of local rainfall and the National Oceanic and Atmospheric Administration regional values was determined to be 5.5 in. for the 100-year rainfall.

FLOOD HYDROLOGY

Because streamflow records and peak-discharge data are not available for Chalone Creek and Bear Valley drainage basins, flood frequency and magnitude were estimated using standard U.S. Soil Conservation Service unit-hydrograph procedures (Mockus, 1969). Regional flood frequency and magnitude equations (Waananen and Crippen, 1977) were not used because of the unique (nonregional) geohydrologic characteristics of the monument. Throughout most of the region, soils are well developed and pervious. In many places within the monument, soil is nonexistent or very shallow. It was assumed that the runoff pattern within the monument is very different from the surrounding region. Further, a great part of the region is rolling hills and flat land, whereas the monument area has abrupt, steep changes in elevation. Due to the lack of soils and steepness of the terrain, it was assumed considerably more runoff would occur than the regional equation would predict.

Because of a lack of specific storm-rainfall data, a storm was simulated over the basins using the TR-20 computer model developed by the U.S. Soil Conservation Service. The TR-20 requires no calibration to an actual storm and can be used in areas where data are unavailable (U.S. Soil Conservation Service, 1982). Generalized rainfall distribution for the geographic region is provided within the program. The TR-20 simulated a 100-year, 24-hour storm with 15-minute time increments. A calibrated rainfall-runoff model would have been more accurate than the TR-20 method; however, data were not available for calibration.

TR-20 is capable of routing hydrographs through stream reaches and combining runoff hydrographs of subbasins with routed hydrographs. The drainage basins were divided into subbasins and successively modeled by adding and routing the combined hydrographs through the basin. The composite flood hydrograph was routed through a valley reach using a modified attenuation-kinematic method. The computed 100-year flood discharges, at selected cross sections within the two basins, are shown in table 1.

Table 1. Estimated 100-year flood discharges at selected cross sections

[Locations shown in figure 2 and plate 1. Discharge, in cubic feet per second, at selected cross sections; differences in the 100-year discharge are due to differences in drainage area and tributary inflow]

Chalone Creek		Bear Valley	
Cross section	Discharge	Cross section	Discharge
1	8,200	1	8,200
7	5,410	7a	3,800
8	4,700		
13	3,980		

The program generates a runoff hydrograph at the point of interest by combining a triangular simulated unit hydrograph, simulated rainfall distribution, and generalized loss-rate functions.

Land use, condition, soil types, and antecedent moisture conditions are the determinant factors of the loss-rate functions used in the program. A hydrologic soil-cover complex is composed of a hydrologic soil group and a land-use and conditions class. The Soil Conservation Service developed tables of runoff curve numbers assigned to these complexes. The curve number indicates the runoff potential of a complex during periods when the soil is not frozen. Runoff curve numbers range from 0 to 100, where 0 represents a soil type and land use that prevents all precipitation from running off and 100 implies an impervious surface where all precipitation runs off. Curve numbers can be adjusted for varying antecedent moisture conditions ranging from drought to exceptionally wet. For this analysis, the normal antecedent moisture conditions were used. Curve numbers for the study area ranged from 65 to 90. Soil types and infiltration were determined from San Benito County soil map (Isgrig, 1969).

MAXIMUM FLOODFLOWS IN CALIFORNIA

A flood of interest is the Q_{me}, or maximum flood experienced. Crippen (1979) qualified the maximum flood experienced as follows:

"The estimated values of Q_{me} represent flows that would in many places exceed the capacity of the channels as they now exist. When such extreme flows occur they defy hydraulic analysis for two principal reasons: The channels themselves are altered by erosion and deposition; and backwater effects cause water to leave the normal channels. Some of the overflow may return to the original channel at downstream points, but if topography and erosion permit, new channels may be formed which in some cases may not rejoin the original channel within the area of study. Therefore, the estimates of quantities and mean velocities for extreme flows have little practical value. They represent potential hydrologic input to the point of interest, but the physical bounds of the channel are overwhelmed, and new, unpredictable, situations are created. Even though magnitudes of estimated maximum flow are shown and theoretical elevations reached at the cross sections are indicated, it is not possible to show the potential hazard areas that correspond. Conditions leading to the occurrence of Q_{me} would be so severe that landslips, extreme erosion, and sheetflow of water and debris would be widespread, even where distinct channels do not now exist."

The Q_{me} for a given drainage area was studied, and regional curves were developed for 17 regions in the conterminous United States (Crippen and Bue, 1977). Region 17, which includes most of California, extends from Baja California to Canada. A review of the curves and additional data resulted in a refinement of the original work (Meyer, 1993). A smooth enveloping curve that provides a graphic representation of the Q_{me} was developed (fig. 3).

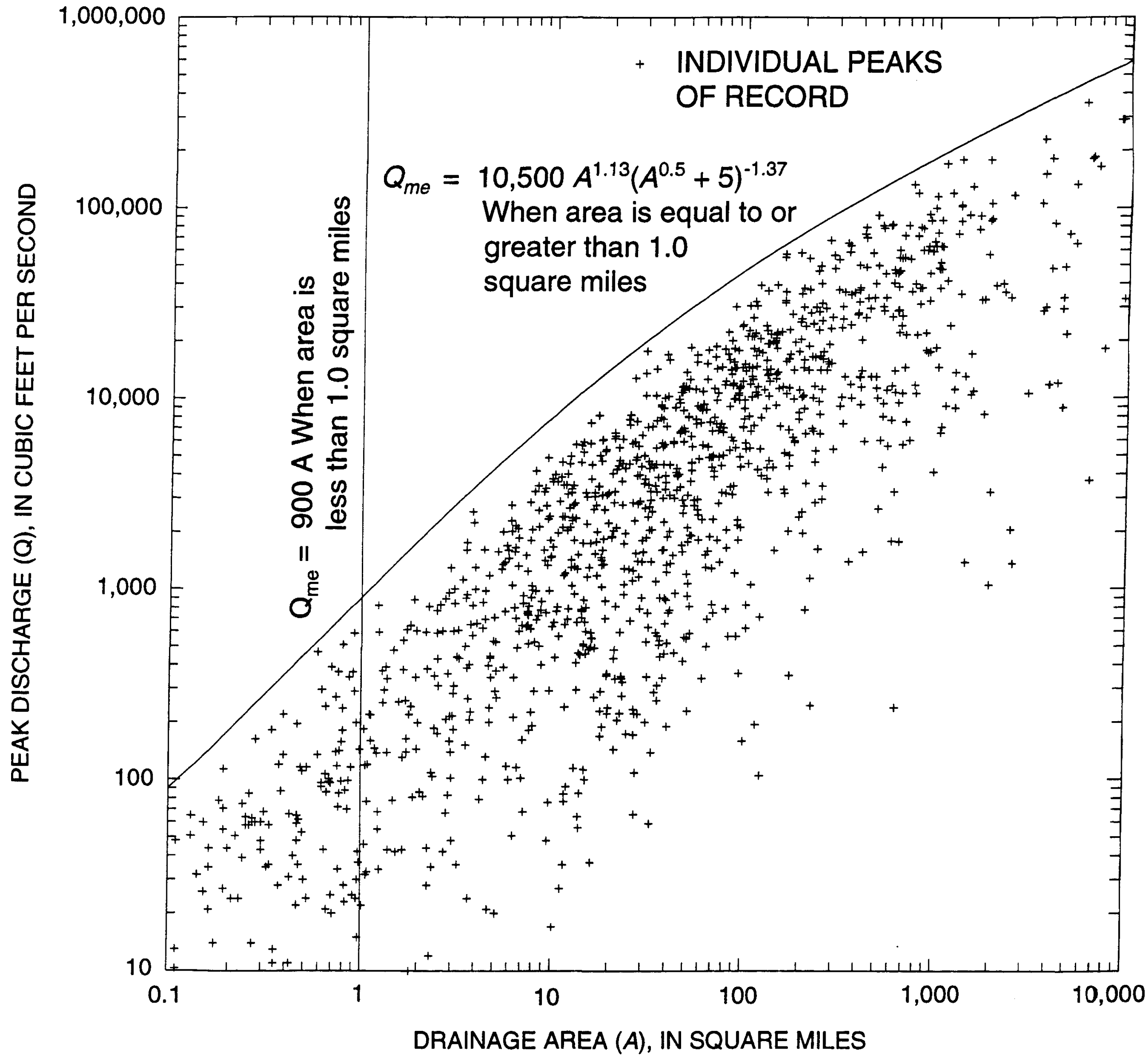

Figure 3. Selected peak discharges of streams in California and regional envelope curve for area shaded in figure 4.

