WATER SUPPLY IMPACTS

Testimony of Ali Shahroody
(Panel V)

1. SUMMARY

The results of analyses based on the Santa Ynez River Hydrology Model indicate that the proposed EIR alternatives will produce substantially greater shortages in Cachuma Project water supply during droughts in comparison with the historical operation (Alternative 1). Under the historical operation, without any releases for fish, the Cachuma Project endured shortages during prolonged drought periods. The interim operations under the Biological Opinion (Alternative 2) as well as the proposed operation with 3.0' surcharge (Alternative 3C) will result in significant increases in shortages of water provided by the Cachuma Project to the Member Units. The Project shortage would be substantially compounded if the 3.0 surcharge is not implemented (Alternative 3A) as otherwise planned under the proposed operation. Under this alternative (Alternative 3A) the shortage in a critical drought year (1951) would be nearly fifty percent of the Project's normal supply. It is also important to understand that the shortages predicted by the model understate the shortages that will occur in actual practice. This happens because the Santa Ynez River Hydrology Model knows the precise length of a drought; while water supply managers do not. Thus, while the model does not operate to reserve water during a drought to meet demands for an additional year of drought, real world water supply managers do, thereby increasing substantially both the shortage in critical drought year deliveries and the cumulative shortage over the critical drought period.

The impacts on Cachuma Project water supply resulting from releases for fish are summarized in Table 1-1. The table shows the shortages to water supply during the last three years of the critical drought period of 1947 through 1951.

TABLE 1-1 Impacts of Fish Water Releases on Cachuma Project Water Supply in Critical Drought Period 1949 – 1951 (acre-feet)

Cachuma Operations	Shortage in Critical Drought Year 1951	Shortage as Percentage of Annual Draft	Cumulative Shortage in Critical Drought Period 1949-1951	Shortage as Percentage of Annual Draft for 3 Years
Historical Operation – no surcharge (no releases for fish)	7,070	27%	14,210	18%
Interim Operation 0.75' surcharge (1.5/2.5/5.0 cfs @ 154; 2 cfs @ Hilton)	9,810	38%	20,130	25%
Proposed Operation with 3.0' surcharge (2.5/5.0/10.0 cfs @ 154; 1.5 @ Alisal in spill and year after spill; 2 cfs @ Hilton; also includes 3,200 af Passage Account and 500 af Adaptive Management Account in spill year)	9,890	38%	19,920	26%
Operation with 0.75' surcharge (2.5/5.0/10.0 cfs @ 154; 1.5 @ Alisal in spill and year after spill; 2 cfs @ Hilton; also includes 3,200 af Passage Account and 500 af Adaptive Management Account in spill year)	11,810	46%	24,850	32%

Note: Annual draft from Cachuma Project is 25,714 acre feet.

2. KEY HYDROLOGIC ASPECTS OF THE BIOLOGICAL OPINION/ FISH MANAGEMENT PLAN

YEAR-LONG HABITAT FLOWS

The BO and FMP provide year-long habitat flows in the lower Santa Ynez River through releases from Cachuma Reservoir. By comparison, the minimum stream flow below Cachuma prior to the construction of Bradbury Dam would typically be zero during the late spring, summer, and early fall months. The year-long habitat flows provided by the BO and FMP were structured to provide the most benefit for the steelhead given the variable rainfall and streamflows, habitat quality, and limited water supply.

Downstream Target Habitat Reaches

Downstream target habitat reaches are categorized by the SYRTAC biologists into primary and secondary reaches based on field surveys of habitat and water quality. Releases from Cachuma Reservoir for spawning and rearing habitat are structured to focus on the reaches where the likelihood for successful protection and improvement of steelhead populations is highest. Basically, water temperatures are elevated and canopy cover decreases about 3-10 miles downstream from the dam (FMP, 10/2000). The priority of habitat reaches for management (FMP, 10/2000) is as follows:

- Hilton Creek (1st Priority)
- Mainstem from Hilton Creek to Highway 154 Bridge (2nd Priority)
- Mainstem from the Dam to Hilton Creek (3rd Priority)
- Highway 154 Bridge to Solvang (4th Priority)

Opportunistic Nature Of Variable Target Flows

Target flows for the priority reaches are variable, depending upon the hydrologic conditions of the watershed. Fish population surveys show that fish are much more abundant in wet years compared to dry and average years. Releases for fish are structured to ensure higher levels of flow in the primary and secondary habitat reaches during years when steelhead are more likely to benefit (*i.e.*, Cachuma Reservoir spills more than 20,000 acre-feet). Also, impacts on Project water supply deliveries from releases for fish are greatest during droughts, when fish populations are also the smallest. Target flows are then reduced when Cachuma storage drops below 120,000 acre-feet.

