ANCIENT, HISTORICAL AND POTENTIAL FLOODS

Introduction

Articles in newspapers and journals have reported several great floods along the Salt River within the Tempe Quadrangle during the last 100 years. Indications of ancient flooding during the last 1500 years or more have been found along the Salt River at study sites of the pre-historic Hohokam Indian civilization. The Hohokams inhabited this area from at least 1500 to 500 years ago (Masse, 1976). Geologic evidence noted in the Tempe Quadrangle and nearby areas indicate that great floods have occurred here countless times for at least two million years.

Our more recent floods, the ones within the last 100 years, seem more spectacular because vivid written accounts are available. For example, the depth of water during the February 1891 flood was reported to be "belly high on a pony" near the village of Lehi, east of Tempe (Péwé, 1978). In November 1905, all three railroad bridges across the Salt River at Tempe were damaged; the older Maricipa and Phoenix Railroad bridge was damaged so badly that it was abandoned. The north approaches of the new, steel Maricopa and Phoenix bridge, and the Phoenix and Eastern Railroad bridge were both washed away. In February 1920, the south abutments for both the Central Avenue bridge and the highway bridge at Tempe were damaged (Corps of Engineers, 1957).

The greatest flood of historical record was in 1891 and it had a peak flow of about 260,000 cubic feet per second (cfs) (7363 cubic meters per second; cms) through the Tempe Quadrangle; measured at Granite Reef Dam, that floodflow was 300,000 cfs (8495 cms). The 1891 flood damaged all the railroad bridges in the valley, and cut telegraph connections with the West for nine days. More than 100 families lost their homes and five lives were lost. An outline of the approximate area thought to have been flooded is indicated on the map (U.S. Geological Survey, 1969). The flood boundaries were estimated from newspaper accounts and information in files at the Maricopa Flood Control District. A minor change in this outline is indicated for downtown Tempe by our study. A statistical flood frequency table has been compiled by the Corps of Engineers utilizing Salt River floodflow data since 1891 (see Table 2 on reverse side of this sheet).

The geologic floodplain (see map) consists of two different landforms: the modern Salt River bed, or the active geologic floodplain, and the Lehi Terrace, consisting of alluvial terraces along both sides of the river. The Lehi Terrace surfaces are about 5 feet (1.6 m) above the present river bed (see GI-2-D for a more complete discussion of these two landforms).

Pre-1891 floods

Archeological and geological studies reveal that great floods occurred along the Salt River for milleniums, and probably were larger than any recorded historical flood. The Hohokam Indians had an extensive irrigation system, which they abandoned at least 500 years ago. Masse (1976) and Woodbury (1960) indicate that ancient Indian canals along both banks of the modern Salt River on the Lehi Terrace near Pueblo Grande (46th Street at Washington Street in Phoenix) are now buried by silt and laminated sands (Fig. 1). These fluvial sediments are evidence that great floods occurred during the last 500 years, and possibly during the last 1500 years along the Salt River, inundating the Lehi Terrace. Some of the buried Indian canals studied were outside and above the area thought to have been inundated by the 1891 flood.

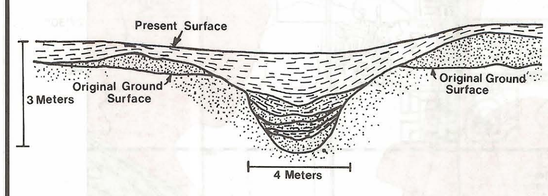

Figure 1.- A typical cross-section of a Hohokam canal filled by silt and laminated sand showing deposits from several floods.

Fluvial deposits of the terraces adjacent to the present Salt River bed (see the Geologic map, GI-2-A) indicate great floods have occurred in this valley over the last two million years. Floods for approximately the last 20,000 years have been restricted to the geologic floodplain, or the modern Salt River bed and the Lehi Terrace.