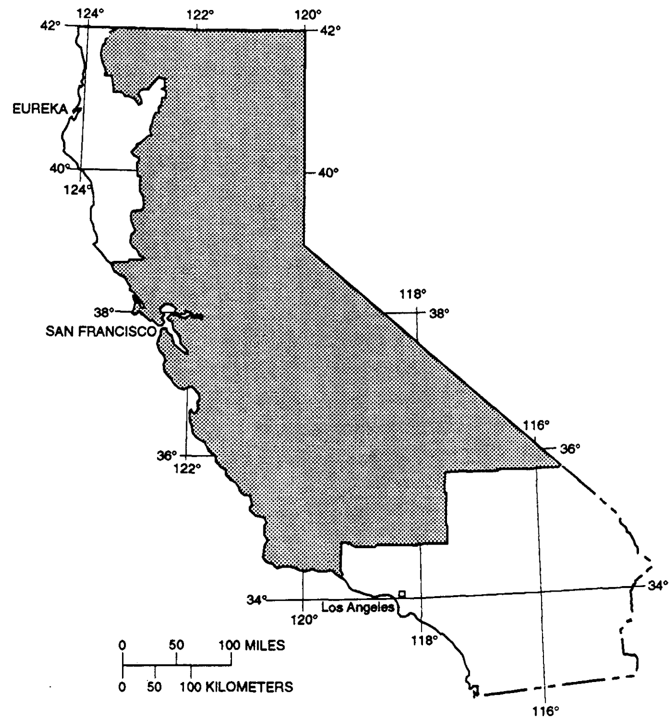

Figure 4. Area (shaded) of highest recorded peak flows used to estimate the maximum flood experienced (Q_{me}).

There is no specific frequency associated with the curve, but it gives evidence to the magnitude of flow that has occurred within a region. The curve is similar in shape to region 17, but different in magnitude from Crippen and Bue (1977). The area of California for which the graph/equation applies is shown in figure 4.

The equation that describes the envelope curve for drainage areas greater than 1.0 mi is

$$Q = 10{,}500\ A^{1.13}\ (A^{0.5}+5)^{-1.37},$$

where Q is in cubic feet per second and A is in square miles.

About 3,000 ft downstream from the mouth of Bear Valley, the Q_{me} is 30,600 ft^3/s. About 250 ft upstream from the mouth, the Q_{me} is 20,300 ft^3/s for Chalone Creek and 16,100 ft^3/s for Bear Valley. Computed discharges are flows that would, in many places, exceed existing channel capacity. The 100-year flood plain for both channels would be overtopped at all points by a Q_{me}. Channel integrity would be virtually nonexistent during such a flood; therefore, hydraulic analysis, based on current conditions, is not valid, except as a poor indication of water-surface elevations.

WATER-SURFACE ELEVATIONS

Water-surface elevations for selected floods (tables 2 and 3) were computed by conventional step-backwater procedures (Shearman, 1986) using surveyed cross-section channel geometry and TR-20 discharge data (table 1). All surveys for this report were based on National Park Service reference point KL-1. The elevation of this reference point above mean sea level was reported to be 1,002.41 ft. Elevations presented in this report are based on that datam. Stationing was established along the roads paralleling the stream channels and along the stream channel. Distances were determined using stadia. All step-backwater computations assumed that channel conditions, surveyed in the 1985 water year, would not change. Twenty-six cross sections were surveyed in the Chalone Creek drainage basin and 10 in the Bear Valley drainage basin (figs. 7 and 8, at back of report). Cross sections 1-6, downstream

Table 2. Water-surface elevations for the 100-year and maximum flood experienced (Q_{me}) for Chalone Creek drainage basin

[ft, foot]

Cross section	Distance from initial point (ft)	Elevation (ft)		
		100-year flood	Q_{me}	Thalweg
1	0	914.0	918.0	905.7
2	313	917.6	923.6	911.6
3	667	921.2	927.1	914
4	1,023	924.5	930.9	917.1
5	1,744	930.8	934.5	922.1
6	2,239	935.2	938.8	924.8
7	2,984	943.9	949.3	935.3
8	3,810	950.8	954.4	943.5
9	4,270	954.2	957.4	946.8
10	5,417	962.4	965.6	958
11	5,910	964.9	968.1	959.8
12	6,690	971.9	974.6	968
13	7,190	977.1	980.5	972.3
14	7,810	981.6	985.5	977.3
15	8,460	990.1	996.3	982.9
16	8,920	996.7	1,006.7	986.4
17	8,970	996.7	1,006.7	987.2
18	9,044	1,000.9	1,009.0	989.1
19	9,319	1,001.7	1,011.0	992.0
20	9,593	1,003.9	1,012.0	994.8
21	10,060	1,007.6	1,014.6	1,000.8
22	11,044	1,017.2	1,022.0	1,014.1
23	11,655	1,024.3	1,028.0	1,016.8
24	12,083	1,026.8	1,031.0	1,021.2
25	12,519	1,031.9	1,034.0	1,027.3
26	13,325	1,039.8	1,043.0	1,032.4

Table 3. Water-surface elevations for the 100-year and maximum flood experienced (Q_{me}) for Bear Valley drainage basin, beginning upstream from Chalone Creek

Cross section	Elevation, in feet		
	100-year flood	Q_{me}	Thalweg
7a	949.43	954.8	[1]946.2
8a	957.0	960.3	952.5
9a	962.8	969.3	955.1
10a	966.1	972.5	960.5
11a	971.2	976.3	966.4
12a	979.2	982.9	974.0
13a	980.9	984.1	977.0
14a	988.4	991.4	982.6
15a	995.0	997.8	985.8
16a	1,004.9	1,008.3	996.2

[1]Interpolated cross sections not shown

from the mouth of Bear Valley, were used in the step-backwater computations for both drainage basins. Cross section 17 in the Chalone Creek basin, used for computational purposes only, is similar to 16 and, therefore, is not shown. The calculated water-surface elevations are more uncertain as flood-flows increase because of the ability of a stream to scour, fill, or change direction as a flood wave passes.

Flood zone boundaries (pl. 1) were based on the computed water-surface elevations. Map contours were used as a guide for the shape of the boundary, but not for the exact location of the boundary between cross sections because of map inaccuracies. The map contours have a ±1.0 ft elevation uncertainty, and locations of contours can have a lateral uncertainty of more than 10 ft in some areas.

POTENTIAL HAZARDS FROM FLOODFLOWS

Potential hazard from floodflows at a site is determined by defining the relation between flood magnitude and frequency. For public-safety and economic analyses involving high levels of flood protection, hazard generally is expressed in terms of the magnitude and frequency of the annual flood, which is the largest flood event in a given year. Flood magnitude may be defined by various criteria such as the peak rate of water discharge, the flow depth or velocity, the volume of water discharged, inundated. Annual-flood frequency is defined as the aggradation or degradation of the stream channel, amounts and types of debris transported, or area fraction of years, over a long period of time, in which the magnitude of the annual flood exceeds a specified value. The frequency also is called the annual exceedance probability of the specified magnitude. The recurrence interval (for annual floods) is the average time, in years, between annual floods that exceed the specified magnitude; numerically, the recurrence interval is the reciprocal of the exceedance probability. The flood magnitude that has a specified annual-flood recurrence interval is called the T-year annual flood, where T is the recurrence interval. For example, if the annual maximum flood exceeds a specified magnitude in one year out of a hundred over a long span of time, then the annual-flood recurrence interval is 100 years, the annual frequency or exceedance probability is 1 percent (0.01), and the magnitude in question is the 100-year annual flood. The term "recurrence interval" does not imply regular or cyclic recurrence; the 100-year flood may be exceeded in two consecutive years or not at all in 200 years.

In this report, flood magnitudes are expressed in terms of peak rate of water discharge and frequencies are expressed in terms of recurrence intervals.

Magnitude may be defined by various criteria such as the amount of water discharge, aggradation or degradation of the stream channel, amounts and types of debris transported, areas of inundation, or depths and velocities.

Floodflows in the main stream channels and on the flood plains are direct hazards for Chalone Creek and Bear Valley. A direct hazard of floodflows is caused by deposition from Bear Gulch tributary because its flow intersects Chalone Creek at a nearly perpendicular angle. Floodflow from this tributary could cause major deposition in the main channel or onto the Old Pinnacles Campground Road (fig. 1). More sediment could change the water-surface elevation or the course of Chalone Creek and significantly increase flooding along the roadway.

Evidence of aggradation and degradation is abundant in many places in the Chalone Creek channel. Significant channel-geometry changes may be expected for any flood of a 10-year magnitude or greater. According to Akers (1967), between 5 and 38 ft of alluvium is in the channels.

Inundated areas (pl. 1) and water-surface elevation profiles (figs. 5 and 6) corresponding to 100-year flood and Q_{me} were determined using methods that assume steady flow and a static channel geometry based on the 1985 water survey.

Most buildings and proposed building sites in the study area are above the 100-year flood elevation, except the proposed building site near the

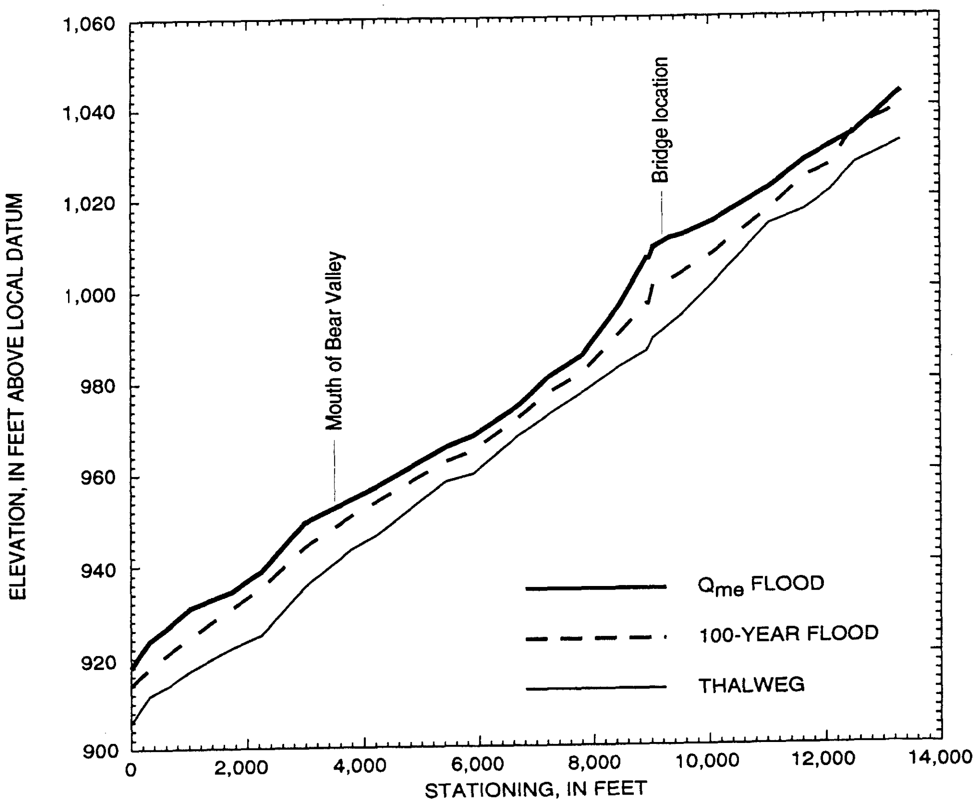

Figure 5. Water-surface elevation profiles of the 100-year and Q_{me} floods, Chalone Creek.