The interim and final target flows of the Biological Opinion (BO) by the National Marine Fisheries Service (NMFS) (Sep. 2000) and the Lower Santa Ynez Fish Management Plan (FMP) (Oct. 2000), are shown in Table 2-1 and Table 2-2.

TABLE 2-1 Long-Term Mainstem Rearing Target Flows

Lake Cachuma Storage	Reservoir Spill?	Target Flow	Target Site
> 120,000 AF	Spill > 20,000 AF	10 cfs	Highway 154 Bridge
> 120,000 AF	Spill > 20,000 AF	1.5 cfs*	Alisal Road Bridge
> 120,000 AF	If Spill is >20,000 AF in previous year	1.5 cfs*	Alisal Road Bridge**
> 120,000 AF	Spill <20,000 AF or No Spill	5 cfs	Highway 154 Bridge
< 120,000 AF	No Spill	2.5 cfs	Highway 154 Bridge
<30,000 AF	No Spill	Periodic release; ≤30AF per month	Stilling Basin and Long Pool

(Source: Lower Santa Ynez River Fish Management Plan, October 2, 2000, pg. 3-9)
** When rainbow trout/steelhead are present in the Alisal Reach.*
*** This target will be met in the year immediately following a >20,000 AF spill year.*

TABLE 2-2 INTERIM MAINSTEM REARING TARGET FLOWS

Lake Cachuma Storage	Reservoir Spill?	Target Flow	Target Site
> 120,000 AF	Spill > 20,000 AF	5 cfs	Highway 154 Bridge
> 120,000 AF	Spill <20,000 AF or No Spill	2.5 cfs	Highway 154 Bridge
< 120,000 AF	No Spill	1.5 cfs	Highway 154 Bridge
<30,000 AF	No Spill	Periodic release; ≤30AF per month	Stilling Basin and Long Pool

Conjunctive Use Of Water Rights Releases

Water rights releases are coordinated with scheduled releases for fish and provide flows for the habitat reaches in the lower Santa Ynez River, including Hilton Creek. Water rights releases provide flows for a designated period as a conjunctive operation with the fish water releases. The conjunctive use operation of water rights releases would extend the period of time each year when instream flows improve fisheries habitat for over-summering and juvenile rearing within the mainstem river.

PASSAGE RELEASES AND ADAPTIVE MANAGEMENT RELEASES

In addition, under both the BO and FMP, a specific volume of water is dedicated for the "Fish Passage Account" of 3,200 Acre-feet and for the "Adaptive Management Account" of 500 acre-feet, for a total of 3,700 acre-feet when the Cachuma Reservoir is surcharged to 3.0 feet. The water in these two accounts is allowed to carryover from one year to the next; however, the accounts are deemed to spill first and are then reset to their maximum amount of 3,700 acre-feet. Water in the passage account is planned to be used to supplement storms by augmenting the descending limb of the storm hydrograph below Bradbury Dam. The actual procedure for determining when and how passage releases will be made is still being developed with AMC.

RAMPING OF RELEASES (INCLUDING WATER RIGHTS RELEASES)

The Biological Opinion and Fish Management Plan also sets forth formalized ramping rates (Table 2-3) for downstream releases to minimize the potential for fish stranding.

TABLE 2-3 MAINSTEM RAMPING SCHEDULE FOR DOWNSTREAM WATER RIGHTS RELEASES

Release Rate (cfs)	Ramping Increment (cfs)	Ramping Frequency (no more than once every…)
>90	25	4 hours
90 to 30	10	4 hours
30 to 10	5	4 hours
10 to 5	2.5	4 hours
5 to 3.5	1.5	4 hours
3.5 to 2.5	1	4 hours

SURCHARGE *VS.* PROJECT YIELD IMPACTS

- Surcharge occurs only in spill years (only partially offsets continuous fish releases in all years when storage >30000 af)
- Critical droughts

Reclamation is proposing to surcharge the reservoir 3.0 feet above the top of the spillway gates (750.0 feet level). Currently Reclamation can surcharge the reservoir by 0.75 feet. The reason for this surcharge is to partially offset the water supply impact of releases for fish and downstream habitat. A recent Cachuma Lake bathymetric study (October 2000) shows that Cachuma Lake capacity at 750.0 feet is 188,035 acre-feet, a reduction of 2,374 acre-feet from the year 1989 survey capacity of 190,409 acre-feet. It also represents a reduction of 17,000 acre-feet from the original capacity of 205,000 acre-feet.