Historical references to floods on the Salt and Gila Rivers from the McDowell Dam site (mouth of Verde River) to Gillespie Dam 48 miles (77 km) downstream from Phoenix extends back to 1833, but estimates of discharge are for only the period 1888 to date. Historical records indicate that prior to 1891, general floods occurred in 1833, 1862, 1869, 1880, 1884, 1886, 1889, and 1890. The floods of 1884 and 1890 were almost comparable to the 1891 flood (U.S. Army Corps of Engineers, 1957).

Twentieth century floods

Because there have been many floods recorded during the 20th century, one should not think that there has been an increase in the rate of flooding of the Tempe Quadrangle. Rather, the method of recording has improved, and all floodflows are now being measured.

Prior to 1911

Prior to the completion of the Roosevelt Dam in 1911, records exist for two very large floods which occurred: the 1891 flood, described above, and another in 1905 (Table 1). Both flooded much of the Salt River Valley and caused extensive damage to physical structures of that time. The November 1905 floodflow was more than 200,000 cfs (5663 cms) measured at Granite Reef, making it a 75 year flood.

Table 1. Significant flows of the Lower Salt River*

Date	Flood Peak Flow (measured at Granite Reef) (cfs)	(cms)	Recurrence Interval year flood +
Feb. 1891	300,000 (est.)	8496	200
Apr. 1905	115,000	3257	13
Nov. 1905	200,000	5664	75
Jan. 1916	120,000	3398	14
Jan. 1916	102,000	2889	11
Feb. 1920	130,000	3682	16
Mar. 1938	99,000	2803	10
Mar. 1941	40,000	1132	5
Dec. 1965	67,000	1897	8
Feb. 1973	22,000	623	4
Mar. 1978	122,000	3455	15
Dec. 1978	140,000	3965	20
Jan. 1979	88,000	2492	9
Mar. 1979	67,400	1909	8
Feb. 1980	180,000	5098	55
Dec. 1982	25,000	708	4
Oct. 1983	45,000	1275	5

*Aldridge, 1970; written commun: Feb. 21, 1984, Reigle, Dallas, Senior Hydrologist, Salt River Project; written commun: May 23, 1984, D. S. Wilson, Jr., Manager, Water Resource Operations, Salt River Project.

+ Regulated discharges for present conditions from: Central Arizona water control study, 1982, U.S.A. Corps of Engineers.

After 1911

Since water storage behind Roosevelt Dam began in 1911, and within the other five reservoirs which were subsequently constructed, there have been 17 floodflows (Table 1). They occurred from 1 month to 24 years apart, and ranged in magnitude from 22,000 cfs (623 cms), a 4 year statistical flood, to 180,000 cfs (5098 cms), a 55 year flood. The areas inundated by certain large floods are shown on the map.

With an increase in population in the Tempe Quadrangle, and settlement and development of more of the floodplain, each large flood can be expected to be more damaging and disruptive. The December 1978 flood, outlined on the map, caused damages along the entire Salt River length which were estimated to be $38,956,000, and about 33% of that was estimated to have been income lost because of traffic delays (Corps of Engineers, 1979c). The February 1980 flood, also outlined on this map, caused damages estimated to be $63,700,000 (Corps of Engineers, 1981).

Future floods

A great flood inundating the geologic floodplain of the Salt River is possible at any time. The geologic floodplain is that area shown on the map as the Modern Salt River bed, plus the Lehi Terrace. Such a floodflow might exceed 300,000 cfs (8495 cms) which is that of the 200 year flood, measured at the Tempe Bridge. Since the SRP dams have been built 74 years ago, there have been no 100 year floodflows through the Tempe Quadrangle. There have been, however, floods within the watersheds above the dams for which the flows probably exceeded that of the 100 year flood at a given measuring point (Aldridge, 1979). Calculations by Aldridge and Eychaner (1982) show that without the SRP dams in place, the March 1978 and the December 1978 Salt River floods would have been extremely large flows through the Tempe Quadrangle resulting in maximum floodflow of 260,000 cfs (7363 cms) spilling across Granite Reef Dam, which is the flow of a 140 year flood.

Flood control and flood management such as reservoirs, levees and channelization projects may provide flood protection for many years. But flood protection can seldom be complete. There is always a probability that a greater flood will occur than has been experienced in recorded history. However, such a great flood would be restricted to the modern geologic floodplain.

