Evaluation of Two Low-Flow Releases from Big Tujunga Reservoir, Los Angeles County, California, 2003

By Gregory O. Mendez

In cooperation with the U.S. Department of Agriculture, U.S. Forest Service

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Conversion Factors, Datum, and Abbreviations

Multiply	By	To obtain
acre	4,047	square meter
acre-foot (acre-ft)	1,233	cubic meter (m^3)
foot (ft)	0.3048	meter (m)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
inch (in.)	25.4	millimeter (mm)
mile (mi)	1.609	kilometer (km)
square mile (mi^2)	2.590	square kilometer (km^2)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$°F=(1.8\times°C)+32$$

Datums

Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD 88).

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Altitude, as used in this report, refers to distance above the vertical datum.

Abbreviations

LACDPW	Los Angeles County Department of Public Works
USFS	U.S. Forest Service

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Abstract

Since 1973, the Santa Ana Sucker (*Catostomus santaanae*) has been listed as a threatened species under the Endangered Species Act. The Lower Big Tujunga Creek, in Los Angeles County, is one of the areas in southern California where the Santa Ana Sucker is still present. This study was designed to assess two flow releases from Big Tujunga Dam that may contribute to favorable habitat conditions for the Santa Ana Sucker. It is important for the Santa Ana Sucker's survival that pools in the lower reach of the study area are replenished periodically. The focus of the study area was on the Lower Big Tujunga Creek within a reach extending approximately 6 miles downstream from the Big Tujunga Reservoir. Six sites were established from the Big Tujunga Dam to Delta Flats day-use area for data collection. This report describes the study design, discharge measurements, and the flow data collected from the two releases.

Two scheduled flows (phases 1 and 2) were released from the Big Tujunga Reservoir in August and September 2003. During the first phase, which lasted 50 hours, travel times from the dam to four sites downstream were determined. Arrival times at the four sites were determined on the basis of temperature data. Travel time from the dam to site 6 (the furthest downstream site) was about 51.5 hours. Travel times for subreaches were 3 hours from site 1 to site 2, 6.5 hours from site 2 to site 3, almost 18 hours from site 3 to site 4, and 24 hours from site 4 to site 6. The temperature probe at site 5 was destroyed, and thus the arrival time could not be estimated. A probe that measures stage was placed in one of the many pools downstream from site 4 to evaluate a typical pool response to a low-flow release. Also, discharge measurements were taken at four sites along the study reach.

In phase 2, which lasted 5 days (121 hours), flow losses along the 6-mile reach were analyzed. Losses were estimated by measuring difference in flow from the dam to sites 3, 4, 5, and 6, when flow was most stable at each site or when the last measurement made before flow decreased due to flow from dam being shut off. Losses in the plunge pool, directly below the dam were assumed to be negligible for this study. Overall creek loss between the dam and site 6 (the last site) was estimated to be between 4.0 and 4.2 ft^3/s (cubic feet per second). Estimated losses between the dam and intermediate sites were about 1.5 ft^3/s to site 3; 2.5 ft^3/s to site 4; and between 3.7 and 4.1 ft^3/s to site 5.

Introduction

The U.S. Department of Agriculture, Forest Service (USFS), the U.S. Department of the Interior, Fish and Wildlife Service, the California Department of Fish and Game, the City of Los Angeles, the Los Angeles County Department of Public Works (LACDPW), and the Upper Los Angeles River Area Watermaster have been working closely over the last several years to develop a flow-release strategy for maintaining and enhancing Santa Ana Sucker habitat within the lower Big Tujunga Creek. The U.S. Geological Survey in cooperation with the USFS conducted a low-flow study on the Lower Big Tijunga Creek to evaluate the creek's response to low-flow releases.

Potential flow-release considerations include releasing water periodically during the summer months to refresh the numerous pools within the study reach and providing continuous low flows during the year to maintain sucker habitat throughout the study reach. Pools provide habitat for the Santa Ana Sucker during summer dry months and early fall when most of the stream channel outside of pool areas is dry. Pools within the study area are maintained during the summer through subsurface seepage and occasional releases from the dam. Because water is expensive and is needed for recharge downstream from the study area, releasing only enough flow to make it to the end of the reach will save money and reduce the potential for lost recharge.

The Santa Ana Sucker (*Catostomus santaanae*), one of only a few fish native to southern California, was listed as a threatened species under the Endangered Species Act of 1973 (amended in 2000). The Santa Ana Sucker is about 6 in. in length and has large thick lips with a small mouth that enable it to vacuum algae and invertebrates from the streambed. Santa Ana Suckers appear to be most abundant in clean, clear water although they can tolerate seasonally murky water. The native range for the Santa Ana Sucker includes the Los Angeles, San Gabriel, and Santa Ana River drainage systems (Smith, 1966). The lower reach of the Big Tujunga Creek, in Los Angeles County, is one of the areas in southern California where the Santa Ana Sucker is still present (Haglund and Baskin, 2001). The reach below the Big Tujunga Dam consists of many pools and riffles, which with the right water-supply conditions can be suitable habitat for the Santa Ana Sucker.

For the Santa Ana Sucker's survival in this section of the river system, an adaptive approach to water management (storage and release) is needed (Bill Brown, U.S. Forest Service, written commun., 2004). Additional data are needed to help provide an understanding of how water moves through this controlled stream system. Currently, habitat conditions within lower Big Tujunga Creek are not favorable for the sucker; their population has decreased and their distribution is spotty. There is not enough continuous flow from Big Tujunga Reservoir to provide suitable habitat for the Santa Ana Sucker during critical dry months (normally June through October) (Andresen, 2001). Different protocols are needed for releases during wet and dry years in order to maintain favorable conditions in the study reach. Habitat conditions, however, can be improved in the long-term through the establishment of a flow-release regime from Big Tujunga Dam. Large releases in the early spring (February–April) have the greatest potential for removing fish. Storm releases are usually at flows higher than desirable for fish survival and are not predictable. When feasible, ramping of water release from the dam to mimic natural flows would minimize impacts to downstream aquatic organisms and reduce the risk of Santa Ana Suckers being washed downstream. Ramping down would also minimize impacts and reduce the risk of individuals being stranded (Bill Brown, U.S. Forest Service, written commun., 2004).