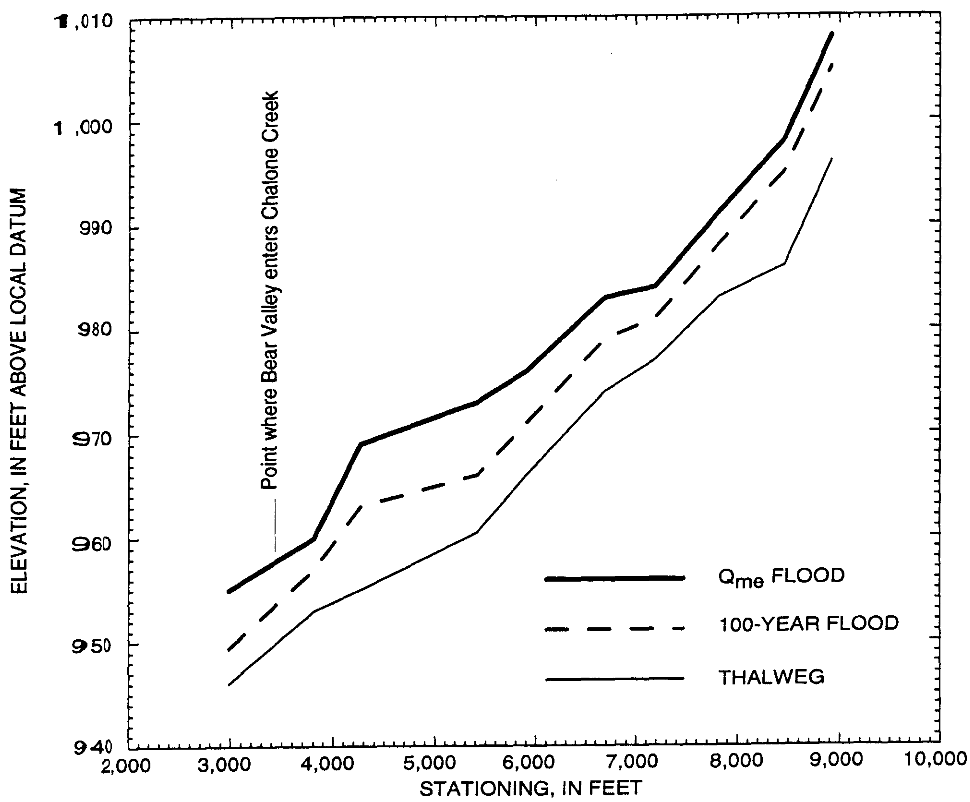

Figure 6. Water-surface elevation profiles for the 100-year flood and Q_{me} floods, Bear Valley.

horse corral, which is partly within the 100-year flood inundation area. Buildings constructed in this area would be at risk of flooding.

Chalone Creek Campground is protected from low-level flooding by the Old Pinnacles Campground Road embankment, which acts as a levee. In the center of the campground, along the road, a 12-in. culvert passes through the embankment. Floodflows greater than the 100-year flood can cause reverse flow through the culvert. Several feet of hydraulic head during peak flow could cause a significant flow into the low-lying campground areas. Normal drainage of the campground could be completely blocked and flooding increased. This problem probably could be eliminated by installing a flap valve on the culvert.

A threat to occupants of the campground area is a sudden failure of the road embankment. A small ridge on the opposite creek bank several hundred feet upstream could direct high flow from Chalone Creek toward Old Pinnacles Campground Road near the culvert area. If road failure occurred, the entire campground area could be flooded to a depth of several feet. Channel material, primarily unconsolidated alluvium, can scour or fill to an unknown degree; therefore, changes in channel-bed configuration also are likely during a major flood.

Analysis of flow indicates that the Chalone Creek bridge, which leads to the monument headquarters, would not be inundated by a 100-year flood. The inundation map indicates that all flow of a 100-year flood would pass under the bridge if the bridge opening were not blocked. A 100-year or greater magnitude flood could inundate a section of the main access road, several hundred feet downstream from the bridge and directly across from Bear Gulch. This would prevent access to or from the monument area.

The road that fords Chalone Creek and accesses the horse corral and barn area would be damaged by moderate floods and probably destroyed by 100-year or greater magnitude floods, because it is in the main flowpath. Buildings constructed in this area would be at risk of flooding.

SUMMARY

A flood-hazard study was done for the Pinnacles National Monument. Annual precipitation in the area averages 14 in. A 100-year, 24-hour rainfall is estimated to be about 5.5 in. Streamflow records and peak-discharge data are not available for Chalone Creek and Bear Valley drainage basins. Therefore, flood frequency and magnitude were estimated using standard U.S. Soil Conservation Service unit-hydrograph procedures. Because of a lack of specific storm-rainfall data, a simulated storm was applied to the basins using a computer model, TR-20, developed by the U.S. Soil Conservation Service. Possible inundated areas and water-surface elevation profiles were determined using a step-backwater program that assumes steady flow and, for this study, a static channel geometry on the basis of the 1985 water survey. Flood-zone boundaries were drawn based on these computed elevations.

About 3,000 ft downstream from the mouth of Bear Valley, the Q_{me} is 30,000 ft^3/s. About 250 ft upstream from the mouth, the Q_{me} for Chalone Creek and Bear Valley is 20,300 ft^3/s and 16,100 ft^3/s, respectively. The 100-year flood plain for both channels would be inundated at all points by a Q_{me}.

Floodflows in the main stream channels and on the flood plains, as well as deposition from Bear Gulch tributary, are direct flood hazards for Chalone Creek and Bear Valley.

Two roads in the study area have a potential of being inundated by a major flood. The road that fords Chalone Creek and accesses the horse corral and barn area would be damaged by moderate flooding and probably destroyed by a 100-year or greater magnitude flood. The road is in the main flowpath where depth and velocity would be large. A 100-year or greater flood could also inundate a section of the main access road to Pinnacles National Monument.

Several areas of Pinnacles National Monument, including campgrounds and proposed development sites are within the 100-year flood plain. Failure of the Old Pinnacles Campground Road embankment could cause sudden flooding in the Chalone Creek Campground. Reverse flow through a 12-inch culvert, embedded in the embankment along the road near the center of the campground could cause minor flooding in the campground area. The areas of proposed development near the horse corral would probably be safe, and the bridge spanning Chalone Creek to the Monument headquarters would not be inundated. However, the area of proposed development near the east Monument entrance is within the 100-year flood boundary and probably would be inundated by a major flood.

REFERENCES CITED

Akers, J.P., 1967, The geohydrology of Pinnacles National Monument, California: U.S. Geological Survey Open-File Report, 14 p.

Crippen, J.R. and Bue, C.D., 1977, Maximum floodflows in the conterminous United States: U.S. Geological Survey Water-Supply Paper 1887, 52 p.

Crippen, J.R., 1979, Potential hazards from floodflows and debris movement in the Furnace Creek area, Death Valley National Monument, California-Nevada: U.S. Geological Survey Open-File Report 79-991, 23 p.

Isgrig, D., 1969, Soil survey, San Benito County, California: U.S. Department of Agriculture, Soil Conservation Service, 111 p.

Miller, J.F., Frederick, R.H., and Tracey, R.J., 1973, Precipitation frequency atlas of the Western United States: Silver Spring, Maryland, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service, NOAA Atlas 2, 69 p.

Meyer, R.W., 1993, Potential hazards from floodflows within the John Muir House National Historic Site, Franklin Creek Drainage Basin, California: U.S. Geological Survey Water-Resources Investigations Report 93-4009, 9 p.

Mockus, V., 1969, National Engineering Handbook, Section 4, Hydrology: U.S. Department of Agriculture, Soil Conservation Service, variously paged.

Shearman, J.O., 1986, User's guide, step-backwater and floodway analyses, computer program J635: U.S. Geological Survey Open File Report.

U.S. Soil Conservation Service, 1982, Computer program for project formulation-hydrology: U.S. Department of Agriculture, U.S. Soil Conservation Service Technical Release no. 20, variously paged.

Waananen, A.O., and Crippen, J.R., 1977, Magnitude and frequency of floods in California: U.S. Geological Survey Water Resources Investigations Report 77-21, 96 p.