The question is often raised concerning the area that would be flooded if one or more of the dams on the Salt and Verde Rivers were to fail with reservoirs at full capacity. Such a scenario is considered in a 1984 publication by the U.S. Bureau of Reclamation and briefly summarized here for the Tempe Quadrangle. If only Stewart Mountain Dam were to fail, the flood in the Tempe Quadrangle would be restricted to about the modern geologic floodplain, equal to about 150,000 to 180,000 cfs (4248 cms to 5097 cms). In a worst case scenario where all dams fail, little water would go north of the river bed but the entire Tempe Quadrangle south of the river, except for bedrock highlands would be flooded.

BASE MAP FROM U.S. GEOLOGICAL SURVEY TOPOGRAPHIC MAP, 1:24,000 SERIES TEMPE QUADRANGLE (1952, PHOTOREVISED 1967) Additional revisions compiled by the Geological Survey from aerial photographs taken 1978 and other sources. This information not field checked. Map edited 1982.

Source of flood outlines:
1891 — U.S. Geological Survey Map, 1969, with modifications from data in Southern Pacific-Tempe Railroad Bridge plans
1965–66 — Péwé, unpublished data
1978 — Corps of Engineers, 1979c
1980 — Aerial photos (Arizona Depart. of Transportation)

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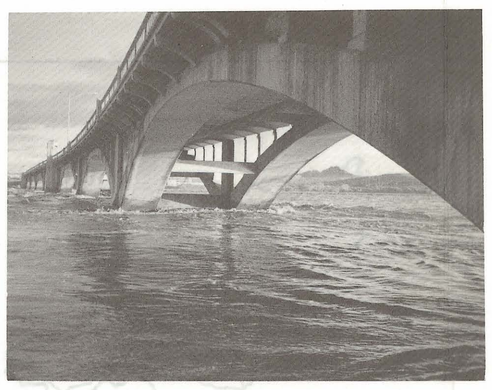

Salt River in flood stage at Tempe Bridge February, 1980. Flow of 180,000 cubic feet per second is largest in the river since 1905 and represents the 55 year flood. (Photograph No. 4502 by Troy L. Péwé, Feb 16, 1980).

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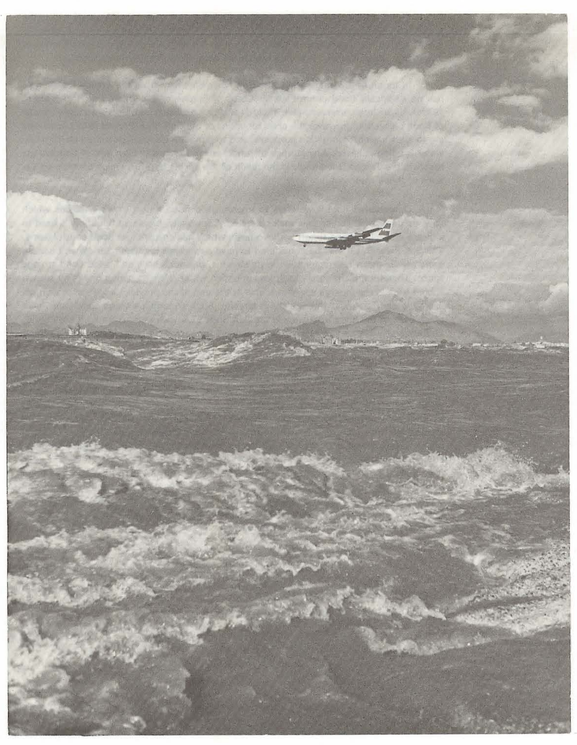

Turbulent Salt River in flood near end of runway of Sky Harbor Airport, Phoenix in January 1979. About 2,500 feet of airport runway was washed away as the river is crowded between the runway and industrial sites on the south side of the river. Photograph at 40th Street looking north when river was running 72,000 cubic feet per second (Photograph No. 4252 by T. L. Péwé, Jan 19, 1979).