The Big Tujunga Creek headwaters are located in the Angeles National Forest, which occupies part of the San Gabriel Mountains, and the creek drains into the Los Angeles River (*fig. 1*). The Big Tujunga Creek watershed is the second largest in the San Gabriel Mountains. Big Tujunga Creek has two dams that regulate flow: Big Tujunga Dam, located at the upper end of the study reach, and Hanson Dam, located downstream from the mountains (*fig. 1*). Big Tujunga Dam, built in 1931, is a 200-ft-high concrete variable-arch dam. The drainage area upstream of Big Tujunga dam is 82.3 mi^2. The Big Tujunga Reservoir covers 141 acres and its original capacity was 6,240 acre-ft. The capacity of the reservoir has been reduced because of sedimentation. The elevation decline of the creek within the 6-mile study reach is more than 400 ft.

Purpose and Scope

The purpose of this report is to present an evaluation of the effects of different flow releases from the Big Tujunga Reservoir on a reach extending 6 miles downstream from the dam. The study was designed to release water from the Big Tujunga Reservoir in two phases. The first phase was used to determine travel times to selected sites downstream and the second phase was used to determine flow losses in specific reaches downstream. The Los Angeles County Department of Public Works provided two releases from the reservoir; the first release (50 hours) was in August 2003 and the second release (121 hours) was in October 2003.

Acknowledgments

The author thanks the Los Angeles County Department of Public Works (LACDPW) for releasing water from the Big Tujunga Reservoir for this study.

Study Design

There are no recent gages in the study reach and little was known about downstream effects of low-flow releases from the dam. Two scheduled flows (phases 1 and 2) were released from Big Tujunga Dam in August and September 2003. Phase 1 was designed to evaluate travel times to selected sites downstream. The initial study design was to release 5 ft^3/s (cubic feet per second) from the reservoir and track it downstream. After 7 hours the flow was increased to 10 ft^3/s because water had traveled less than a mile owing to filling of the many pools. Temperature probes were placed at five sites to determine arrival times to each site. A factor in determining how long it takes water to move from site to site is the number of pools between sites. A probe was placed in a pool downstream from site 4 to evaluate a typical pool response to a low-flow release. Phase 2 was designed to quickly fill the pools along the reach and then stabilize the flow to calculate losses. Losses were estimated by measuring difference in flow from the dam to specific sites downstream when flow was stable at each site or the last measurement made before flow decreased due to flow from dam being shut off. Flow was assumed to be stable when two consecutive measurements are within measurement error (5%) of each other. The second release had an initial release rate of 20 ft^3/s; after 24 hours, the flow was reduced to 10 ft^3/s.

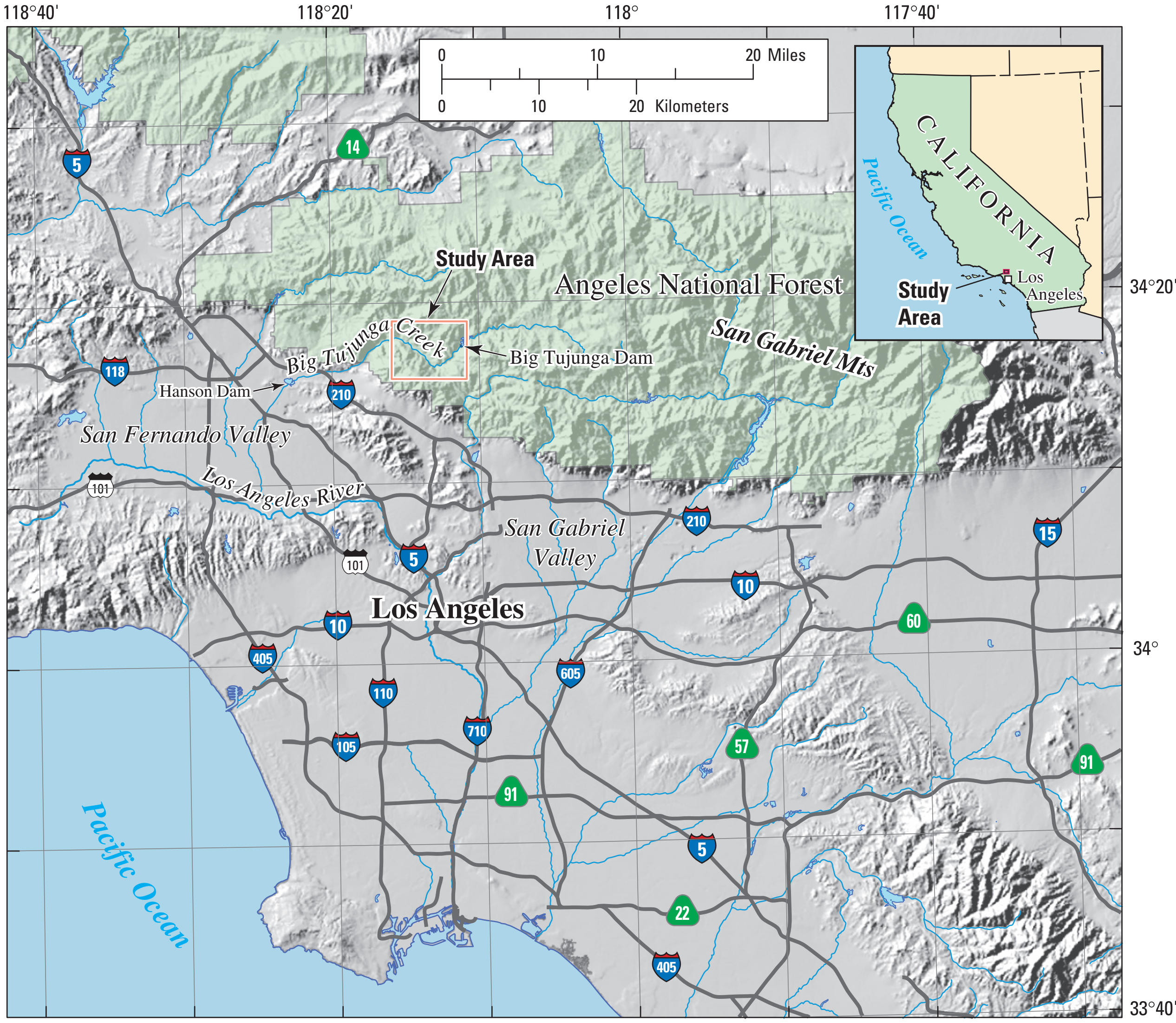

Figure 1. Location of the lower Big Tujunga Creek study area.

Description of Sampling Sites

The study area consists of a 6-mile reach of the Big Tujunga Creek immediately downstream from the Big Tujunga Dam (*fig. 2*). Although the study area is in the Angeles National Forest, private inholdings are scattered along the creek. In the upper section of the study reach, the river is contained within a steep-sided canyon. The creek widens in the lower section of the reach upstream from Wildwood picnic ground. Streamside vegetation consists of willows, white alders, cottonwoods, brush, and Arundo Donax (non-native). Near Stonyvale picnic ground there are some Ailanthus trees, which are exotic to the area. The Arundo (giant reed) population starts above the Stonyvale picnic ground, becomes abundant around Vogel Flat, and extends to the end of the study reach. The USFS has already started a plan to reduce the Arundo population because of their high consumption of water (Bethke, 2001).