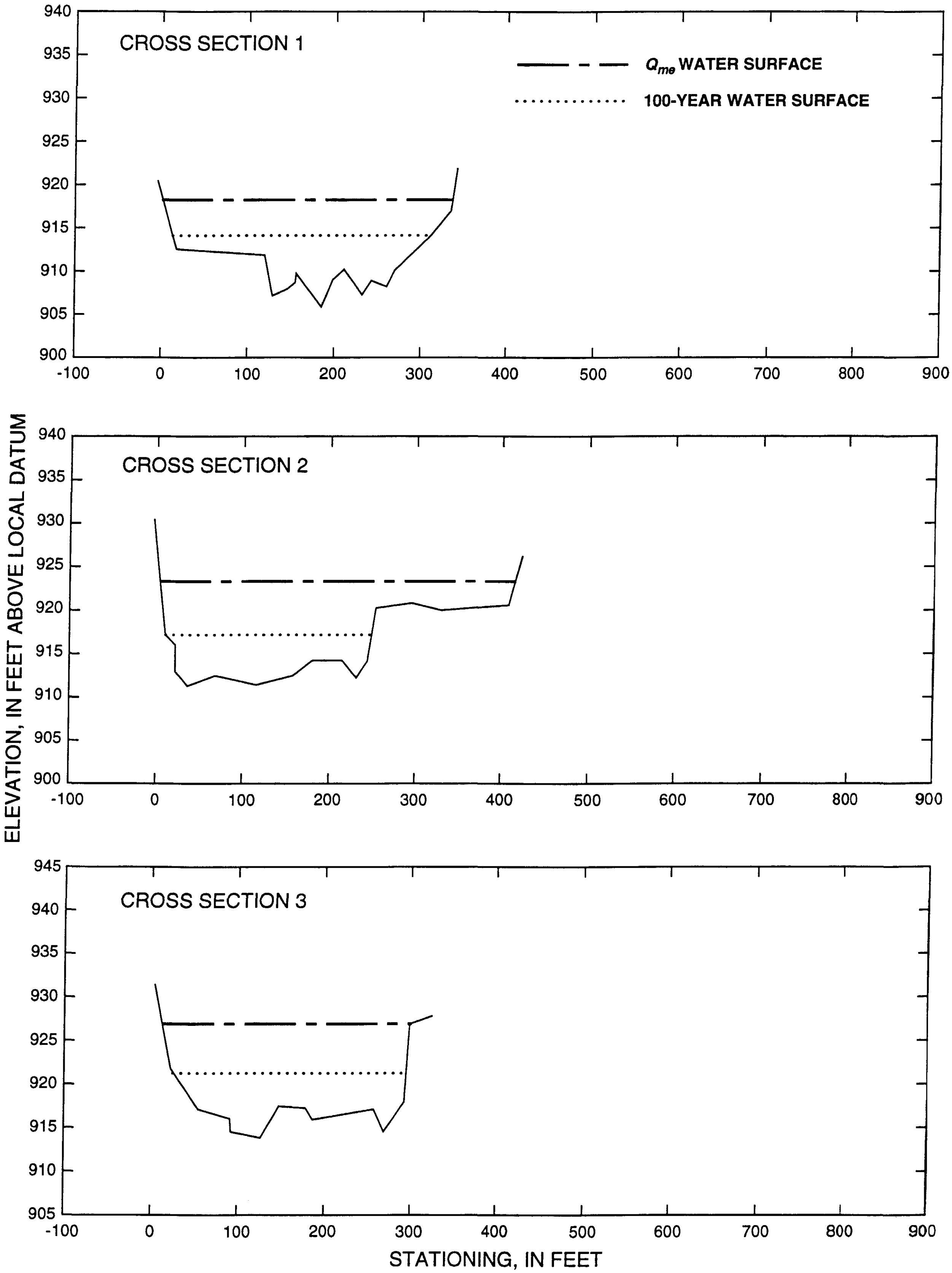

Figure 7. Cross sections and estimated flood elevations for Chalone Creek in Pinnacles National Monument, California.

