APPENDIX B-9

FLOW DATA ANALYSIS MEMO

MEMORANDUM

January 24, 2013

To:
Mr. Eric Lim, P.E.
Water Resources Division
Los Angeles County Department of Public Works

From:
Carl Demetropoulos
Senior Fisheries Biologist
BonTerra Consulting

Subject: Flow Data Analysis for the Big Tujunga Reservoir Sediment Removal Project, Los Angeles County, California

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Dear Mr. Lim:

The purpose of this Memorandum is to analyze potential impacts of the proposed sediment removal activities at the Big Tujunga Reservoir and the associated changes in reservoir water releases on the Santa Ana sucker (*Catostomus santaanae*), a federally Threatened fish species that inhabits Big Tujunga Creek below Big Tujunga Dam. With respect to the Santa Ana sucker, there are two potential impacts of concern: (1) maximum water releases during dewatering and (2) lack of operational releases during the dry season. An analysis of the project's anticipated effects on the Santa Ana sucker are discussed below in this Memorandum.

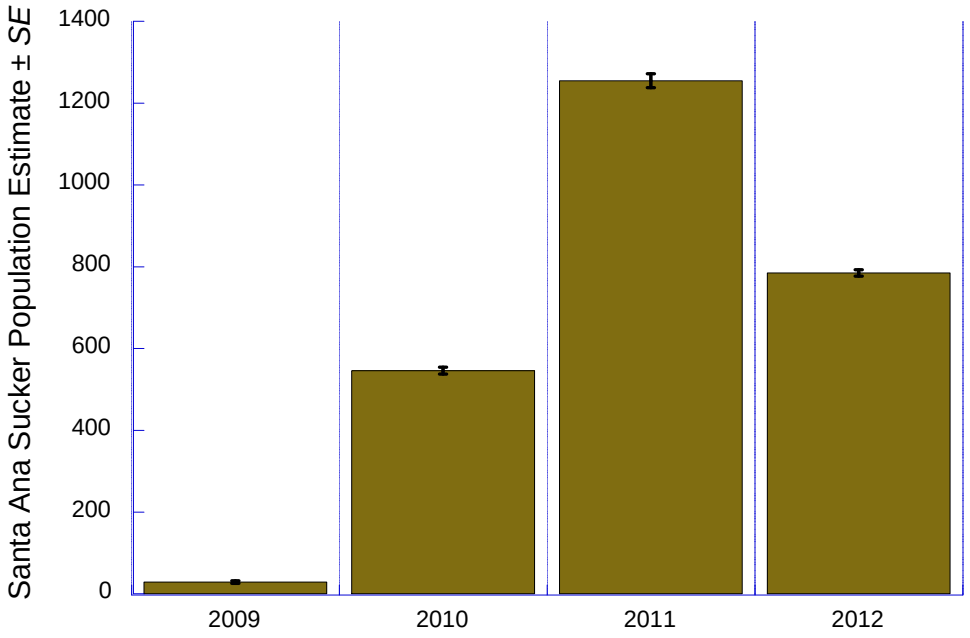
EXISTING CONDITIONS

Santa Ana Sucker Background

The Santa Ana sucker is known to occur in Big Tujunga Creek just downstream of the plunge pool (BonTerra Consulting 2011, 2012, 2013). Santa Ana sucker typically begins to breed (i.e., lay eggs/spawn) in March and April and continue breeding through mid-August (Moyle 2002).

Figure 1 shows Santa Ana sucker populations for 18–22 reaches in Big Tujunga Creek below the dam as described in the 2009–2012 Santa Ana sucker long-term monitoring conducted during September and October of each year by San Marino Environmental Associates (SMEA) and BonTerra Consulting (SMEA 2010a, 2010b; BonTerra Consulting 2012, 2013). In this study, a series of 25-meter reaches are sampled in order to assess the sucker population within Big Tujunga Creek. It should be noted that the first year of sucker population surveys (2009) followed the Station Fire and population counts were extremely low that year; since then, the sucker population has been increasing (Figure 1).