Six sites were selected to represent different types of stream reaches; the sites were selected based on easy access to the creek (*fig. 2*). The site number, 15-digit identification number, and name of the sites are given in *table 1*. These sites are cross-referenced with pool locations from a U.S. Forest Service report (Andresen, 2001). Site 1 is at the dam. Site 2 is located about one-forth mi downstream from the pool beneath the dam at a low-flow bridge used as a maintenance crossing. Site 3 is located about 1 ½ mi downstream from the dam, on a utility access road. This site is 200 ft upstream from a destroyed Burbank YMCA Camp and about 80 ft upstream from a 5-ft manmade waterfall. This waterfall created a pool which is referred to as “pool number 1” (Andresen, 2001). The left bank has natural vegetation, but the right bank has been covered to a height of 100 ft with concrete to stabilize the channel. This is the only site in the study area that has perennial flow. Site 4 is located near the Stonyvale picnic ground at a bridge crossing to La Paloma Flat (a small residential area). This site, located about 3 ½ mi downstream from the dam near the Big Tujunga Fire Station, is upstream from “pool number 34” (Andresen, 2001). Both sides of the creek are natural for a distance of about 100 ft. Site 5 is located near the Wildwood picnic ground. This site, located about 4 ¾ mi downstream from the dam, is near “pool number 39” (Andresen, 2001). The left bank has natural vegetation and steep cliffs. The right bank has natural vegetation and opens to the picnic area. Site 6, located about 6 mi below the dam at the Delta Flats day-use area, is the most downstream site. This site is near “pool number 47” (Andresen, 2001). This site has the least vegetation and much bigger rocks and boulders. At high flows, the channel at this site can be several hundred feet wide. There are many private homes between sites 4 and 6.

Methods

Temperature Measurements

Temperature measurements were made with a single-channel self-contained temperature logger used to determine the arrival time at sites 2 to 6 for the first release from the Big Tujunga Reservoir. No temperature data were collected at site 5 because the probe was destroyed. The temperature logger contains a thermistor or thermocouple integrated with signal-conditioning circuitry, a real-time clock, a memory unit, and an optical or infrared interface to provide access by computer or portable data shuttle. A temperature probe was placed in a culvert at site 2, and the probes at the other four sites were attached to a piece of rebar placed in the creek bottom. Temperature probes at sites 2, 5, and 6 were placed in the dry streambed and collected air temperature data until flow reached them. Temperature probes at site 3 and site 4 were placed in small pools. All temperature probes were set to record every 5 minutes, except the probe at site 3, to get a more accurate arrival time. The probe at site 3 was set to record every 15 minutes because flow was expected to reach this site during the day and could be visually verified.

Discharge Measurements

During phase 1 and phase 2, measurements of discharge were made to assess the flow characteristics along the lower Big Tujunga Creek. Discharge measurements were made during daylight hours with either an “AA” or “pygmy” meter using equal-width measurement techniques outlined by Carter and Davidian (1968). There are several potential sources of error associated with flow measurements (Rantz and others, 1982). A discharge measurement is rated using several criteria pertaining to the channel characteristics and number of sections measured. Most measurements made during this study were rated “good” or “fair,” indicating possible errors of 5 to 8 percent. Measurements rated fair were the result of unfavorable channel conditions. Several very low-flow measurements were rated poor when velocities were below the rating of the meter, indicating possible errors greater than 8 percent. Since losses were determined using stable (high) flows, higher error percentages for low-flow measurements are not a concern. No errors were associated with the discharge data from the dam, which were provided by LACDPW. In general, LACDPW measures flow based on rating curves for each valve. The rating curves are compared to reservoir elevation and valve percent open to determine outflow.