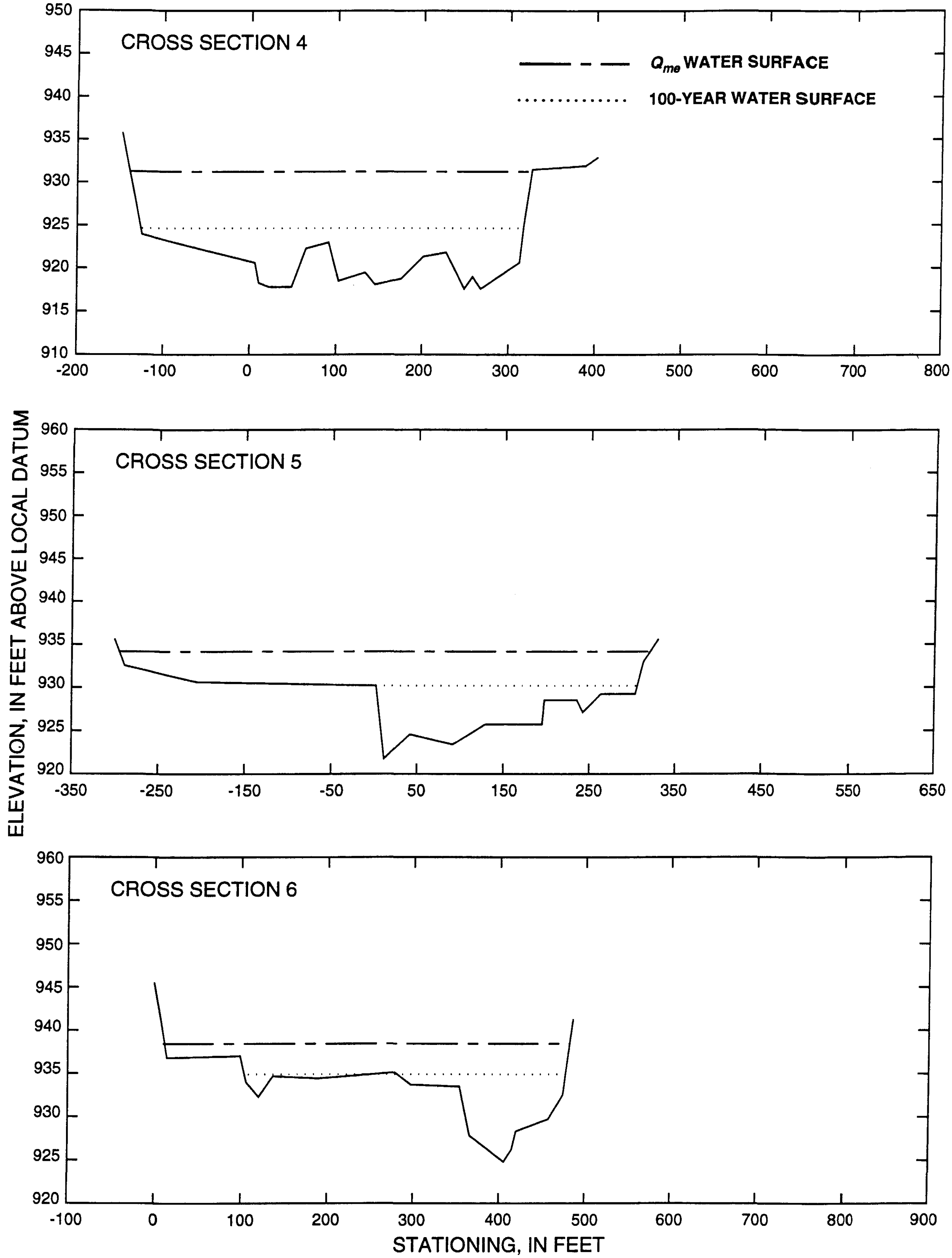

Figure 7.—*Continued.*

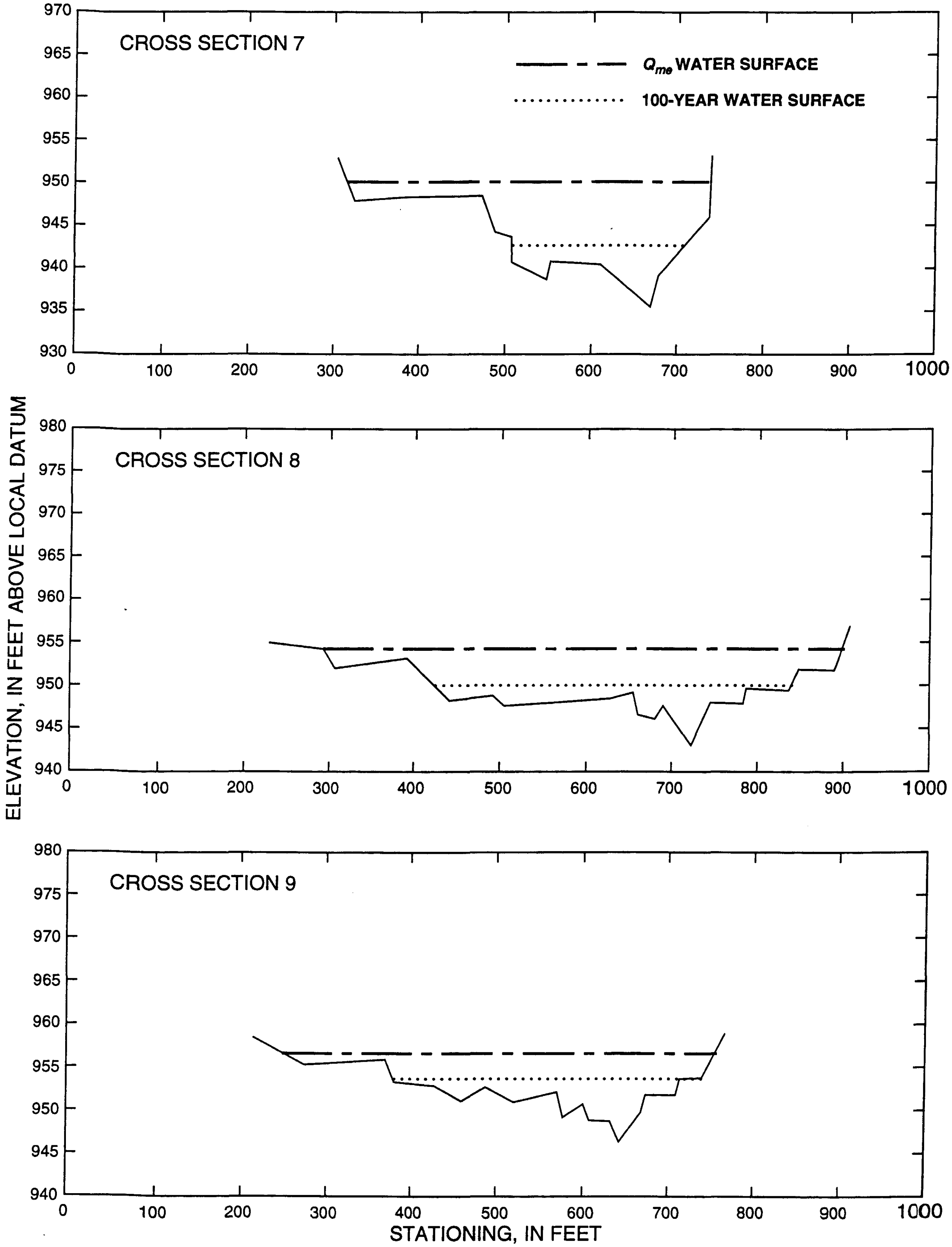

Figure 7.—*Continued.*

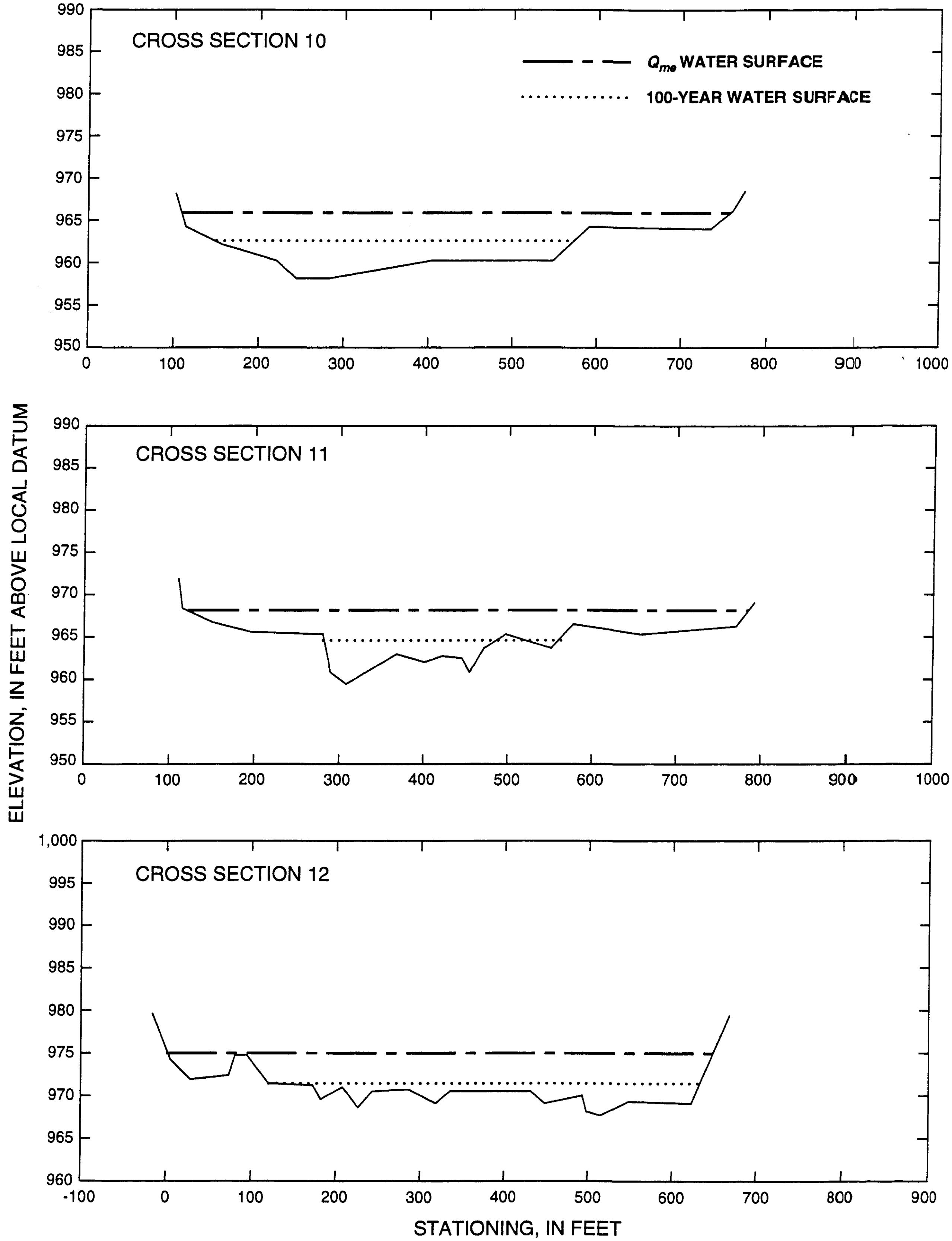

Figure. 7.—*Continued*