Figure 1
Santa Ana Sucker Population Estimates
September/October 2009–2012



Regular water releases from Big Tujunga Dam are part of Santa Ana sucker ecology in Big Tujunga Creek. Typically, dam releases track what occurs naturally; during a storm, higher flows are released, while during a dry year, lower flows are released. However, the dam operations buffer the Santa Ana sucker somewhat from natural conditions by: (1) dampening high storm flows during the rainy season, and (2) providing water releases during the dry season for water conservation purposes. The Los Angeles County Department of Public Works (LACDPW) has been participating in the Santa Ana Sucker Working Group (SASWG) in order to adaptively manage releases to minimize adverse effects and to increase beneficial effects of releases on the sucker population.

Historic Average Annual Reservoir Reductions

On an annual basis during the storm season, the reservoir flows are released on an as-needed basis, particularly after a large storm event, to ensure adequate capacity behind the dam. These large dam releases during the rainy season are illustrated by the high mean flows in January, February, and March shown in Figure 2 below, which shows average releases for each month of the year from the reservoir from 1999 to 2012. Per discussions with County staff, the dam operators typically release flows from the dam to reach a “minimum pool” by April 15th (i.e., the end of the rainy season) (Mahulikar 2013).

Figure 2
Mean Annual Flow Rates From 1999 Through 2012 ± Standard Error (SE)

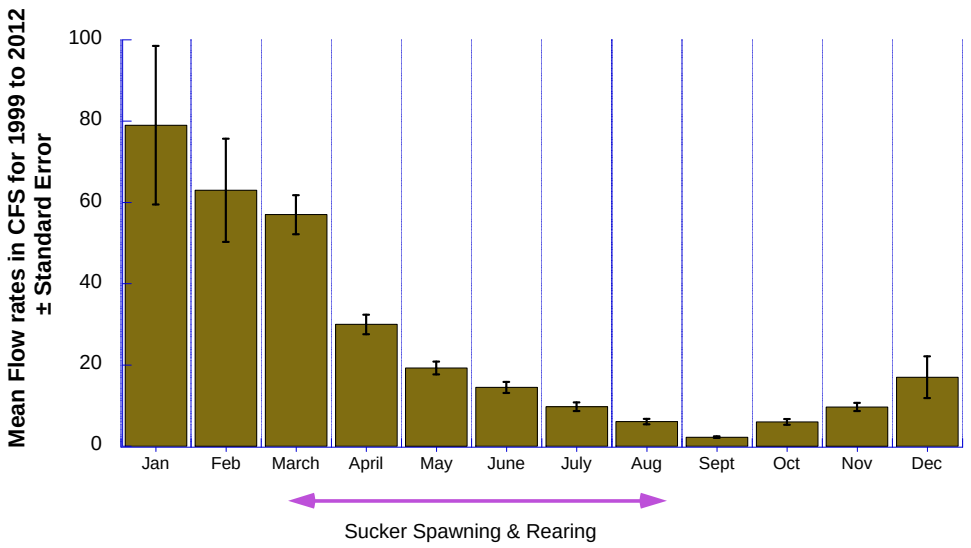
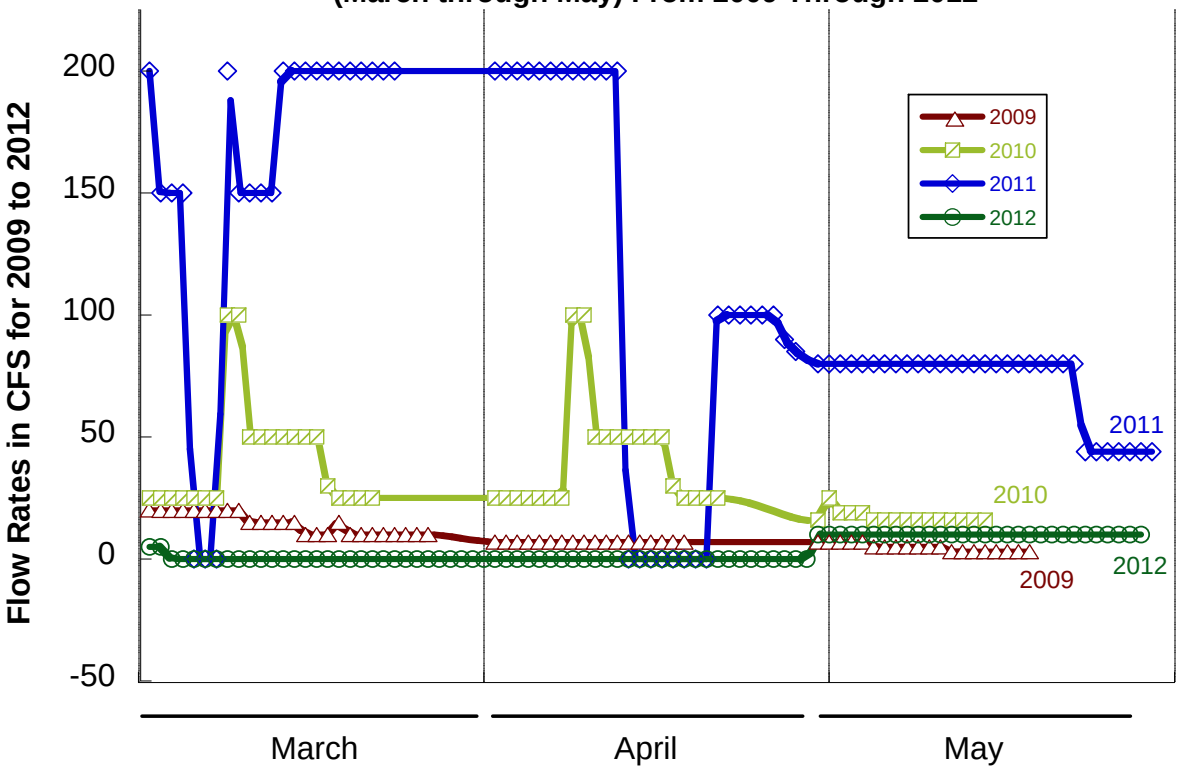