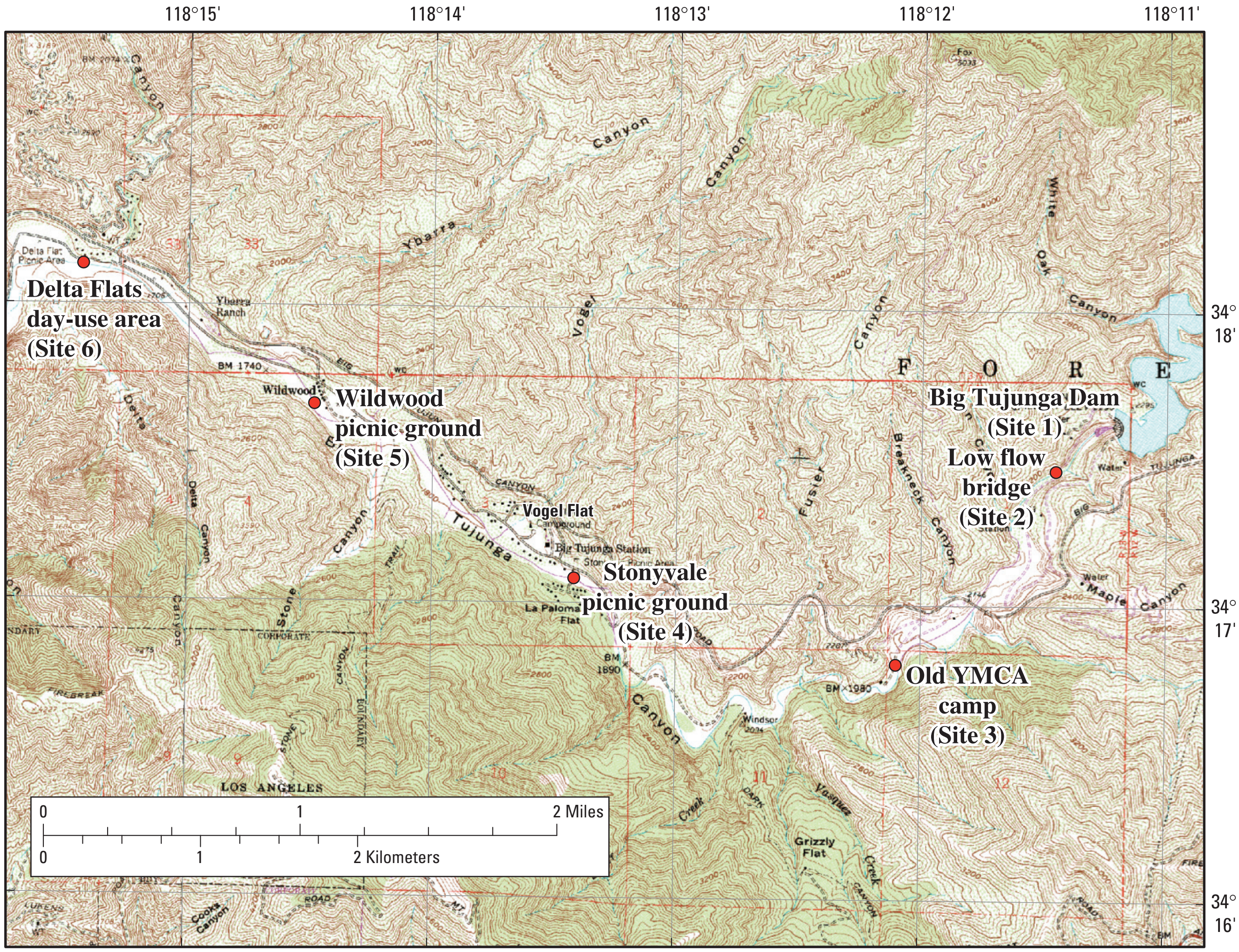

Figure 2. Location of surface-water sites.

Table 1. Site identification numbers and corresponding site names, lower Big Tujunga Creek, Los Angeles County, California.

[See figure 2 for site locations]

Site No.	Site identification No.	Site name	Distance from dam
1	341737118111501	Big Tujunga Dam	0.0
2	341727118113001	Big Tujunga Creek at low-flow bridge below pool at Big Tujunga Dam	0.25
3	341648118120601	Big Tujunga Creek near Burbank YMCA Camp	1.45
4	341705118132401	Big Tujunga Creek near Stonyvale picnic ground	3.65
5	341740118142901	Big Tujunga Creek at Wildwood picnic ground	4.80
6	341808118152601	Big Tujunga Creek at Delta Flats day-use area	5.90

Data Analysis

Flow Releases

The Los Angeles County Department of Public Works provided two flow releases (phases 1 and 2) from the Big Tujunga Reservoir in August and September 2003. The phase 1 release lasted 50 hours, which was not long enough to stabilize flow in the creek. As a result, losses were not analyzed, but the release was used to determine travel times to selected sites downstream. The first release started at 0800 hours (8:00 a.m.) on August 12 and ended at 1000 hours on August 14. Because the initial release of 5.0 ft^3/s had not reached the bridge between sites 2 and 3 after 7 hours, the flow was increased to 10.0 ft^3/s for the remaining 43 hours of the release.

The phase 2 release was used to determine losses at selected locations along the lower Big Tujunga Creek. This second release lasted 5 days (121 hours); the release started with a flow rate of 20.0 ft^3/s at 0800 hours on October 19 and was decreased to 10.0 ft^3/s at 0800 hours on October 20. The 10 ft^3/s rate was maintained for 4 days (97 hours) to stabilize flow in the creek. The release ended at 0900 hours on October 24.

Travel-Time Data

Stream temperature has long been recognized as an important water-quality parameter and has been used as a heat tracer in a variety of applications. For the phase 1 release, temperature was used to determine arrival times at site 2, site 3, site 4, and site 6 (*fig. 2*). Temperature was used because it is a robust, inexpensive parameter to measure, and is immediately available for inspection and interpretation. For an ephemeral stream, a distinct temperature signal almost always marks the initiation of flow (Constantz and Stonestrom, 2003). Site 2 was dry when the temperature probe was deployed in a culvert. When the flow arrived at this site, at about 1119 hours on August 12, a distinct change in the temperature pattern occurred (*fig. 3A*). The travel time to site 2 was about 3 hours. It took most of the 3 hours to fill the pool beneath the dam. Site 3 has a small base-flow (about 0.10 ft^3/s) component that was about 18.5º Celsius (C). When the flow release arrived at 1725 hours on August 12, the temperature rose to 24.0ºC (*fig. 3B*). The travel time to site 3 was about 9.5 hours. At site 4, the temperature probe was placed in a pool about 50 ft upstream from the bridge-crossing at Stonyvale picnic ground. A temperature inflection occurred at about 1107 hours on August 13 (*fig. 3C*), which indicates the start of flow. The arrival of flow at this site was confirmed by observation. The travel time to site 4 was about 27 hours. The temperature probe installed at site 5 was destroyed, and thus travel time to site 5 is unknown. At site 6, the last site, the temperature probe was installed below a dry pool. A temperature inflection occurred around 1028 hours on August 14 (*fig. 3D*), which indicates the start of flow. The arrival of flow at this site was confirmed by observation. The travel time to site 6 (Delta Flats day-use area) was about 51.5 hours.

Monitoring of Pool Stage

The long travel times along the 6-mile study reach were due to the many large pools that had to fill consecutively. Some pools were partially full, but most were dry when the release started. A transducer was installed in a pool a few hundred feet downstream from the bridge at Stonyvale picnic ground (site 4) to monitor the response of a typical pool (*fig. 4*). Although response time for each pool is different depending on the physical parameters of the pool, the shape of the hydrograph of each pool will be similar. The control point of a pool changes as flow increases. When the initial flow enters a pool, smaller rocks will pond the water behind them. As the flow increases, larger rocks or boulders downstream will become the control, until the flow has stabilized. The hydrograph in *figure 4* demonstrates this process. The initial flow fills the pool rapidly to a control point, and keeps filling as the first control is submerged and the next control becomes effective. This process continues as the pool's inflow is greater than the outflow to some point at which the pool is full. When the pool is full the outflow is about equal to the inflow and the flow is considered stable. The hydrograph declines at a much lower rate than it rose as one pool drains into another.

Discharge Measurements

To assess the flow characteristics of the lower Big Tujunga Creek, discharge measurements were collected at sites 3 through 6 (*fig. 2*) during the phase 1 and phase 2 releases. Flow data from the dam were provided by the LACDPW. The dam release was from a 12 in. hollow jet valve which was installed in May 1973. Dam-release and discharge measurements at sites for phase 1 are given in *table 2*. Flow during the first release from the dam and discharge measurements made at sites 3 through 6 are shown in *figure 5*. The flow peaked at about 8.5 ft^3/s at site 3, about 7.0 ft^3/s at site 4, about 4.5 ft^3/s at site 5, and 2.0 ft^3/s at site 6. Release from the dam was shut off an hour after flow arrived at the last site.