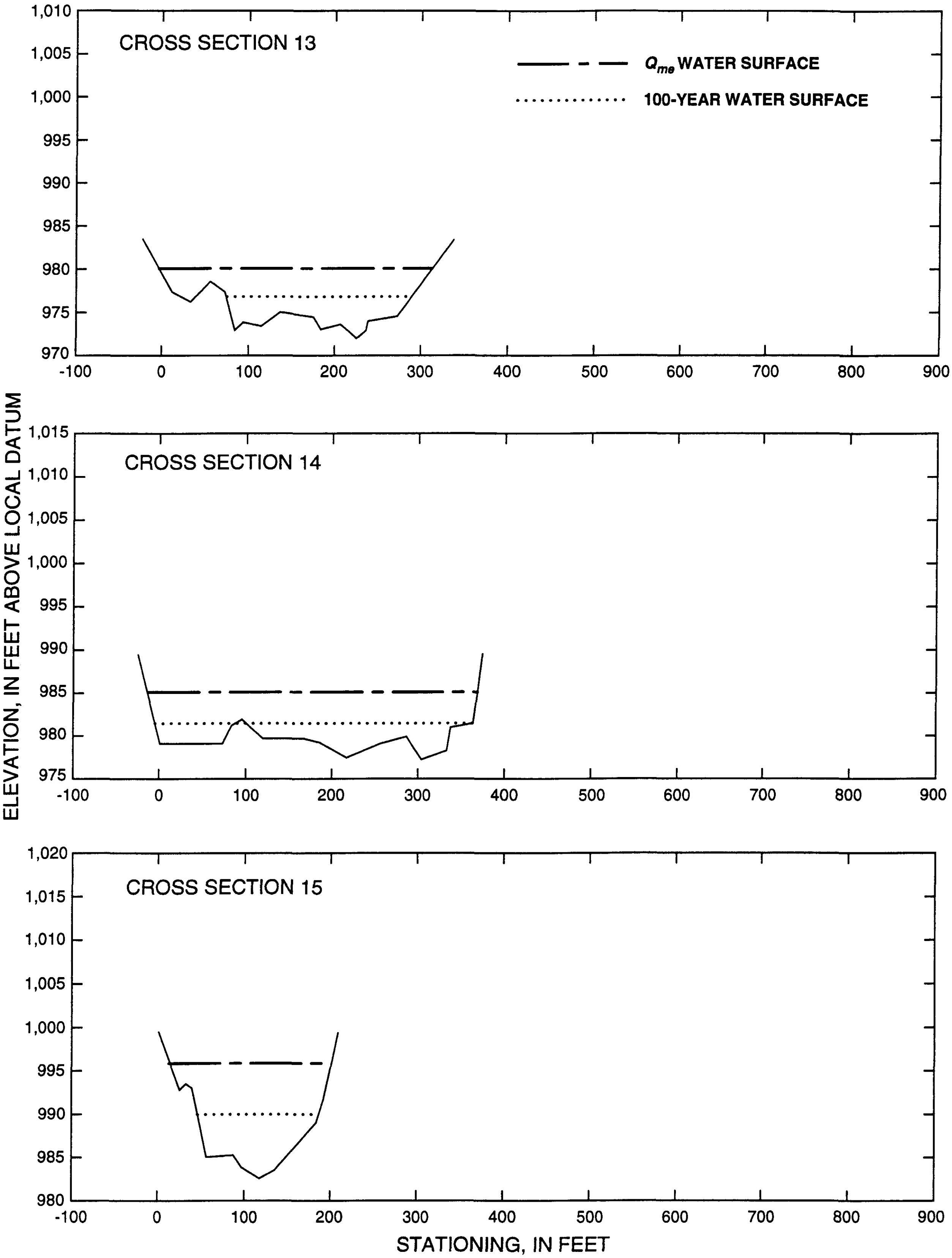

Figure. 7.—*Continued*

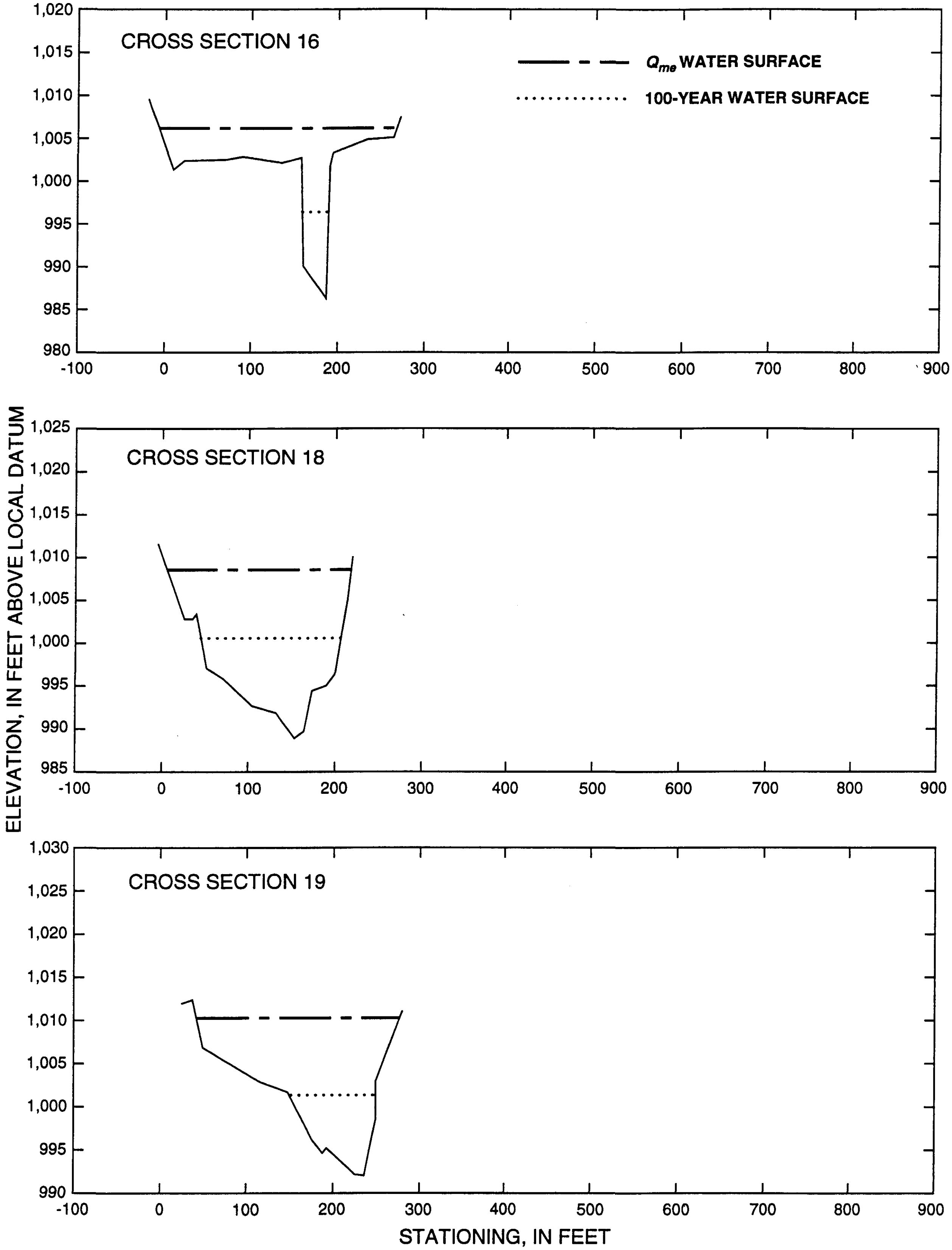

Figure. 7.—*Continued*

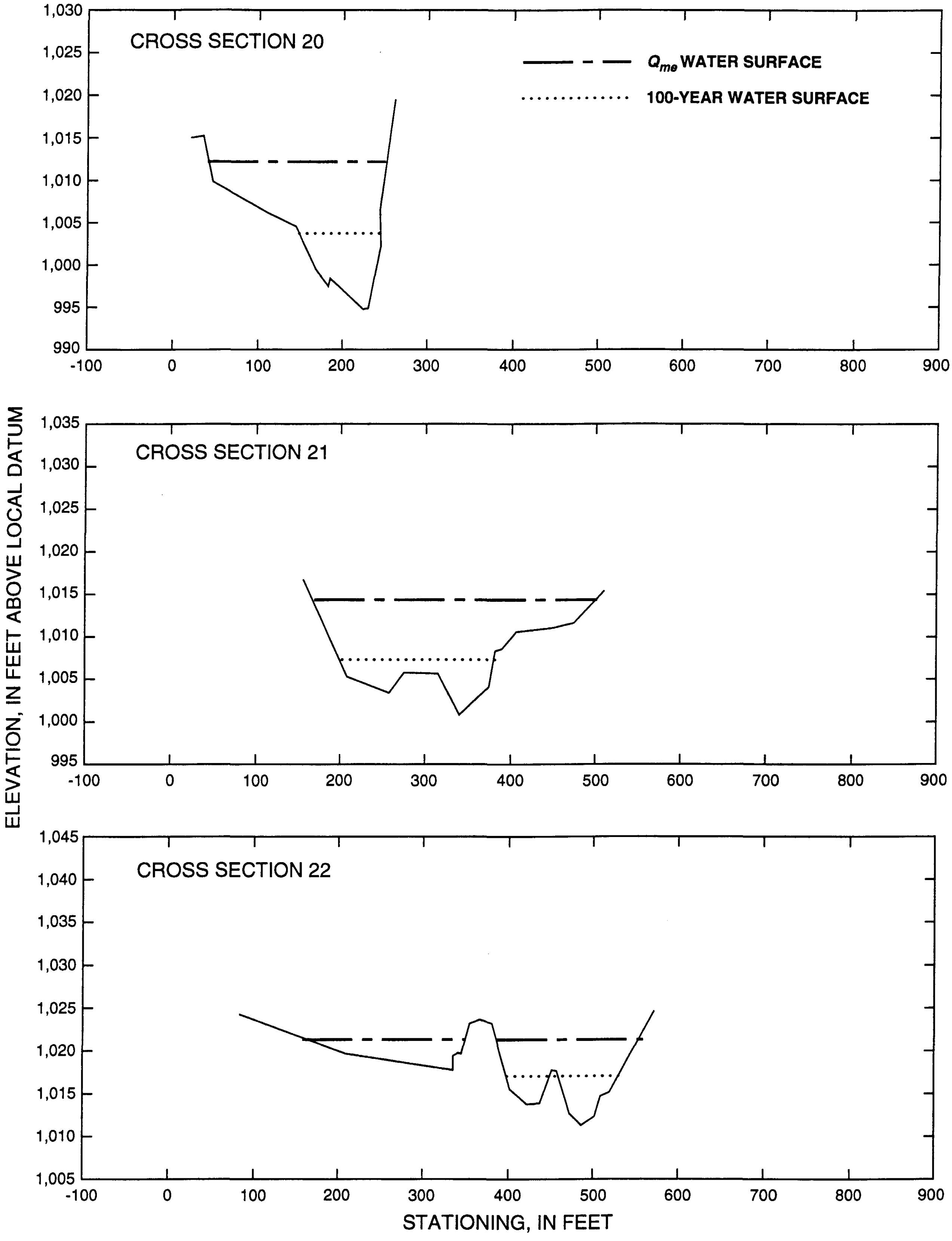

Figure. 7.—*Continued*

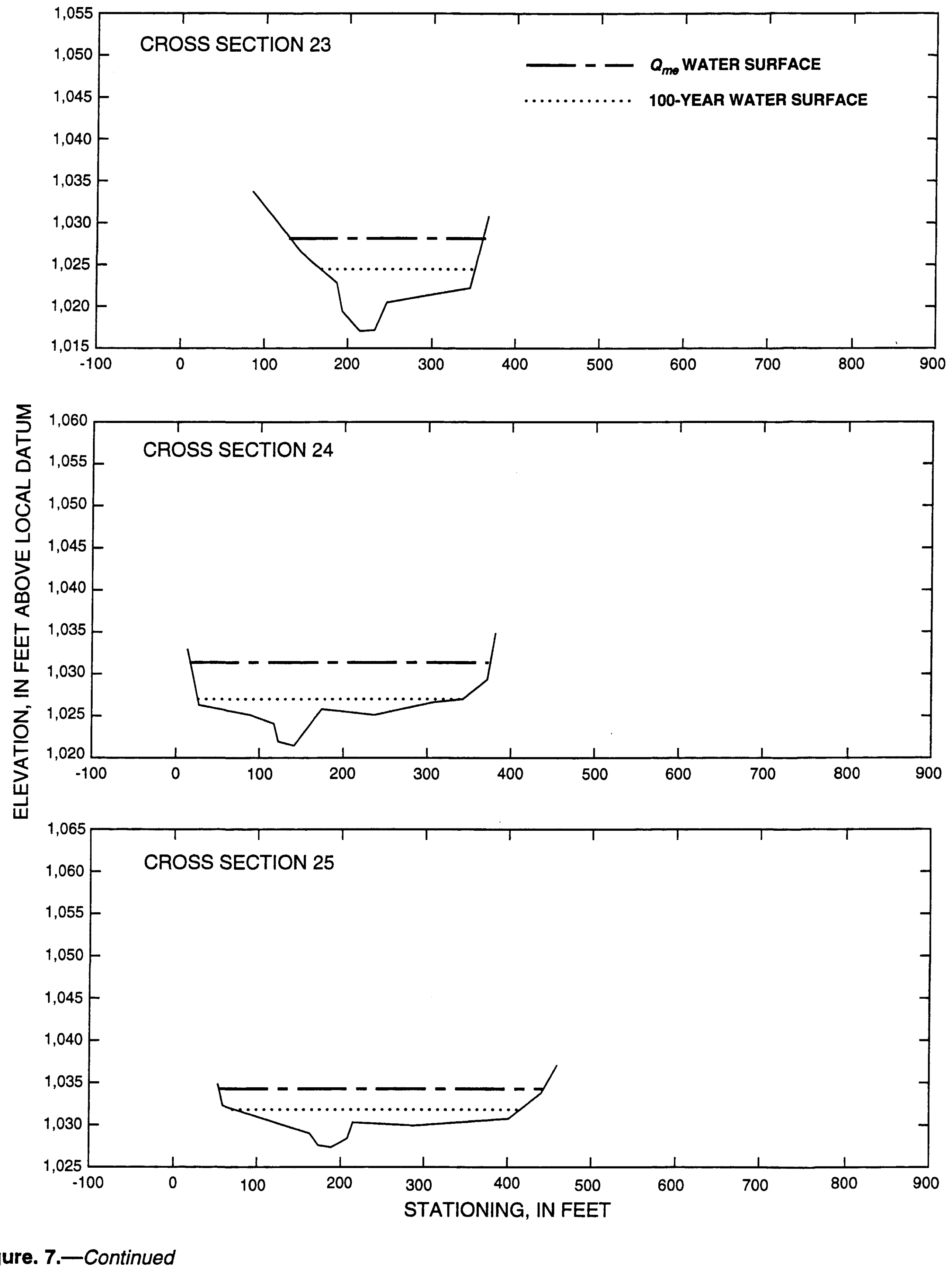