Figure 3
Flow Rates as a Function of Release Dates
(March through May) From 2009 Through 2012[1]



[1] Missing days of flow rate data were assumed to have flow rates equal to days immediately prior to and after those days

Flow data is available that can be compared to the same years as the Santa Ana sucker population survey data (Figures 1 and 3). As illustrated in Figure 3, March 13, 2011 through April 12, 2011 had the highest flow releases of any of the four years of data analyzed. During this time period, a total of 27 of 31 days were at releases of 200 cubic feet per second (cfs), with the remaining 4 days at 150 cfs.

PROJECT DEWATERING PROGRAM

The reservoir is expected to be at a minimum pool elevation of currently estimated at 2,188 ft at the end of the rainy season (April 15th). During each year of sediment removal, dewatering activities would start on or shortly after April 15th. The Contractor would be responsible for two initial tasks: (1) installing a bypass line to direct inflow from upstream of the reservoir into the plunge pool thus "bypassing" the work area in the reservoir, and (2) dewatering the plunge pool and relocating any special status fish[2] from the plunge pool to downstream areas. These efforts are anticipated to take approximately five days.

As the fish relocation efforts are occurring, all valves would be closed; no water releases would occur from the dam into the plunge pool. During this time, recession flows (inflow into the reservoir) would pond behind the dam. Wet and average season recession flows (which are estimated through modeling) show that, in a wet year, the reservoir would rise to elevation of 2,221 feet and in an average year, the reservoir would rise to 2,207 feet (calculated using the average recession flow rates). In a dry year, the flows would be negligible. For the purpose of preparing a conservative analysis with respect to potential impacts to the SAS, only the wet year scenario (i.e., rainfall greater than 32 inches) is considered. The wet year scenario would require the most water to be released from the dam, thus, it is the worst-case scenario that should be evaluated with respect to the Santa Ana sucker. The average inflow to Big Tujunga Reservoir during the months of April and May in a wet year is estimated to be 72.5 cfs.

Table 1 presents the proposed dewatering schedule for a typical wet year; it should be noted that timing and intensity of storms of the rainy season could modify the schedule. This is the anticipated schedule that LACDPW would adhere to during a wet year to dewater the reservoir after April 15th. As previously mentioned, per discussions with County staff, the dam operators typically release flows from the dam to reach a "minimum pool" by April 15th; therefore, dam operations prior to April 15th are considered to be a part of typical operations and are not considered to be dewatering activities associated with the Project.

[2] Arroyo chub (*Gila orcutti*) and Santa Ana speckled dace (*Rhinichthys osailolus*) are known to occur in the plunge pool. Santa Ana sucker has not been found within the plunge pool, but is known to occur in the Big Tujunga creek just below the plunge pool.

TABLE 1
PROPOSED "WET YEAR" DEWATERING SCHEDULE

Day	Time	Dam Flows	Estimated Elevation
1	All Day	None (Close Valves)	2,188
2	All Day	None (Close Valves)	–
3	All Day	None (Close Valves)	–
4	All Day	None (Close Valves)	–
5	All Day	None (Close Valves)	2,221
6	8:00 am to 3:00 pm	Ramp from15 cfs to 60 cfs	2,222
7	8:00 am to 3:00 pm	Ramp from 75 cfs to 100 cfs	2,221
8	All Day	120 cfs	2,220
9	All Day	140 cfs	2,216
10	All Day	160 cfs	2,210
11	All Day	180 cfs	2,202
12	8:00 am to 5:00 pm	180 cfs*	2,188
13	All Day	82.5 cfs	–
14	All Day	82.5 cfs	–
15	All Day	82.5 cfs	–
16	All Day	82.5 cfs	–
17	All Day	82.5 cfs	–
18	All Day	82.5 cfs	–
19	All Day	82.5 cfs	–
20	All Day	82.5 cfs	–
21	All Day	82.5 cfs	–
22	All Day	82.5 cfs	–
23	All Day	82.5 cfs	–
24	All Day	82.5 cfs	–
25	12:00 am to 3:00 am	82.5 cfs	2170
Although not specifically shown through a change in valve pressure in this table, the flows would ramp down naturally as the water approaches elevation 2,188 feet (current minimum pool) and there is less water pressure from water in the reservoir (Chimienti 2013).			

The Contractor would begin dewatering the plunge pool and installing the water diversion system no sooner than April 15th. For five days, the Contractor would dewater the plunge pool and begin to install the bypass line and upstream cofferdam. A qualified Biologist would perform fish relocation in the plunge poolif needed. During these five days, all valves on the dam would remain closed and inflow to the reservoir would pond behind the dam. Although the valves to the dam would be closed, pumping to dewater the plunge pool and leakage from the dam would still provide water to Big Tujunga Creek downstream of the dam.

At the end of the 5 days, ponded water would have reached elevation of 2,221 feet based on an average inflow of 72.5 cfs in a wet year. At this time, Valve A-1 would be used to release water starting at 15 cfs and ramping flows up to 180 cfs (Table 1). It would take approximately 5 days of ramping flows to reach an outflow of 180 cfs. After 1 additional day of releasing at 180 cfs, the water elevation would be below the elevation of the inlet riser for Penstock 1, which is 2,188 feet. At this time, either Valve 2 would be used or pumps would be used to continue to dewater

the reservoir. Therefore, in total, approximately 5 days of ramping releases from 0 to 160 cfs, and 2 additional days of releases at 180 cfs, would be required to dewater the reservoir in a wet year from an elevation of 2,221 feet to an elevation of 2,188 feet. Flows would ramp down (decrease) naturally as the water approaches minimum pool since there will be less water pressure from the depth of water in the reservoir to push flow through the outlet. (Chimienti 2013).