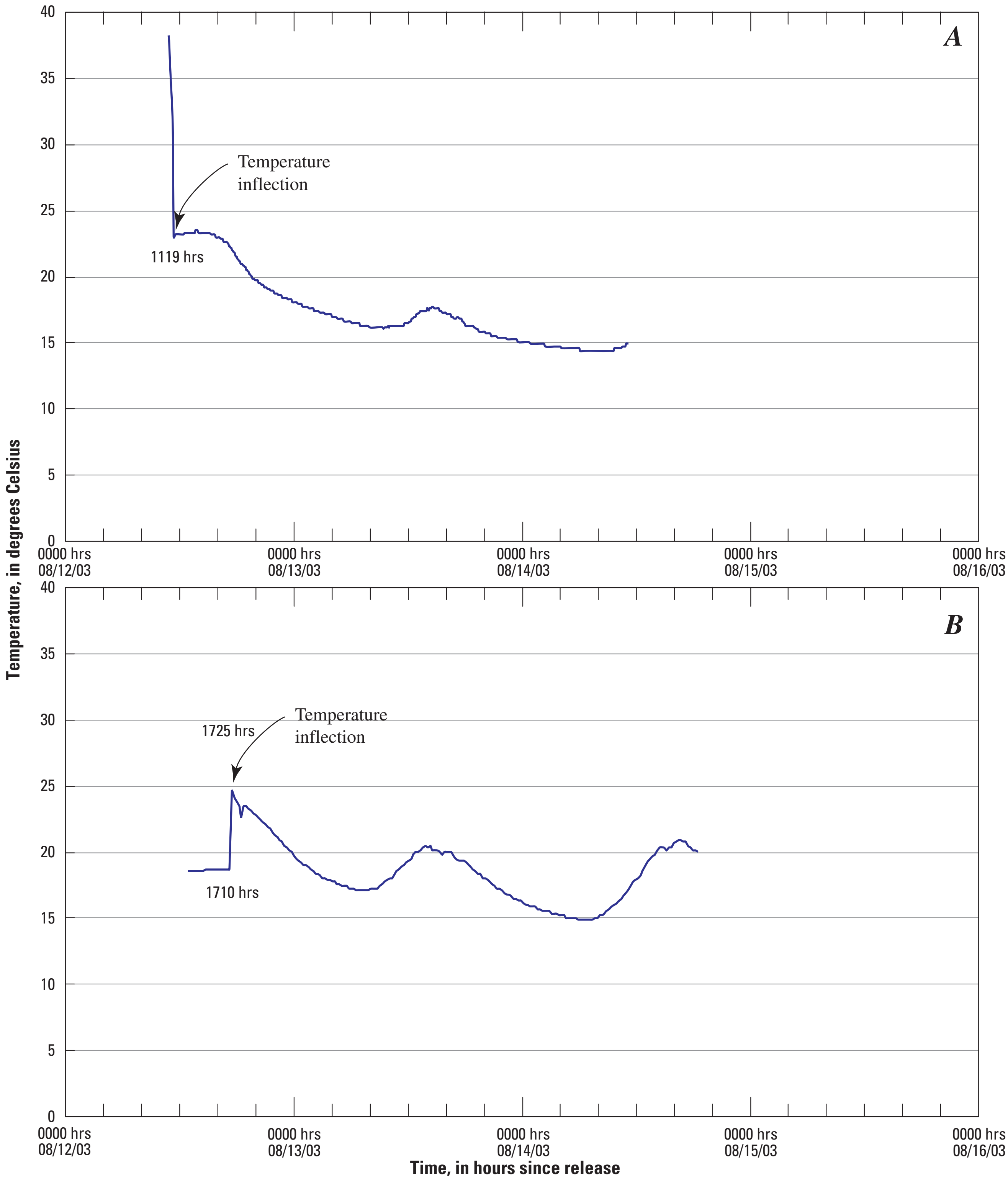

Figure 3. Temperature data at sites 2, 3, 4, and 6 during the first release (August 2003) on Big Tujunga Creek, Los Angeles County, California.