Figure. 7.—*Continued*

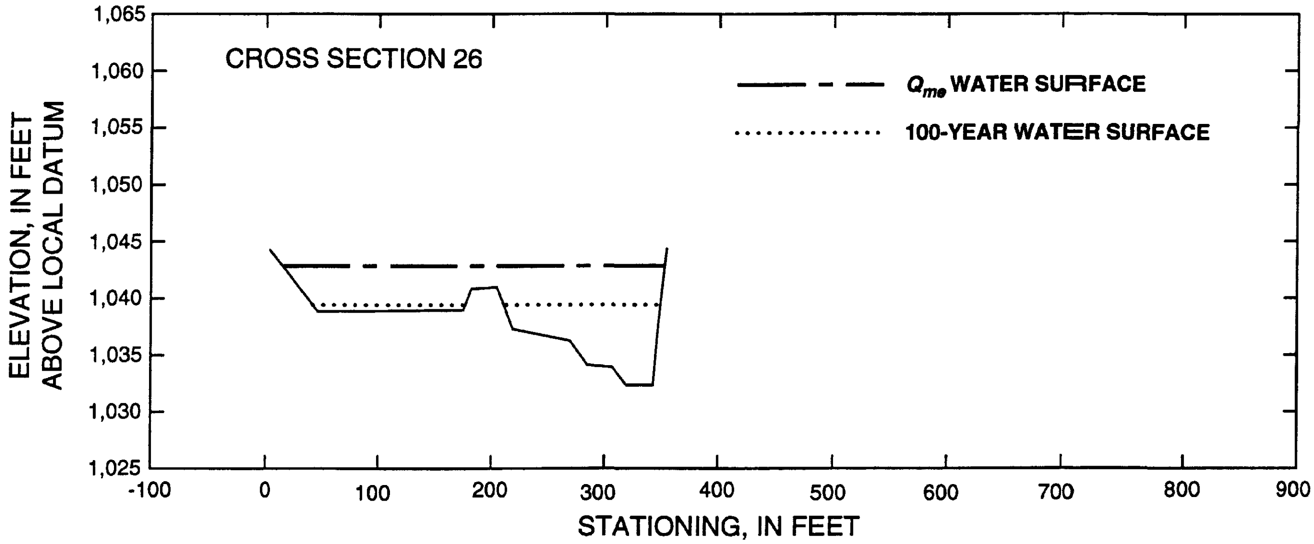

Figure. 7.—*Continued*

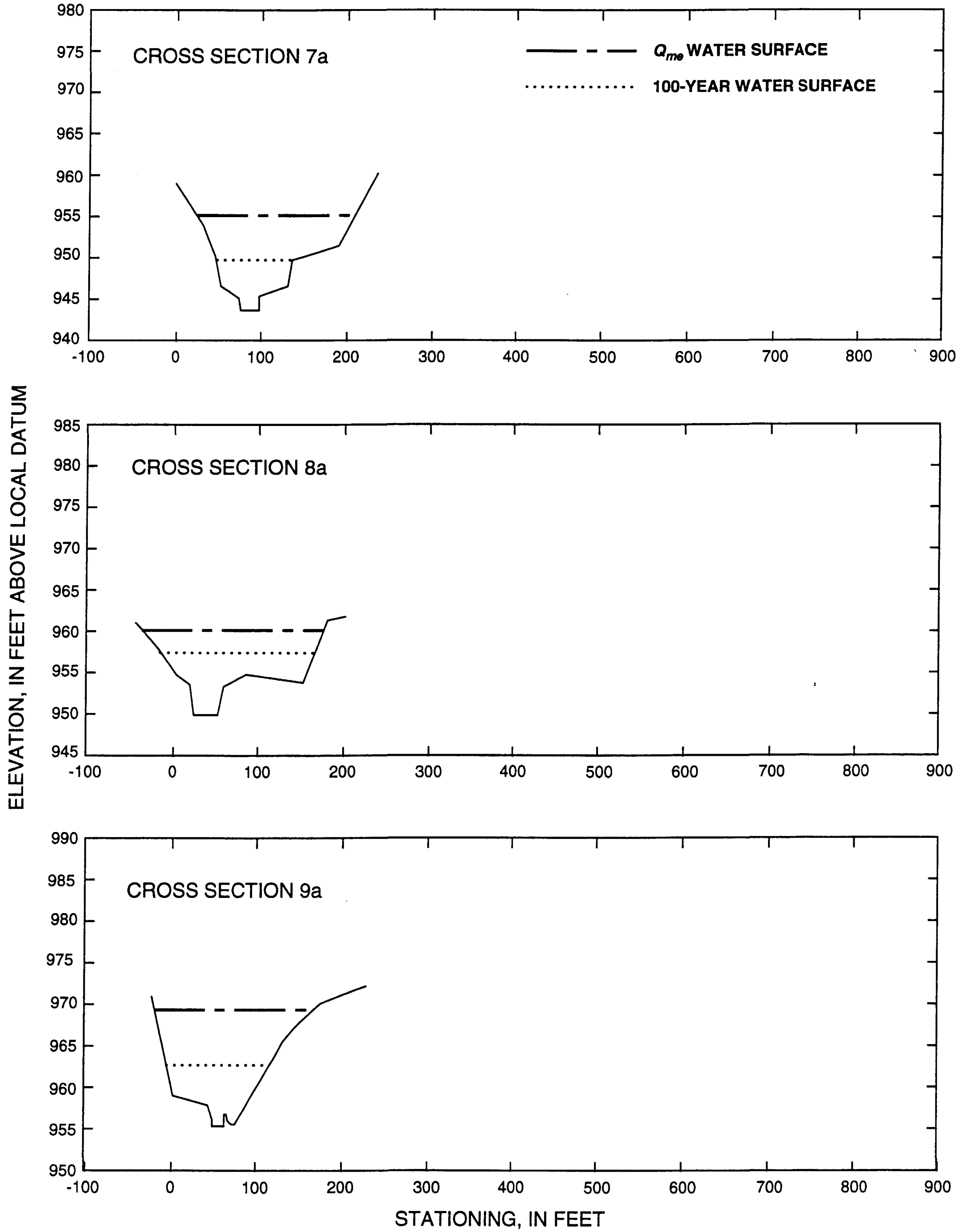

Figure 8. Cross sections and estimated flood elevations for Bear Valley.