At this point, the Contractor would have completed installation of the upstream bypass line (a high density polyethylene pipe), and inflows to the reservoir would then be diverted past the reservoir directly into Penstock 1 or 2. The Contractor would use a floating barge and pumps to continue to dewater the reservoir from an elevation of 2,188 feet to the top of sediment elevation at 2,170 feet. The pumps would release approximately 10 cfs through either Penstock 1 or 2. The pumped water would combine with the bypass water for a total of approximately 82.5 cfs, and this outflow would continue for approximately 13 days until the reservoir is completely dewatered to an elevation of 2,170 feet (i.e., the sediment level) (Table 1). In total, the dewatering process in a wet year would take a minimum of 25 days; however, only 2 days would include releases of 180 cfs. It should be noted that this time frame is an estimate only; dewatering activities may take longer if late season storms occur late in the rainy season or after April 15th.

Dewatering activities in Year 2 and subsequent years would be similar to those in Year 1. Penstock 1 would be used to dewater the reservoir until it reaches an elevation of 2,202 feet or at the elevation of the Penstock 1 inlet riser. In order to dewater the reservoir from the elevation at 2,202 feet to the sediment level, the hydraulic slide gate may be used if the sediment in the vicinity of the gate has been removed during the previous season's sediment-removal activities.

POTENTIAL DEWATERING IMPACTS TO SANTA ANA SUCKER

A threshold (i.e., maximum) of this species' tolerance to storm or other high water flows has not yet been established. If dewatering occurs at a rate similar to a typical storm, the Santa Ana sucker can likely withstand the higher volume flows for a limited period of time. However, if dewatering flows are large enough for an extended period of time, they could displace suckers and their eggs downstream, affecting their breeding activity. In order to determine whether dewatering would affect the Santa Ana sucker, the maximum storm flow releases from the dam during the months of March and April (see Figure 3) were compared to recent Santa Ana sucker population counts (see Figure 1) recorded during long-term monitoring efforts for the Santa Ana sucker in 2009–2012 (SMEA 2010a, 2010b; BonTerra Consulting 2012, 2013).

Within the time period for which there is sucker population data, only one year (2011) had high flows for consecutive days (Figure 3). Between March 13 and April 12, 2011, 27 of 31 days included releases of 200 cfs, with the remaining 4 days at 150 cfs. This time period corresponds to the survey results in September/October 2011, which indicate that Santa Ana sucker populations were at their highest numbers (Figure 1). When examining the data by size class, the number of juveniles observed in 2011 was not significantly different from the number of juveniles observed in 2010 or 2012; the number of adults was not significantly different from the number of adults observed in 2012 and was greater than the number of adults observed in 2010 (BonTerra Consulting 2013).The data does not indicate sucker populations were impacted by increased flows from the dam during March–April 2011. Moreover, flows up to 200 cfs for 27 days during 2011 correlate to relatively strong sucker population numbers 5 months later.

It should be noted that, while the Santa Ana sucker breeding season begins in March or April, it continues into May and even into the summer months if conditions are suitable. It is not known whether the high flows for extended periods of time have any effect on sucker breeding, potentially by delaying the spawning until May. It is possible that historic high releases during a wet year result in conditions that would be suitable for the sucker to continue breeding into the later spring and early summer months, thereby offsetting potential negative effects caused by high flows in the early spring.

While one year maximum flow data is not enough to draw conclusions for the species' tolerance range, it can be assumed that the Santa Ana sucker was able to persist during the previous periods of extremely high flows (e.g., 2005, 2006). This relationship can be further examined as additional years of sucker population data are collected for the Santa Ana Sucker Working Group.