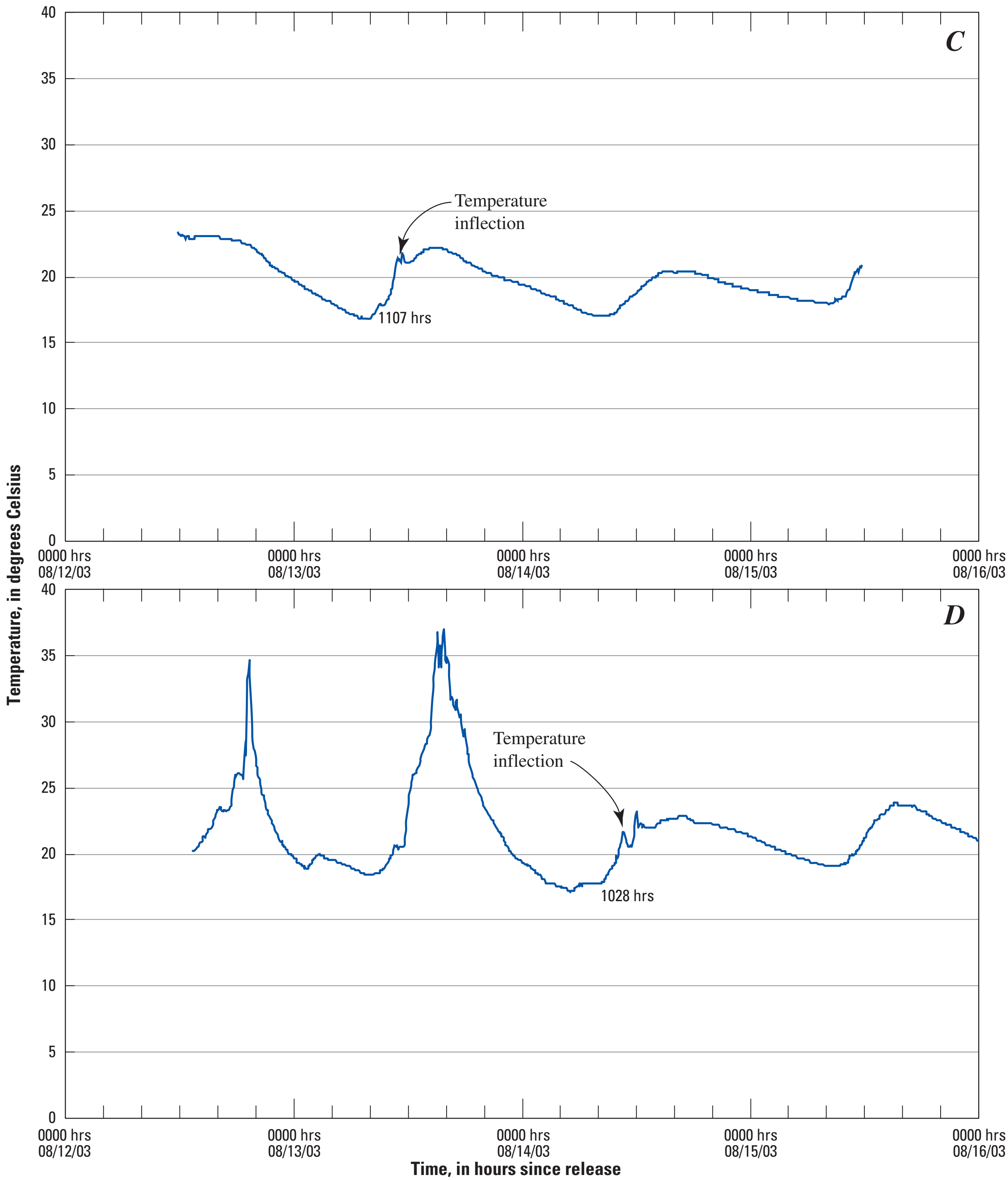

Figure 3—Continued.

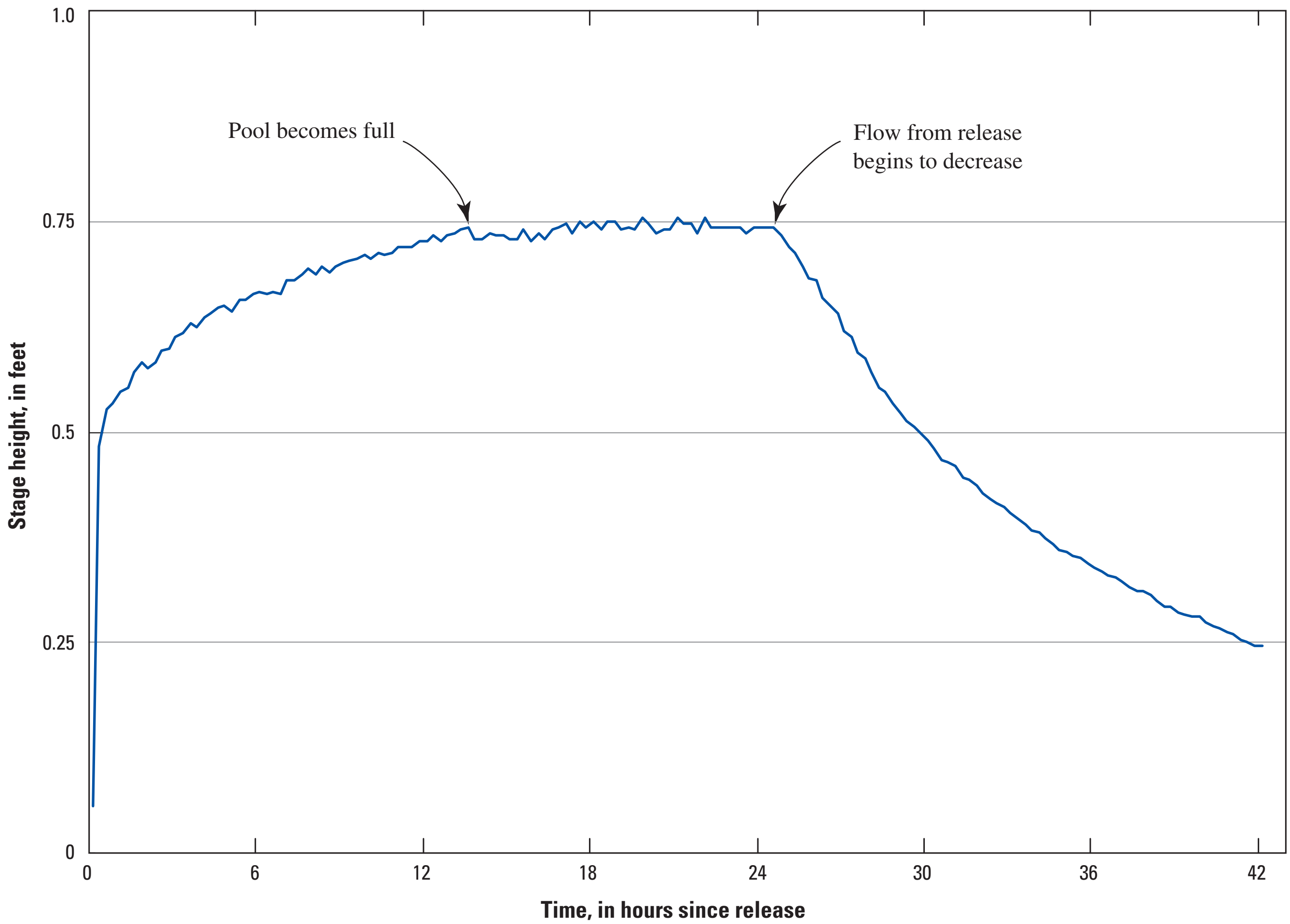

Figure 4. Typical pool-stage response on Big Tujunga Creek (site 4) during the first release, August 2003, Los Angeles County, California.

Table 2. Discharge measurements at five sites on lower Big Tujunga Creek during the first release from Big Tujunga Dam, August 2003, Los Angeles County, California.

[Time is denoted in 24-hour time; ft^3/s, cubic foot per second]

Site name	Site No.	Date	Time	Flow (ft^3/s)
Big Tujunga Dam[1]—release site	1	08/12/2003	0755	0.00
		08/12/2003	0800	5.00
		08/12/2003	1600	10.00
		08/14/2003	1000	10.00
		08/14/2003	1005	0.00
Big Tujunga Creek at low-flow bridge below pool at Big Tujunga Dam	2	08/12/2003	1120	5.00
Big Tujunga Creek near Burbank YMCA Camp	3	08/12/2003	1230	0.03
		08/12/2003	1700	0.03
		08/13/2003	0810	7.73
		08/13/2003	1050	7.53
		08/13/2003	1400	7.90
		08/14/2003	1020	8.76
		08/14/2003	1420	2.40
		08/14/2003	1900	0.43
Big Tujunga Creek near Stonyvale picnic ground	4	08/13/2003	1120	0.00
		08/13/2003	1320	3.11
		08/13/2003	1500	3.25
		08/13/2003	1630	3.83
		08/13/2003	1730	3.67
		08/14/2003	0700	6.88
		08/14/2003	1000	6.74
		08/14/2003	1250	6.60
Big Tujunga Creek at Wildwood picnic ground	5	08/14/2003	0830	3.53
		08/14/2003	1140	4.36
		08/14/2003	1400	4.16
Big Tujunga Creek at Delta Flats day-use area	6	08/14/2003	0800	0.00
		08/14/2003	1300	1.05
		08/14/2003	1520	1.74
		08/14/2003	1740	2.01

[1]Discharge data provided by Los Angeles County Department of Public Works (Sterling Klippel, unpub. data, 2004).