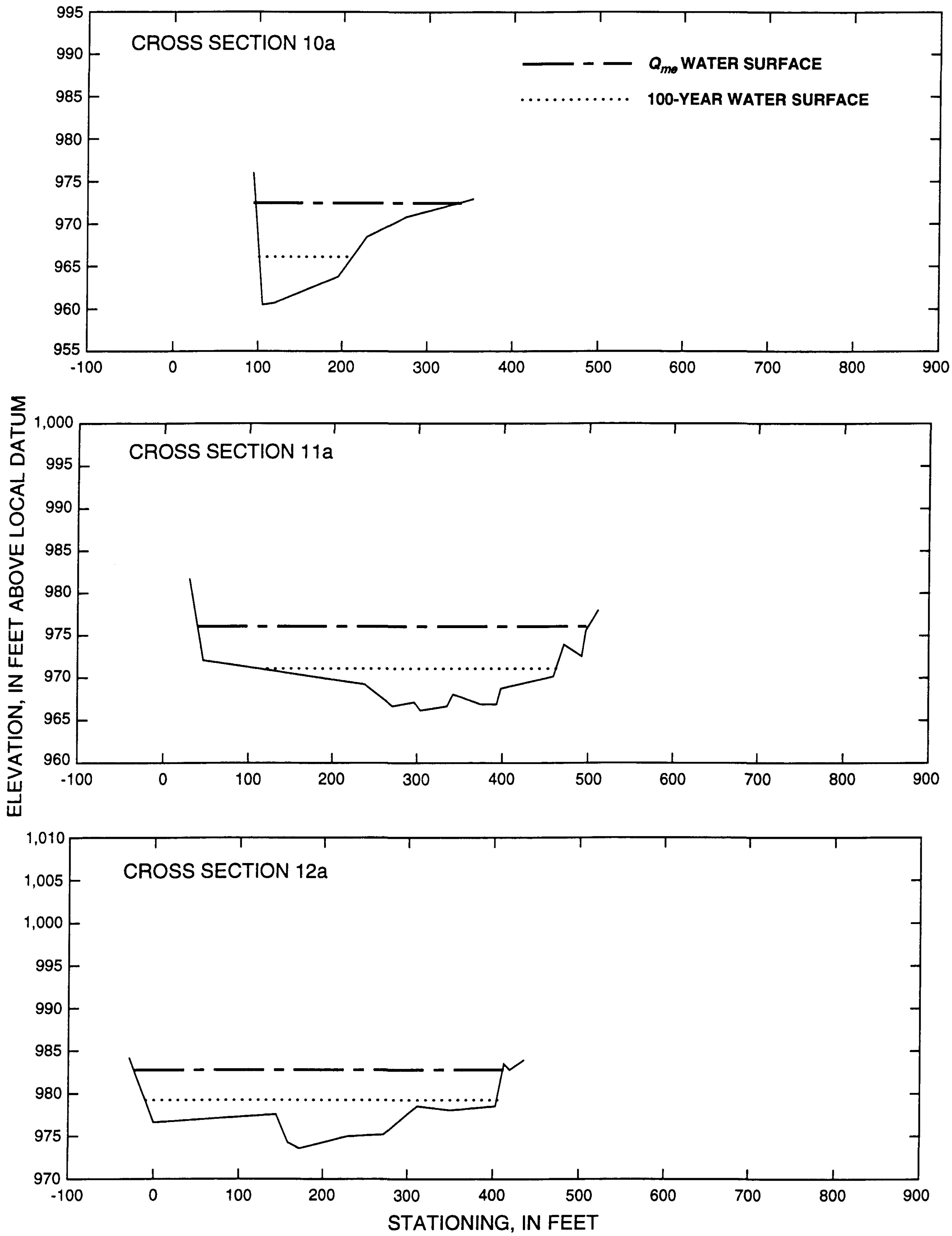

Figure 8.—*Continued.*

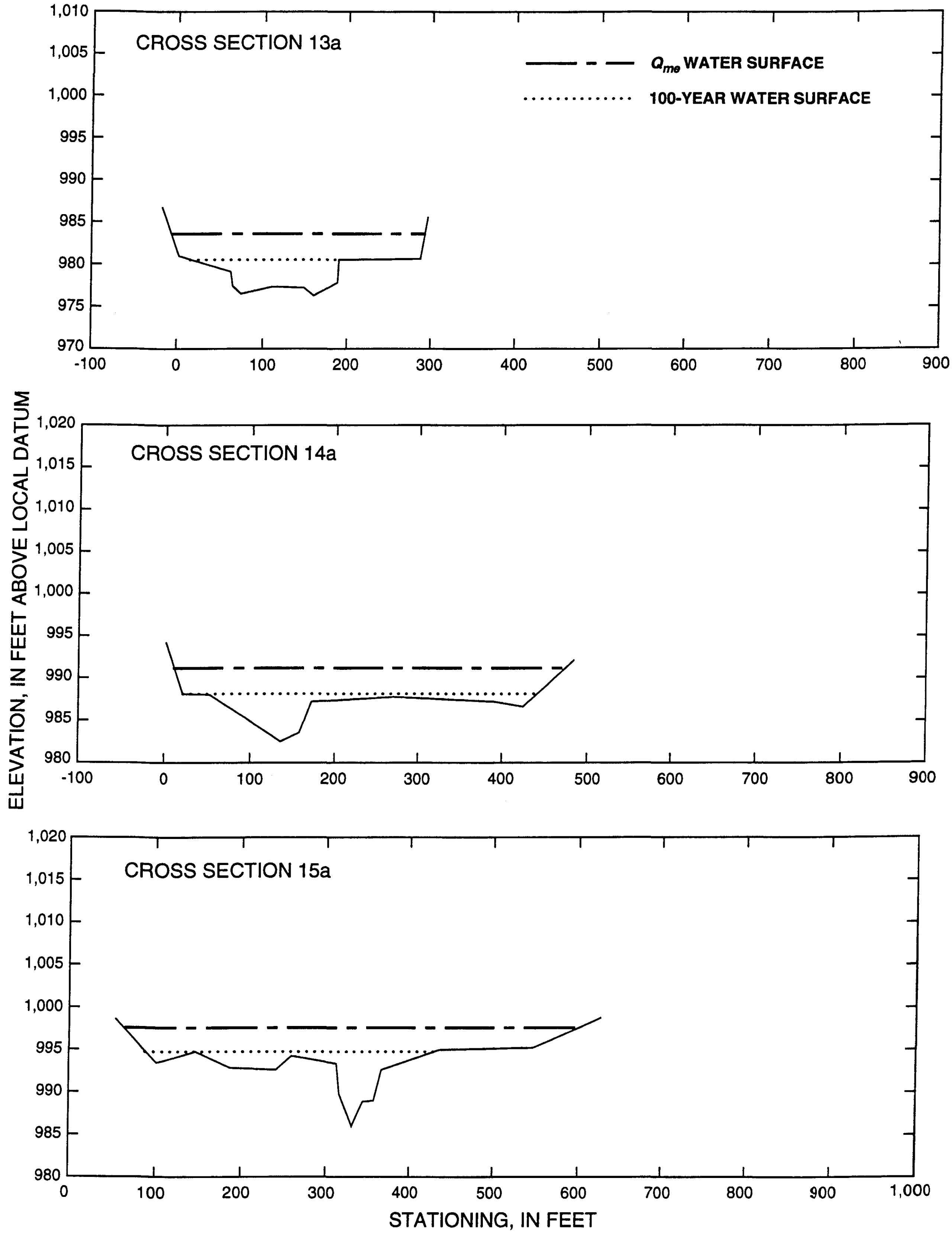

Figure 8.—*Continued.*

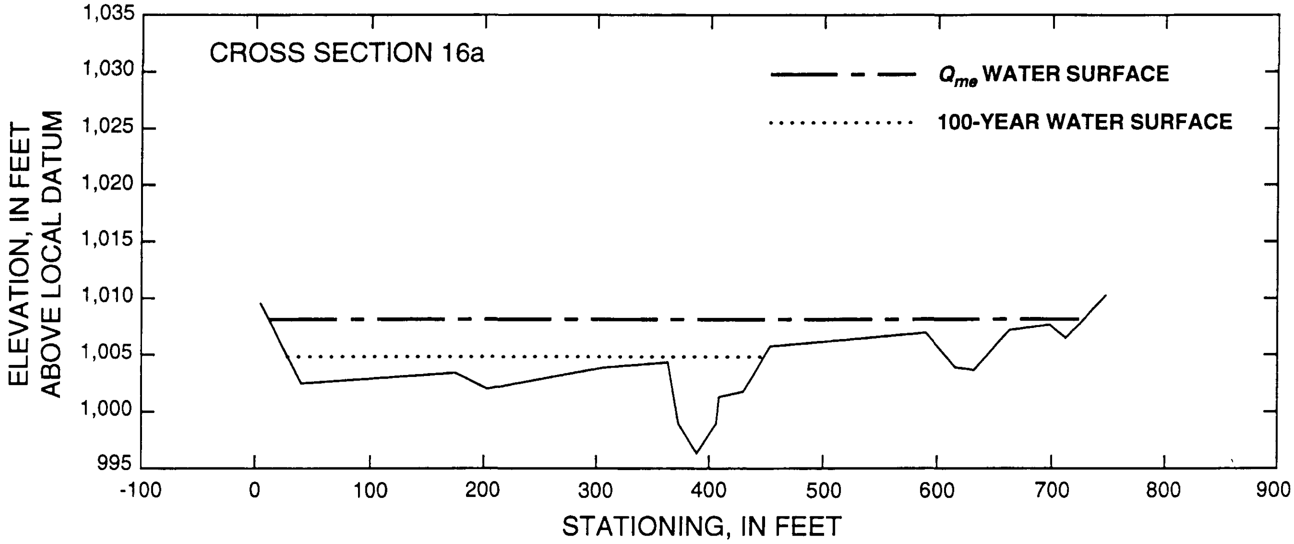

Figure 8.—*Continued.*