Table 2-4 shows the maximum surface elevation and storage capacity associated with each corresponding surcharge level using the 2000 elevation-area-capacity curves for Cachuma.

TABLE 2-4 CACHUMA RESERVOIR SURCHARGE

Surcharge (feet)	Maximum Elevation (feet)	Maximum Storage (acre-feet)	Storage Difference from No Surcharge (acre-feet)	Maximum Surface Area (acres)
0	750.0	188,035	0	3,048
0.75	750.75	190,336	2,301	3,076
1.8	751.8	193,585	5,550	3,113
3.0	753.0	197,343	9,308	3,155

The surcharge only partially offsets the water supply effects of releases for downstream habitat because the surcharge only occurs during spill years (approximate 1/3 of years) while fish releases occur every year. The releases for downstream habitat especially affect the water supply during critical droughts when shortages in available water supplies are experienced without fish releases. In other words, fish releases will increase the amount of shortages in available water supplies. The results of analysis based on the

Santa Ynez River Hydrology Model indicate that even with the proposed surcharges the shortages in water supply during droughts in comparison with the baseline WR89-18 will be exacerbated by the releases for downstream habitat (see Table 1-1).

3. HYDROLOGIC ANALYSES OF EIR ALTERNATIVES

Seven alternatives were analyzed for the draft environmental document. They consist of the following alternatives:

- Baseline WR89-18
- Interim Phase BA/BO/FMP
- 3A Final Phase BA/BO/FMP, Reduced Surcharge (0.75')
- 3B Final Phase BA/BO/FMP, Reduced Surcharge (1.8')
- 3C Final Phase BA/BO/FMP, Surcharge (3.0')
- 4A Final Phase BA/BO/FMP plus Below Narrows Exchange via artificial recharge
- 4B Final Phase BA/BO/FMP plus Below Narrows Exchange via direct delivery to the City of Lompoc

The Santa Ynez River Hydrology Model (SYRHM) including USGS and USBR data were used to analyze the hydrologic impacts of the releases for downstream habitat. The results are summarized in the following sections of this testimony.

CACHUMA RESERVOIR OPERATIONS

Magnitude and Frequency of Spills and Releases

On average, over the hydrologic period (1918-1993), the total amount of water passed through at Bradbury Dam, by spills, water right releases, and fish releases, is about the same or with slight variations (except for Alternative 4 in which less water would pass through at the dam due to BNA exchange). Figures 3-1A & B show the frequency of releases and spills from Cachuma Reservoir for all alternatives. In summary, the

changes in Cachuma Reservoir operations due to releases for fish would result in conditions in more low flow releases and less spills which affect the Santa Ynez River flows below Bradbury Dam.

FLOWS WITHIN THE PRIMARY AND SECONDARY HABITAT ZONES OF THE LOWER SANTA YNEZ RIVER

Figures 3-2A – F show the frequency of flows at six different locations downstream of Cachuma Reservoir for the various alternatives based on the results of SYRHM. The releases for fish and downstream habitat create year-long habitat downstream of Bradbury Dam compared with historic Cachuma operation (Alternative 1). The low flow magnitudes are raised to 2.5, 5.0, and 10.0 cfs at the Hwy 154 Bridge depending on hydrologic conditions.

IMPACTS ON PROJECT WATER SUPPLY

- Critical droughts
- Real time management during critical droughts

The results of analyses from Santa Ynez River Hydrology Model indicate that the proposed EIR alternatives will produce substantially greater shortages in water supply during droughts in comparison with baseline operation under WR89-18 (Alternative 1). During the critical drought period of 1947 through 1951, the historical precipitation at Gibraltar Dam varied from 35% to 60% below normal. The shortages to water supply during the last three years of this critical period for the various EIR alternatives are shown in Table 3-1.