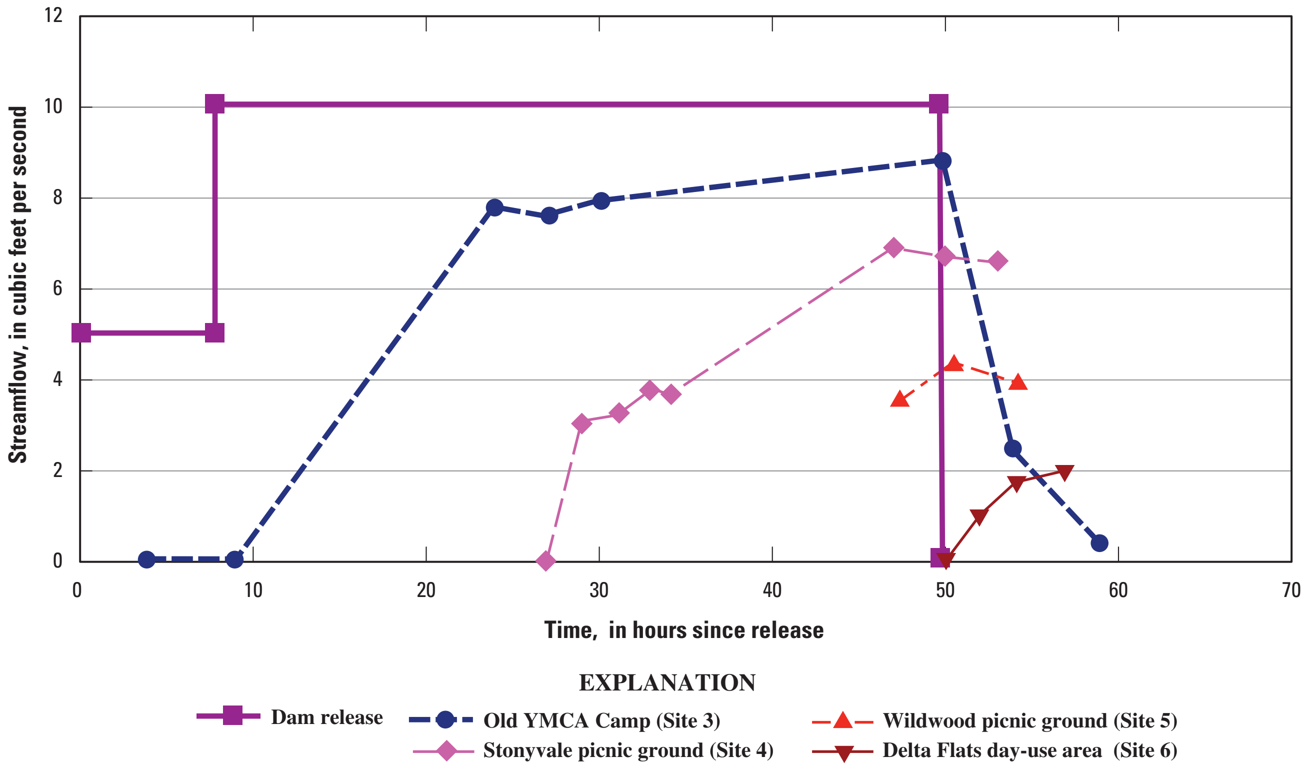

Figure 5. Flow at sites 3–6 on Big Tujunga Creek during the first release, August 2003, Los Angeles County, California.

Table 3. Discharge measurements at five sites on lower Big Tujunga Creek during the second release from Big Tujunga Dam, October 2003, Los Angeles County, California.

[Shaded areas considered stable flow; time is denoted in 24-hour time; ft^3/s, cubic foot per second]

Site name	Site No.	Date	Time	Flow (ft^3/s)
Big Tujunga Dam[1]—release site	1	10/19/2003	0755	0.0
		10/19/2003	0800	20.0
		10/20/2003	0755	20.0
		10/20/2003	0800	10.0
		10/24/2003	0900	10.0
		10/24/2003	0905	0.0
Big Tujunga Creek near Burbank YMCA Camp	3	10/21/2003	1150	8.7
		10/21/2003	1700	8.3
		10/22/2003	1710	8.5
		10/23/2003	1550	8.5
		10/24/2003	0900	8.3
		10/24/2003	1330	2.3
		10/25/2003	1520	1.1
Big Tujunga Creek near Stonyvale picnic ground	4	10/20/2003	1715	7.2
		10/21/2003	1030	7.2
		10/21/2003	1600	7.0
		10/22/2003	1445	6.9
		10/22/2003	1610	6.9
		10/23/2003	1050	6.9
		10/23/2003	1420	7.5
		10/24/2003	1000	7.4
		10/24/2003	1400	7.0
		10/24/2003	1600	4.3
		10/24/2003	1720	3.6
		10/25/2003	0930	0.9
Big Tujunga Creek at Wildwood picnic ground	5	10/20/2003	1615	3.6
		10/21/2003	0930	4.5
		10/21/2003	1500	5.0
		10/22/2003	1000	5.5
		10/22/2003	1500	5.5
		10/23/2003	0950	6.3
		10/23/2003	1300	6.3
		10/23/2003	1730	6.0
		10/24/2003	1110	5.9
		10/24/2003	1420	6.2
		10/24/2003	1645	6.3
		10/25/2003	0900	0.8

Table 3. Discharge measurements at five sites on lower Big Tujunga Creek during the second release from Big Tujunga Dam, October 2003, Los Angeles County, California—Continued.