The proposed dewatering regime flow rate recommendation (i.e., maximum of 180 cfs) is within the range of flows and the below the maximum flow (i.e. 200 cfs) experienced by the Santa Ana sucker in 2011 (and during previous wet years), and is therefore not expected to affect the sucker population. As shown in Table 1, Dam operations would 'ramp' flows (i.e., step-wise increases and decreases) to mimic natural stream hydrology.

Dewatering Impact Conclusion

Flow data show that 31 days of relatively high flows (i.e., March 13, 2011–April 12, 2011) did not cause a reduction in the Santa Ana sucker population count the following fall (October 2011); therefore, it can be assumed that future flow rates at this same level and for a similar interval of time would not negatively impact the Santa Ana sucker population. As such, the proposed Dewatering Program with only two days of releases at 180 cfs after April 15th (Table 1) is not expected to impact the Santa Ana sucker population.

It should be noted that appropriate sediment controls would be in place to ensure that increased flow velocity and reservoir dewatering would not cause increased siltation impacts. The breeding season is a critical time of year for Santa Ana sucker, when egg-laying, hatching of larva, and fry rearing occur. It is critical for Best Management Practices for sediment control operate effectively because silt has the potential to smother lithic diatoms (algae) critical to the growth of early life-stages of the sucker and can cause fouling of gills in larvae and juvenile sucker. The Biological Monitor would inspect the sediment controls in the plunge pool and at the outflow into the creek downstream of the plunge pool to ensure that these protective measures are functioning properly.

DRY SEASON BYPASS FLOWS

During sediment removal, flows from Big Tujunga Creek would be taken in a bypass line around the reservoir and released into the plunge pool. Therefore, the inflow into the bypass line from the creek above the reservoir would equal the amount of outflow from the bypass downstream of the dam. During this time, the Santa Ana sucker would be completely dependent on natural flows; there would be no water in the reservoir to release to supplement the creek flows. As under natural conditions in a dry year, the stream could dry up and strand the sucker in small puddles, and could kill the sucker if the stream becomes too shallow or dries completely.

During typical operating procedures, the LACDPW generally releases water from the reservoir at the same rate as the inflow into the reservoir (Chimienti 2012); thus, the stream flows mimic

natural conditions during the dry season. A t-test analysis was performed on inflow/outflow data[3] during the months of May, June, July, August, and September to verify whether water releases during the dry season have typically equaled inflow to the reservoir. While this time period included a wide range of natural variation with both extremely dry and wet years, the analysis verifies that inflow typically equals outflow. September was the only month to show an inflow vs. outflow difference, with a mean outflow of 0.60 cfs compared to inflow of 1.6 cfs ($p < 0.0001$), which suggests that, on average, September may provide more water during bypass operations than has typically been released in this month.

Dry Season Bypass Flows Impact Conclusion

Although Santa Ana sucker population estimates were not available until 2009, the flow data between 1999 and 2012 show that there were multiple cycles of dry years and wet years, and the Santa Ana suckers were able to persist through dry years (e.g., 2002, 2007, and 2012). Additionally, as shown from the long-term monitoring data to date (2009–2012), the Santa Ana sucker population is able to recover from disturbance relatively quickly. For example, following the Station Fire in 2009, the Santa Ana sucker only occurred in two reaches (EDAW and SMEA 2009), but by 2011, they had expanded to 17 of the 18 reaches surveyed (BonTerra Consulting 2012) . Therefore, if there is a dry year and Santa Ana sucker die off (as would be expected under natural conditions [i.e. without the dam in place impounding additional water] in a dry year), the Santa Ana sucker have the capacity to recover from the disturbance within a few years. Based on observable historic data, the bypass system (inflow equal to outflow) is not expected to negatively impact the Santa Ana sucker.

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[3] It should be noted that inflow data was measured in the morning once per day compared to gauge measurements continuously taken for outflow data; continuous inflow data is not available.

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