TABLE 3-1 IMPACTS OF FISH RELEASES ON PROJECT WATER SUPPLY IN CRITICAL DROUGHT PERIOD, 1949 THROUGH 1951 (ACRE-FEET)

EIR Alternative	Shortage in Critical Drought Year (1951)	Shortage as Percentage of Annual Draft	Cumulative Shortage in Critical Drought Period (1949-1951)	Shortage as Percentage of Annual Draft for Three Years
1	7,070	27	14,210	18%
2	9,810	38	20,130	26%
3A	11,810	46	24,850	32%
3B	11,260	44	23,270	30%
3C	9,890	38	19,920	26%
4A&B	9,350	36	17,470	23%

Note: Annual draft from Cachuma Project is 25,714 acre-feet.

As shown in the above table, by themselves, the Cachuma operations proposed in Alternative 3C, (surcharging 3.0') will produce substantially greater shortages in the Cachuma Project yield during the critically dry period compared with Alternative 1. During the last three years of the critical period, an incremental shortage of approximately 5,700 acre-feet occurs compared to the baseline (Alternative 1). In the worst year of the critical period, an additional reduction in yield of 2,800 acre-feet occurs compared to the baseline (Alternative 1). Alternatives 3A and 3B substantially increase these already large shortages by an additional 4,930 acre-feet and 3,350 acre-feet, respectively, in the last three years of the critical period.

In real-time planning for water supply during a prolonged drought, water supply managers do not know if they are in the last year of the drought. They have to plan as if the next year would be an additional dry year. Table 3-1 above is based on the historical hydrology, with a perfect forecast, when the exact length of drought is already known. In actual practice, however, Project managers have to plan for water supply assuming the year following the worst historical drought period itself would be dry. With reserves set aside for an additional dry year following the worst year of the critical period, the shortages are substantially greater as described in Table 3-2.

TABLE 3-2 IMPACTS OF FISH RELEASES ON PROJECT WATER SUPPLY IN CRITICAL DROUGHT PERIOD, 1949 THROUGH 1951
WITH RESERVES SET ASIDE FOR AN ADDITIONAL DRY YEAR (ACRE-FEET)

EIR Alternative	Shortage in Critical Drought Year 1951	Shortage as Percentage of Annual Draft	Cumulative Shortage in Critical Drought Period 1949-1951	Shortage as Percentage of Annual Draft for Three Years
1	12,740	50	22,800	30%
2	14,790	58	27,030	35%
3A	16,500	64	31,220	40%
3B	15,940	62	29,460	38%
3C	15,380	60	27,750	36%
4A&B	15,090	59	24,530	32%

Note: Annual draft from Cachuma Project is 25,714 acre-feet.

In summary, Alternatives 3A and 3B in comparison with Alternative 3C will exacerbate the water supply impacts of a prolonged drought and the shortages already associated with the fish releases in the BO, substantially increasing shortages further.

IMPACTS ON LAKE CACHUMA WATER SURFACE ELEVATION

Figure 3-3 shows the Cachuma Reservoir storage level for the 76 year simulation period extending from 1918 through 1993. The minimum storage level (minimum pool) for all alternatives is set to 12,000 acre-feet which occurs during the critical drought of 1947-1951 for all alternatives. Table 3-3 summarizes average Lake Cachuma elevation, storage, and surface area for each alternative. In general, the median elevation, storage, and surface area are higher for Alternatives 1, 3C, and 4A & 4B. Alternative 3A results in the lowest median reservoir elevation, median storage, and median surface area.

TABLE 3-3 CACHUMA RESERVOIR ELEVATION, STORAGE, AND SURFACE AREA AVERAGE FOR 1918-1993 (SYRHM)

Alternative	Surcharge (feet)	Median Elevation (feet)	Median Storage (acre-feet)	Median Surface Area (acres)
1	0	734.08	144,318	2,471
2	0.75	733.73	143,573	2,463
3A	0.75	732.25	139,961	2,425
3B	1.8	733.31	142,531	2,452
3C	3.0	734.62	145,761	2,488
4A&B	3.0	735.19	147,205	2,505

Figures 3-4A – D show the intra-annual variations in reservoir storage for the six alternatives.