[Shaded areas considered stable flow; time is denoted in 24-hour time; ft^3/s, cubic foot per second]

Site name	Site No.	Date	Time	Flow (ft^3/s)
Big Tujunga Creek at Delta Flats day-use area	6	10/20/2003	1515	2.6
		10/21/2003	0810	2.7
		10/21/2003	1300	2.8
		10/21/2003	1800	3.4
		10/22/2003	0830	4.4
		10/22/2003	1400	4.9
		10/22/2003	1800	5.2
		10/23/2003	0900	5.9
		10/23/2003	1310	5.4
		10/23/2003	1810	5.2
		10/24/2003	0900	5.8
		10/24/2003	1210	6.0
		10/24/2003	1800	5.7
		10/25/2003	0800	1.3

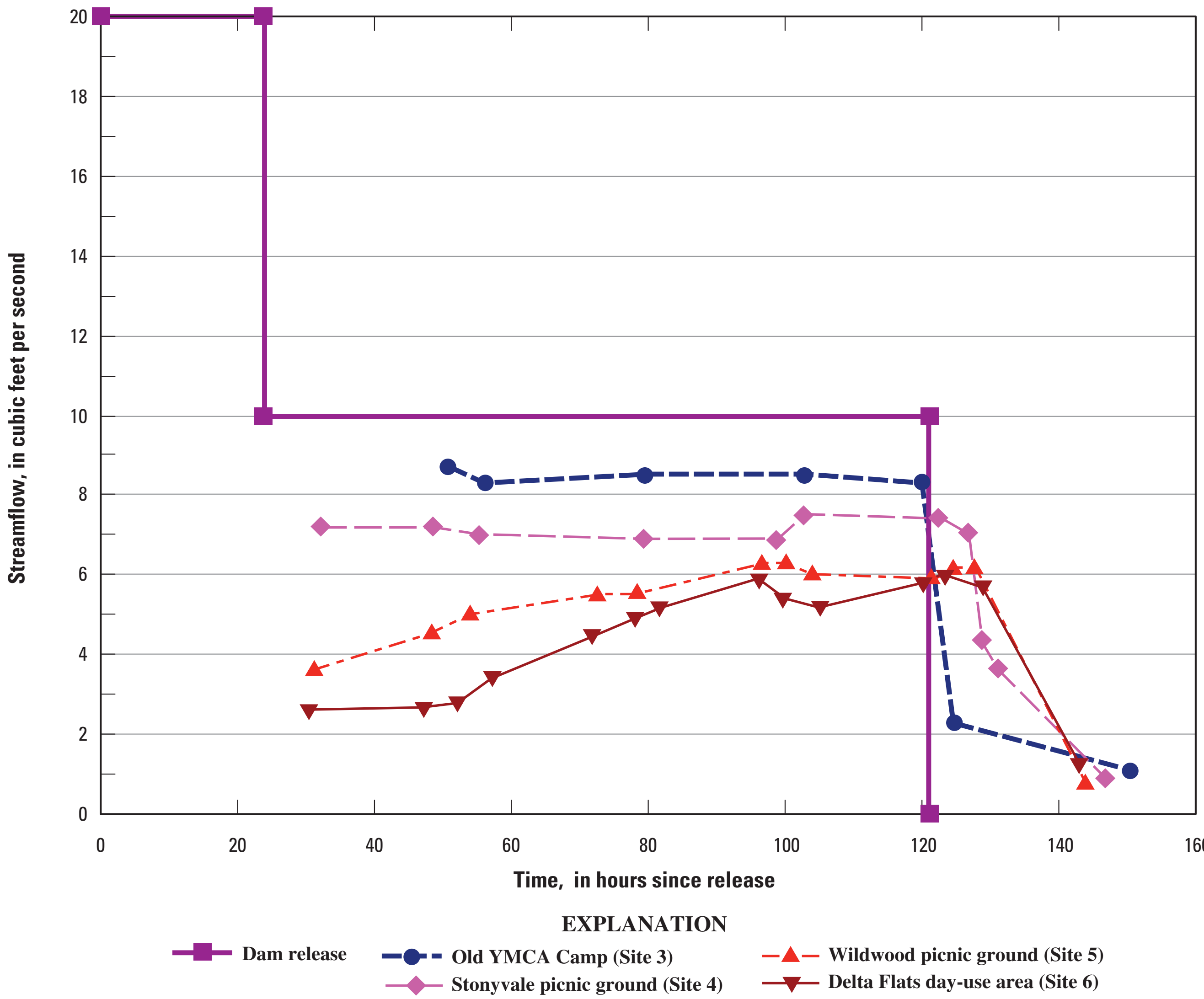

Figure 6. Flow at sites 3–6 on Big Tujunga Creek during the second release, October 2003, Los Angeles County, California.

The phase 2 release rates and the discharge measurements made at sites 3 through 6 are given in *table 3* and shown in *figure 6*. After filling the pools and getting flow through the study reach with a release of 20 ft^3/s for 24 hours, the flow was reduced to 10 ft^3/s. The flow from the dam (site 1) was assumed to be stable (10 ft^3/s) for the remainder of the release. Losses in the plunge pool directly below the dam were assumed to be negligible for this study, so flow at site 2 was assumed to be the same as the release from the dam. Flow at site 3 stabilized at about 8.5 ft^3/s; flow at site 4 stabilized at about 7.5 ft^3/s; flow at site 5 ranged from 5.9 to 6.3 ft^3/s on the last day; flow at site 6 ranged from 5.8 to 6.0 ft^3/s on the last day. Losses were estimated by measuring difference in flow from the dam to sites 3, 4, 5, and 6, when flow was stable at each site or when the last measurement was made before flow decreased as a result of the release being turned off. Flow was assumed to be stable when two consecutive measurements are within measurement error (5%) of each other. Stable flow is designated by shaded areas in *table 3*. Therefore, estimated losses between the dam and selected sites were about 1.5 ft^3/s to site 3; 2.5 ft^3/s to site 4; 3.7 to 4.1 ft^3/s to site 5; and 4.0 to 4.2 ft^3/s to site 6.

Summary

To begin to evaluate proposed release schedules from the Big Tujunga Reservoir that are designed to provide suitable habitat for the Santa Ana Sucker, travel times and creek losses for a 6-mi reach below the reservoir were needed. Although the data collected will not provide managers with all the information necessary to make sound decisions on flow releases to maintain Santa Ana Sucker habitat, the data provide a foundation from which an adaptive approach to water management (storage and release) can be implemented. Considerable uncertainty still exists about how the stream responds to releases in terms of travel times, filling of pools, water loss through evaporation and subsurface seepage (filtration), and how the Santa Ana Sucker population within Big Tujunga Creek may respond to various flow-release strategies.

For conditions similar to those during this study, a 10.0 ft^3/s release from the reservoir will take about 2 days to reach the last site (site 6). If the goal is to release less flow for some duration, about 4 ft^3/s is needed to reach site 6. This study was done during the summer and fall after many years of less than average precipitation. The results presented here may not be typical of travel times or creek losses in other seasons or under other conditions. Travel times will vary depending on the flow released from the dam and amount of water in the pools when the release begins. Losses are dependent on many factors such as the amount of flow in the system, duration since last release, time since last precipitation, number and size of pools, amount of bank storage, evaporation and uptake by plants, and unregulated withdrawals by private homeowners.

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