IMPACTS ON MAGNITUDE AND FREQUENCY OF SPILLS

The magnitude and frequency of spills will decrease in the future due to releases for fish and habitat maintenance, surcharging, and modified storm operations. The SYRHM results show that the EIR Alt3C would only slightly reduce the frequency of spills compared to current operations by about 5 percent, while EIR Alt 3A would reduce the frequency of spills by about 3 percent compared to current operations.

ADDITIONAL HYDROLOGIC IMPACTS

- Water rights releases
- Groundwater levels

During low flow periods, there is more percolation into the ground water basin below Bradbury Dam with releases for fish. As shown in Figure 3-5A, the above Narrows riparian basin recovers to the same levels with the recharge of winter runoff under Alternatives 1, 2, and 3A. Figures 3-5A-B show the changes in total dewatered storage in the entire above Narrows's riparian basin. Figure 3-5B shows that there is only a very small to no difference between Alternatives 3A, 3B, 3C, 4A, and 4B on groundwater storage in the above Narrows basin.

Table 3-4 shows the impacts to water rights releases for the various alternatives as determined by the Santa Ynez River Hydrology Model. The Above Narrows Account is dependent upon groundwater storage in the Above Narrows basin because the account cannot be larger than the dewatered storage under WR89-18. Because there will be relatively less dewatered storage in the Above Narrows aquifer due to fish releases, the Above Narrows account will be reduced consistent with WR89-19 and compared to Alternative 1 the reduction would be 300 to 660 acre-feet per year. The average annual reductions in water right releases under Alternatives 3A, 3B, 3C, and 4A-B compared to Alternatigve1 would be about 10 percent.

TABLE 3-4 SIMULATED IMPACTS TO WATER RIGHT RELEASES FOR WATER YEARS 1918-1993 (ACRE-FEET/YEAR)

	Alt 1	Alt 2	Alt 3A	Alt 3B	Alt 3C	Alt 4 A&B
WR89-18 Releases	6,322	6,023	5,658	5,682	5,737	5,711
Difference in WR89-18 Releases	---	-299	-660	-640	-590	-611
Percent Reduction in WR89-18 Releases	---	4.7%	10.4%	10.1%	9.3%	9.7%

That means, on average, there would be about 10 percent less water available for releases to downstream water users. To the extent water rights releases are managed to meet the calls of downstream users, such as ID No.1, this reduction may negatively impact some of the users in the lower Santa Ynez River basin in drought periods.

4. RELEASES FOR THE B.O. LONG-TERM FLOW REQUIREMENTS

The volume of water required to meet the Biological Opinion long-term flow requirements was analyzed using the Santa Ynez River Hydrology Model. Not including spills and natural flows, the total annual water needed from Cachuma Reservoir to meet the long-term rearing target flows is 3,900 acre-feet on average for the period 1918 through 1993 (76 years). This amount does not include any releases from the 3,200 acre-feet Passage Account or 500 acre-feet Adaptive Management Account. This annual average figure consists of releases from Cachuma Project, contributions from WR89-18 water rights releases, and leakage from the dam.

Figure 4-1 shows the annual releases from Cachuma Project to meet the long-term rearing target flows from the model period 1918 through 1993. As shown in Figure 4-1, the average annual amount released from the Project would be 2,185 acre-feet. Figure 4-2 shows the annual contributions from WR89-18 water rights releases in meeting the rearing habitat target flows. The conjunctive use of WR89-18 water rights releases to meet target habitat flows has been incorporated into the Settlement Agreement. The average annual amount of contributions from WR89-18 releases would be 1,220 acre-feet as shown in Figure 4-2. Figure 4-3 shows the annual contributions from both Cachuma Project and WR89-18 releases. The leakage from the dam toward meeting rearing habitat target flows is calculated to average about 500 acre-feet per year. Table 4-1 shows the breakdown of releases that meet the long-term rearing target flows.

TABLE 4-1 RELEASES MEETING LONG-TERM REARING TARGET FLOWS HYDROLOGIC PERIOD 1918-1993

	Acre-Feet/Year
Project Releases	2,185
Water Rights Releases	1,220
Leakage from Dam	500
Total	3,905

The leakage quantities as used in the model represent the historical rate of leakage from the spillway gates. To the extent the spillway gates are repaired to minimize the leakage, then an additional amount would be released from the Project for the purpose of fish habitat maintenance. But the total amount of water needed from Cachuma Reservoir for the long-term B.O. habitat flows would still be about 3,900 acre-feet per year on average.